# 7 Industrial strategies for the green transition

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Governments have been using industrial policy, to varying degrees and in different forms, since the industrial revolution, but until recently these policies had a bad reputation. Among various criticisms, they were seen as instruments that allowed governments to pick winners or support losers, and that were plagued by so-called government failures, eg asymmetry of information, meaning governments do not have sufficient information to select the right projects, technologies or sectors, and are prone to policy capture by rent-seeking players.

Since the 2008 great financial crisis, and even more so since the COVID-19 pandemic and subsequent geopolitical crises, industrial policies have however made a full comeback. The urgency of global societal challenges, and in particular the need to reach climate neutrality by 2050, have heightened the need for government intervention.

There is now wider recognition of the role of industrial policies, as, in a world of imperfect markets, imperfect government intervention might still be welfare-enhancing.

- For example, the inefficient sectoral allocation revealed by the great financial crisis justified intervention to favour reallocation.
- In a period of multifaceted structural change, there is a major need

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for public impetus and guidance, combined with large-scale private investment. This is particularly the case for the investment needed to transition to climate-neutral economies, which the IEA has estimated at $4.2 billion per year by 2030 (IEA, 2021).

- Similarly, the development of new general purpose technologies (eg artificial intelligence) and green technologies with potentially large spillovers requires new rules, new governance frameworks and high-level domestic and international coordination and cooperation. Some of these new (digital) technologies are also characterised by network externalities, which might provide governments with a justification to support the development of these technologies early on, in order to secure global leadership positions. The COVID-19 pandemic and the geopolitical crisis have highlighted how short-run and potential long-term disruptions in global value chains might call for industrial policy interventions – as a complement to trade and competition measures – to ensure the goals of economic resilience and strategic autonomy.
- Finally, industrial policy is being called on in support of other challenges linked to the slowdown of productivity growth (OECD, 2015), coupled with the increase in productivity dispersion and wage inequality (Andrews *et al*, 2016; Berlingieri *et al*, 2017; OECD, 2021b). In particular, Rodrik and Sabel (2019) have highlighted the potential role of industrial policies in reducing geographical and wage inequalities by providing 'good jobs' and supporting the provision of skills to make productivity more inclusive. The importance of focusing on good jobs, opportunities and skill provision – initially triggered by the impacts of globalisation – is becoming ever more relevant, given the potential costs associated with the digital and green transitions.

The world is thus witnessing the development of a new wave of indus-costs1 (al p)-2 (

resilience and strategic autonomy. Beyond traditional sectoral or place-based orientations, these new industrial strategies focus increasingly on specific technologies or missions. Examples include the US Chips and Science Act and the Inflation Reduction Act, the EU's proposed Net Zero Industry Act and China's 13th Five-Year Plan for Economic and Social Development (2016-2020).

Building on the conceptual framework developed in Criscuolo *et al* (2022a), several of its applications to country- or sector-specific contexts (Anderson *et al*, 2021; Cammeraat *et al*, 2022; Dechezleprêtre *et al*, 2023), and work on the role of innovation and industrial policies to accelerate the development and diffusion of low-carbon technologies (Cervantes *et al*, 2023), this chapter summarises the main lessons learned for the design of effective industrial strategies, with a focus on policies to reach climate neutrality. In fact, the discussion today is no longer about whether industrial policies should exist, but how they should be best designed and implemented.

This chapter emphasises that effective policy design is crucial and should leverage complementarities across different policy instruments within industrial strategies, which Criscuolo *et al* (2022a) defined as a consistent and articulated group of policy instruments aimed at achiev-
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needed to thrive in the new environment. For this, governments might need to be bold and invest in sizeable programmes.

This will not come without significant challenges, not least because of the multiple goals new industrial strategies are asked to achieve, from climate neutrality to strategic autonomy. As the Tinbergen rule (Tinbergen, 1956) highlights, this will require at least as many independent policy instruments as there are policy targets, but also coordination of policies managed by different agencies within countries and, especially when dealing with societal challenges such as climate change, coordination and cooperation across countries.

The rest of the chapter is organised as follows: the next section focuses on the need for green industrial strategies. Section 3 describes the role of innovation and technology diffusion incentives. Section 4 highlights the importance of framework conditions for green industrial strategies, while section 5 focuses on the role of competition. The last section concludes.

*2.1 Industrial decarbonisation faces a number of market and government failures*

Countries representing more than 90 percent of the world economy have adopted or announced targets on climate neutrality by mid-century. Reaching this objective requires rapid deployment of zero-carbon energy sources and production processes across all economic sectors, while reducing emissions unrelated to energy consumption, for example from the agriculture sector.

Some of the carbon-free technologies necessary to reach net-zero emissions already exist, but their cost needs to be reduced so they become fully competitive with carbon-based alternatives and can beeti6 2 (op)-1.9ted (a

In heavy industry and long-distance transport, the share of emissions reductions from technologies that are still under development today is even higher. For example, the decarbonisation of manufacturing requires not only the adoption of technologies that are close to market, such as a

Numerous barriers and market failures discourage low-carbon innovation.

constraints, as shown by Howell (2017). Additional factors include systemic barriers to change and innovation, barriers to competition, lack of co-operation within an innovation system, prevailing norms and habits, and technology lock-in and path dependence (Aghion, 2019).

However, government failures, including a preference for incumbents, lack of policy predictability and stability, and regulatory barriers, may also act as barriers to low-carbon innovation. In particular, climate policy uncertainty is associated with significant decreases in investment, particularly in pollution-intensive sectors that are most exposed to climate policies (Berestycki *et al*, 2022).

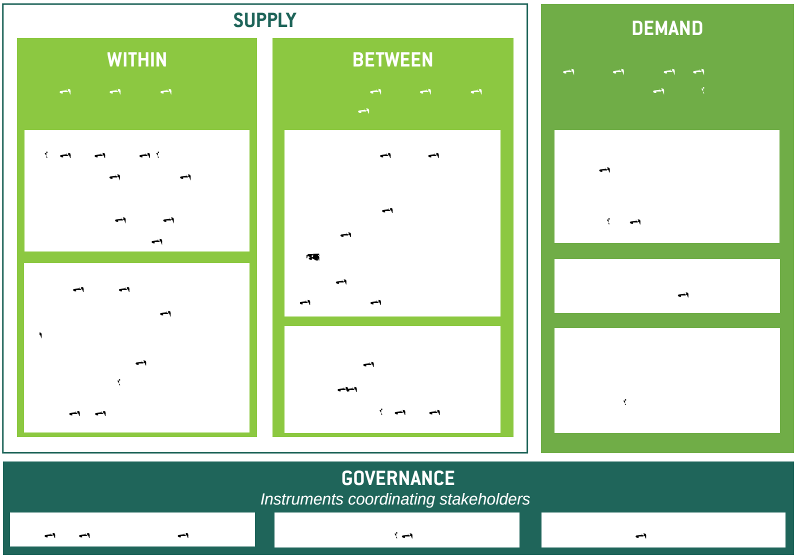
### *2.2 These barriers call for the use of coherent industrial strategies*

(OECD, 2021a). By improving sustainability, mission-oriented strategies can also be understood as contributing to the long-run resilience of industry.

Mission-oriented strategies differ from other types of strategies in that they are "*transformation-oriented*" (Weber and Rohracher, 2012), ie they address the direction of innovation rather than its level, and require coordination across policy domains and across stakeholders (including consumers, governments and research institutions).

Green industrial strategies must therefore feature a variety of industrial policy instruments. Alongside investment incentives, policy instruments on the demand side and governance categories are also required. Criscuolo *et al* (2022a) defined a taxonomy of industrial-policy instruments (Figure 2), which identifies the channels through which policy instruments operate and highlights potential complementarities between them. In addition to keeping with the traditional distinction between horizontal and targeted policies, the taxonomy distinguishes between demand-side instruments and two types of supply-side instrument: those that primarily improve firm performance (such as tax credits, grants, loans or loan guarantees and public support for training within firms) and those that affect industry dynamics (framework instruments including the tax system, capital and labour market policies, competition and trade policies). Green industrial strategies require all these categories of instruments.

This framework can shed light on the design of industrial strategies for the green transition, for example by helping to understand the complementarities between innovation and technology adoption support on one hand and demand-side instruments on the other. The latter can contribute to transformative industrial change by affecting the demand for products through their price, availability or public demand, and have become increasingly common, particularly in transformative mission-oriented strategies. The underlying rationale is the creation of demand to support scaling-up, and in turn lowering costs through learning-by-doing. In the context of targeted industrial strategies, demand-side policies are particularly interesting as they may be less distortive than targeted supply-side policies.

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This framework highlights the need for coherent policy packages adopted as part of industrial strategies. For example, although innovation policies have a major role to play in carbon-neutrality strategies, they are insufficient on their own. While innovation policy can help facilitate the creation of new environmentally friendly technologies, it provides little incentive to adopt these technologies, unless R&D activities manage to make clean technologies competitive with high-carbon alternatives on economic grounds. Until then, incentives for adoption need to be provided by demand-side policies, which can make low-carbon options more attractive economically. However, demand-side policy cannot supplant the need for innovation policy, given the presence of barriers and market failures at the R&D and demonstration stages.

These instruments are thus not substitutes but can instead be mutually reinforcing. Carbon pricing, in particular, is also not sufficient on its own. Carbon prices ensure there will be a demand for new low-carbon technologies. However, they are unlikely to help for technologies that are far from market and require long development timelines. As any technology-neutral instrument, carbon pricing tends to favour technologies that are closest to market and with the shortest payback time. It needs to be complemented by technology-specific support, which, by lower-

barriers discouraging low-carbon innovation, the theoretical justifications for policy intervention are sound and well established.

Innovation and industrial policies can also complement carbon prices, which are often difficult politically to implement. In fact, technology support policies are more popular among voters and citizens than other climate change policies (including carbon pricing, bans or regulations), making them an attractive option from a public acceptability point of view (Dechezleprêtre *et al*, 2022). In addition, by reducing clean technology adoption costs and boosting the growth of new carbon-efficient firms and sectors, such policies can facilitate the adoption of more ambitious emissions reduction targets, including among emerging economies, where the bulk of future emissions growth is projected to take place.

*3.1 Evidence suggests that specific R&D support instruments are required*

Public expenditures on research, development and demonstration of low-carbon technologies are a key element of the toolkit available to governments to achieve climate neutrality. However, low-carbon public R&D spending has remained broadly flat as a percentage of GDP over the last 30 years (Cervantes *et al*, 2023).

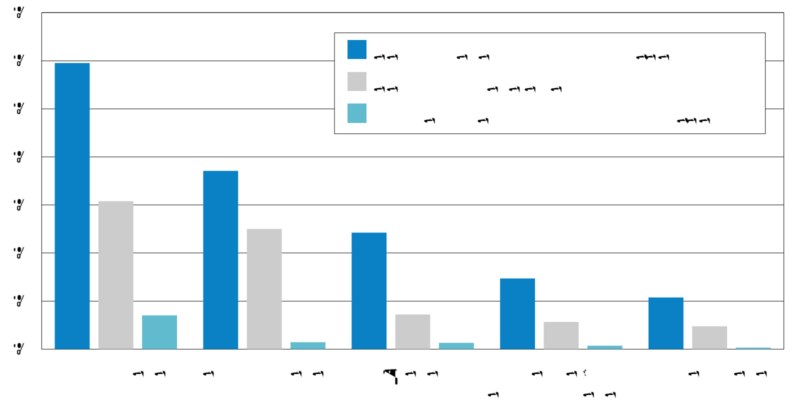
In addition to public R&D spending on low-carbon technologies, governments can support financially the innovation activities of firms through direct and targeted instruments (eg research grants) or via horizontal and untargeted instruments (R&D tax credits). Horizontal R&D support has indisputable advantages, including its low administrative cost and technological neutrality, but by construction, it cannot be directed and likely benefits mostly technologies that have the greatest short-run returns. As such, tax credits may not be the best policy tool to promote new technologies that are far from the market and require long development timelines. Climate neutrality will require innovation in breakthrough technologies, which cannot be incentivised through horizontal support. Support for an emerging technology justifies a stronger focus on targeted instruments for

secure seed funding compared to non-green start-ups, suggesting that in the early phases of product or service development they might be perceived as riskier than their non-green counterparts (Bioret *et al*, 2023). Holding patents also increases the likelihood of being awarded a grant or of receiving VC more for green firms than for non-green firms, suggesting that grant providers and investors potentially wait for green technologies to be de-risked through patent applications before supporting the companies that hold them. The relationship between cumulative grants or cumulative VC received and subsequent innovation is substantially lower for green firms relative to non-green, which might suggest higher development costs for green products and

### *4.1 Education, skills and science policies*

Education, skills and science policies are necessary to ensure that industry can rely on the right set of skills and that new research into low-carbon technologies is not performed at the expense of the development of other productivity-enhancing innovations.

Re-skilling and up-skilling displaced workers with green skills through active labour market policies and adult training is essential to address social concerns and contribute to reducing skill shortages in the future low-carbon industries. Cross-sector training programmes can ease labour market transitions from surplus to shortage sectors. Timely and transparent information on sectoral labour markets can help workers anticipate future labour needs and policyma3.9 (e) tm1 (a)TJ0 -1.45 Td



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## *4.2 Regulatory standards*

Setting regulatory standards is another important complementary policy, which can help reduce uncertainty and facilitate coordination. Standardisation can strongly promote the diffusion of technologies with network externalities, such as carbon capture and storage (CCS; Anderson *et al*, 2021) or green hydrogen (Cammeraat *et al*, 2022).

For instance, defining liabilities would allow investors in CCS to more accurately price and potentially insure this risk. The industry, the

cooperation related to hydrogen is thus mostly about harmonising codes and standards.

### *4.3 Carbon pricing*

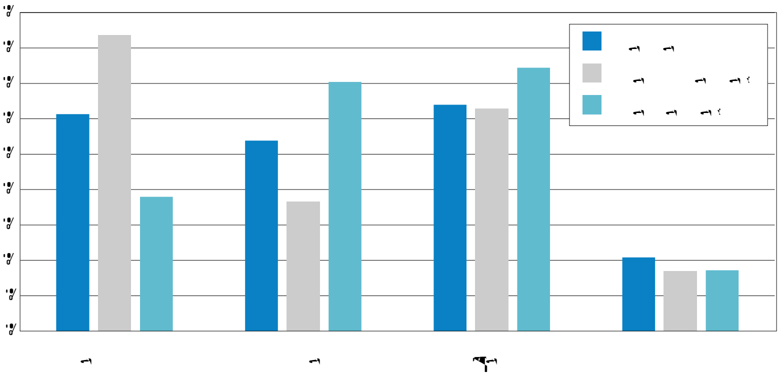
equity concerns as small firms typically face much higher energy and carbon prices than large incumbents (Anderson *et al*, 2021).

(CASE) vehicles, the network externalities linked to the increasing role of data or the potential increase in market segmentation could reduce competition in the medium run. High upfront investment needs, network externalities and high economies of scale required in this sector might indeed lead to a higher level of concentration in this industry. This could be reinforced by the evolution towards increasingly segmented markets.

Dechezleprêtre *et al* (2023) showed that the automotive sector experienced very significant growth in mergers and acquisitions (M&As) before the COVID-19 crisis. Given the likelihood of a new wave of M&As after the crisis, the level of competition and contestability in the ecosystem may decrease in the near future, thereby threatening innovation and the benefits for consumers.

Nevertheless, M&As and concentration are also an effective way to acquire new knowledge, to integrate new technologies, know-how and talents in the products, and to benefit from economies of scale or scope. M&A is often cited as a strategy to acquire external knowledge (Cassiman *et al*, 2005; Phillips and Zhdanov, 2012). If this is indeed the case, the patent portfolio of target firms should reflect the technologies of interest for acquiring firms. As transactions within the automotive sector can have other motives, such as industrial synergies or entry in a new market, target firms outside the automotive sector are more likely to be bought for their technologies.

Compared to firms that are not the target of a merger or an acquisition, target firms outside the automotive sector have a much higher proportion of patents in autonomous vehicle technologies (Figure 5). However, they have significantly lower shares of patents related to combustion engines. Target firms in the automotive sector tend to have higher shares of patents in combustion and electric engine technologies.



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In this context, it is important to find new ways to support collaboration between firms, while preserving competition and a level playing field (eg industrial alliances in the EU). This calls for:

- Ensuring that competition authorities have adequate tools to monitor and enforce merger control. As acquisitions of young firms often remain below applicable thresholds, analyses (Crémer *et al*, 2019; Shapiro, 2019; Digital Competition Expert Panel, 2019; Kamepalli *et al*, 2020; Argentesi *et al*, 2020; Motta and Peitz, 2021) have suggested reassessing them in order to review potentially problematic mergers. Although this literature mainly focuses on acquisitions by large digital platforms, its conclusions may also apply to the automotive ecosystem, which is becoming more digital and prone to network effects.
- Ensuring that young and fast-growing firms can choose between several exit strategies. Being bought by a larger firm should remain a possibility, but young ventures should also be able to opt

deserve a more encompassing approach that takes into consideration other aspects of industrial policy. In particular, this chapter stresses the importance of educ (in)4.tion

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