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A New Approach for Better Industrial Strategies

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Abstract
Industrial policy is back. After having been considered a taboo since the 1970s, "new industrial policies" are at the core of governments' strategies to support countries during crises and enable the green and digital transitions. Virtually, every government has used and uses industrial policy, despite continued concerns related to anticompetitive effects, within and across countries, captured by vested interests and the opportunity cost of public funds, which economists have pointed out, based on previous unsuccessful experiences. In this paper, we contribute to the debate on industrial policy by presenting both a sound and simple framework to help design industrial policies and also data that allow the comparison of industrial strategies and their priorities across countries. First, this paper summarises our recent framework for industrial strategies, which is designed to offer practical policy advice and shed light on the complementarities between different policy instruments. Such a framework is particularly useful when designing complex mission-oriented industrial strategies promoting the green transition of the business sector. Second, this paper presents some salient results from the new "Quantifying Industrial Strategies" (QuIS) project, which gathers harmonised data on industrial policy expenditures, policy priorities, and policy instruments, thereby allowing the benchmarking of industrial strategies across countries. Based on the aforementioned conceptual framework, QuIS measures industrial policy expenditures across 9 OECD members, for the period 2019–2021. The data, now publicly available on the OECD website, show the importance of industrial policy expenditures, and the growing role of green industrial policies in countries industrial strategies.

Keywords New industrial policy · Quantifying industrial strategies · Industrial Policy Framework · Industrial Policy Taxonomy · Green Industrial Policy

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1 Introduction

The debate on industrial policy has made a comeback in both academic and policy circles in the wake of major shocks, such as the 2008 Global Financial Crisis, the current COVID-19 pandemic, the "deglobalisation" wave, but also long-term trends and structural transformation, e.g., the productivity slowdown, growing inequalities, the digital transformation and climate change. These shocks and trends are reinforcing the perceived urgency of global societal challenges and stress the role of industrial policy, notably through the large-scale recovery plans that are now being implemented around the world. Industrial policy is gaining traction as countries seek to ensure a sustainable, digital, and inclusive recovery after the COVID-19 pandemic, with a goal of "building back better." Following these urgent needs, in recent years governments have announced new industrial strategies.

Recent waves of industrial policies aimed at increasing strategic autonomy and resilience of key supply chains (e.g., semiconductors, capital goods linked to the green transition) through reshoring have also raised concerns. They might have detrimental effects on the global level-playing field, and some consider these initiatives as a new form of protectionism.

Yet, no consensus exists on an industrial policy paradigm. The absence of a common reference framework unduly obfuscates the debate—even which interventions are to be considered the realm of "industrial policy" is not clear-cut. In view of the new objectives assigned to industrial policy, the efficiency of horizontal (or untargeted) interventions, but also their sufficiency to address global societal challenges, are increasingly questioned. More and more, policymakers see targeted industrial strategies as having the potential to steer technological change and growth toward greener, more sustainable, inclusive, and resilient paths. Nevertheless, targeted interventions continue to raise concerns related to anticompetitive effects, capture by vested interests, and the opportunity cost of public funds.

In addition to impact evaluation of industrial policies, we argue that economists can contribute to the debate policy by providing a sound and simple framework to help design industrial strategies and by gathering data that allow their comparison across countries. This paper paves the way for better industrial policy by providing the tools needed to address these questions.

This paper shows how a sound framework helps conceptualise both the potential complementarities and the possible conflicting incentives provided by industrial policy instruments and therefore highlights the need for industrial strategies. Such a framework is particularly useful when designing complex mission-oriented industrial strategies aimed at promoting the green transition of the business sector. This paper illustrates how a broad definition of industrial strategies can help leverage complementarities between different instruments (e.g., R&D support, skills development, carbon prices, technological standards, open trade, and de-risking instruments for the case of green hydrogen), while at the same time informing on the details of policy design to maximise positive interactions between instruments. The latter is illustrated with the example of the net-zero transition in the Dutch manufacturing sector. This notwithstanding, improved policy design thanks to a better conceptualisation is not a blank check for targeted industrial policies, which, if ill-implemented, are still prone to many "government failures" and should be evaluated on a regular basis.

Policy design is all the more important, for expenditures on industrial policies are sizeable (1.4% of GDP on grants and tax expenditures in 2021 and another 0.7% on financial instruments, on average across the 9 countries covered in the Quantifying Industrial Strategies—QuIS—project). In addition, industrial strategies are already undergoing significant changes linked to the new goals they are meant to help achieve, such as the green transition but also strategic autonomy and global value chain resilience. The changes are apparent from the data covering the 2019–2021 period. The growth of green and technology-specific industrial policies is likely to continue as most countries have recently committed to increase their support to the green transition, in particular by supporting the greening of firms. Some of these schemes are focused on key emerging green technologies, which are required to achieve carbon neutrality in 2050 (e.g., hydrogen, batteries). But other technology-specific schemes are likely to emerge in the coming years related to strategic autonomy and global value chain (GVC) resilience, for instance, in the field of semiconductors, digital, and pharmaceutical technologies.

The rest of the paper is structured as follows. Section 2 summarises the recent OECD framework for industrial strategies, which is designed to offer practical policy advice and shed light on the complementarities between different policy instruments. Second, Sect. 3 presents some salient results from the new QuIS database, now publicly available on the OECD website, which gathers harmonised data that allow benchmarking industrial strategies across countries in terms of industrial policy expenditures, policy priorities, and policy instruments. Based on the aforementioned conceptual framework, the database includes measures of industrial policy expenditures across 9 OECD members for the period 2019–2021. This paper describes the main orientations of industrial strategies on average in these 9 countries, with a particular focus on the "green" side of industrial strategies. Section 4 concludes.

2 A New Framework for Industrial Strategies

This section summarises the main results from previous work developing a conceptual framework for industrial policy (Criscuolo et al. 2022a, b), and illustrates the main findings using examples from Anderson et al. (2021) and Cammeraat et al. (2022), on the green transition of the Dutch manufacturing sector and green hydrogen strategies, respectively.

2.1 Sound Design of Industrial Policy Requires a Conceptual Framework

This subsection provides a definition of industrial policy and industrial policy instruments, while the next subsection focuses on how industrial policy instruments are bundled into industrial strategies, relying on two examples.

2.1.1 Industrial Policy Intends to Structurally Improve the Performance of the Domestic Business Sector

No single, clear-cut definition has emerged from previous attempts at considering industrial policy within a coherent framework—see Warwick (2013) for an inventory of the definitions used in the literature. Therefore, the scope of instruments that industrial policy is deemed to encompass varies across authors, policymakers, and countries, which unduly obfuscates the debate.

In this paper, industrial policy encompasses all types of instruments that intend to structurally improve the performance of the domestic business sector. Industrial policy does not necessarily focus on manufacturing but concerns the whole private sector.

This definition encompasses both horizontal and targeted (or "vertical") industrial policies. Horizontal policies are available to all firms, irrespective of their activity, technology, or location, e.g., R&D tax credits or fiscal incentives to support the green transformation of businesses. On the contrary, targeted policies are restricted to a subset of eligible firms

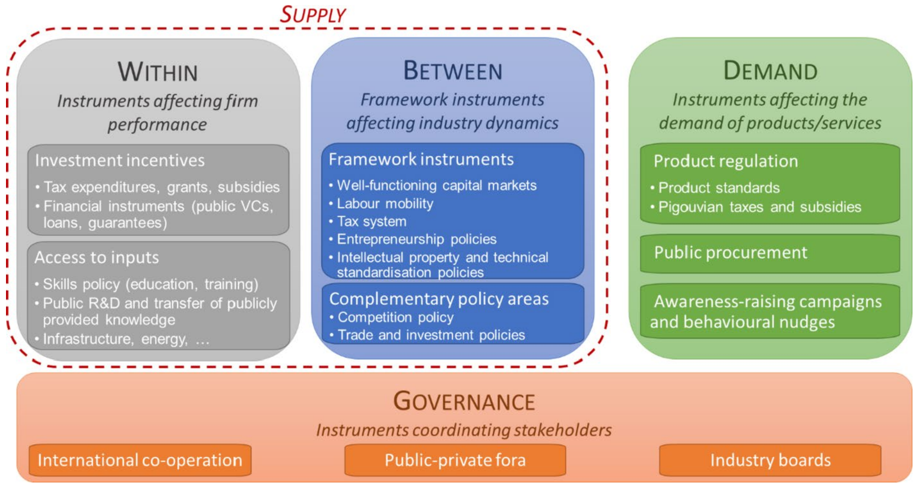

Fig. 1 Taxonomy of policy instruments. Note: Examples based on main channel through which policy instruments work. Source: Criscuolo et al. (2022a)

based on their activity, their technology, or location, e.g., public procurement for specific products; or place-based policies.

Importantly, the objectives of industrial policy (i.e., the performance of the business sector) are multidimensional. Traditional objectives comprise innovation, productivity, economic growth, and competitiveness. More recently industrial policy has been used to target new goals, such as the green transition, a more inclusive economic development, a more resilient economy, or strategic autonomy. This variety of objectives sometimes leads to trade-offs, e.g., between productivity and resilience, green transition and competitiveness, therefore, requiring a prioritisation or weighting of the different objectives.

2.1.2 Industrial Policy Encompasses a Wide Range of Policy Instruments

Such a purposefully broad definition encompasses a vast set of policies (including those implemented without being explicitly labelled "industrial policy"), thereby providing policy makers with a comprehensive framework to discuss policy interventions aimed at improving the performance of the business sector. By this definition, governments have always implemented industrial policies to some extent.

To classify industrial policy instruments, Fig. 1 introduces a new taxonomy, which allows (i) uncovering the rationale and the channels through which different instruments operate and (ii) underlining possible complementarities or trade-offs between different types of instruments. The new taxonomy is designed to serve as a conceptual backbone of industrial policy analysis. It is used as a tool to organise the evidence on industrial policy instruments, as summarised in Criscuolo et al. (2022b), to measure industrial policy expenditures (Criscuolo et al. 2022c) and to provide concrete policy recommendations in country-specific (Anderson et al. 2021) or sector-specific settings (Cammeraat et al. 2022; Dechezleprêtre et al. 2023).

While existing taxonomies typically classify policy instruments according to either the corresponding input factors, the technology-readiness level (TRL), the target group, or the instruments' objective and associated goals (Warwick 2013; O'Sullivan et al. 2013; Steinmueller

2010; EC/OECD 2019; Edler et al. 2016; UNCTAD 2018; WTO 2020), this new taxonomy builds upon two essential distinctions.

First, it borrows from the mainstream split between supply-side instruments and demand-oriented instruments (Edler et al. 2016). Supply-side instruments affect domestic production decisions, regardless of where consumption takes place, while demand-side instruments affect domestic consumption decisions, regardless of where production takes place.

Second, among supply-side instruments, the taxonomy further distinguishes those that affect efficiency, and more broadly performance, within firms from those that affect the allocation of resources (e.g., capital and labour) between firms, in the same spirit as in the productivity literature (Olley and Pakes 1996; Syverson 2011; Bartelsman and Doms 2000).

Distinguishing "between" instruments from "within" instruments is key in thinking about industrial policy. In doing so, the new taxonomy explicitly accounts for Schumpeterian dynamics and the fact that productivity growth partly comes from creative destruction, in particular entry and exit and the reallocation of production factors from less to more productive firms with a superior technology or better innovation capacity (Aghion and Howitt 1992). Empirical work has confirmed that such reallocation between firms is a major growth channel (Haltiwanger et al. 2013; Bravo-Biosca 2016). To ensure that global competition from open trade and foreign direct investment remains a key channel for growth, via both reallocation and market size, it is important that industrial policy does not come at the cost of distortions to both the domestic and the global level playing fields.

In addition to demand- and supply-side instruments, governance is regarded as a necessary enabler of successful policy interventions. Therefore, as depicted in Fig. 1, "governance" instruments complement the three main categories of industrial policy interventions. Their role is to coordinate stakeholders in the business sector, the public sector, and research institutions, e.g., industrial actors, governments, or universities, at the subnational, national, and international levels.

Most categories comprise horizontal and targeted policy instruments. Yet, while "within" instruments typically feature in both types of policies, "between" instruments are more likely horizontal. Conversely, demand-side instruments are more likely targeted, in particular as part of transformative industrial strategies that aim to promote sustainable production and consumption simultaneously (Altenburg and Rodrik 2017; OECD 2021).

The available evidence supports the effectiveness of several categories of policy instruments such as firm-level investment incentives, instruments favouring the access to inputs (e.g., skills, knowledge, infrastructure), and appropriate framework conditions (e.g., sound competition, well-functioning capital markets) (Criscuolo et al. 2022b).

2.2 Policy Instruments Are Often Bundled into Industrial Strategies, Which Are Key to Leverage Complementarities

As industrial policy relies on a variety of different instruments, aimed at addressing several externalities and market failures, countries are often bundling them together into "industrial strategies." This subsection describes several types of industrial strategies, with a particular focus on mission-oriented industrial strategies, which are becoming a cornerstone of decarbonisation strategies. This subsection then illustrates how industrial strategies can leverage complementarities between policy instruments for the development and deployment of specific technologies, focusing on the case of green hydrogen, and for a coherent

Table 1 Industrial strategies and their rationales

	Sectoral	Mission-oriented	Technology-focused	Place-based
Learning-by-doing	✓		✓✓	
External economies of scale	✓			
Informational externalities	✓		✓✓	
Competition creation	✓			
Upstream sectors in value chains	✓		✓✓	
Coordination failures	✓	✓✓	✓	
Societal benefits		✓✓		
Acceptability of public investment		✓		
Regulatory uncertainty or Imperfect commitment		✓		
Marshallian externalities				✓

effort to direct technological change and growth, zooming in on the achievement of the net-zero transition in the Dutch manufacturing sector.

2.2.1 Four Types of Industrial Strategies Can Be Distinguished

Countries are increasingly adopting industrial strategies, which can be defined as a diverse, but consistent and articulated group of policy instruments designed in order to reach specific policy objectives. For example, an artificial intelligence (AI) leadership strategy can combine R&D grants, training programmes, innovative public procurement, and sectoral industry boards (Fig. 1). The framework developed by Criscuolo et al. (2022a) sheds light on the complementarity between investment incentives, instruments supporting access to inputs and framework conditions, thereby rationalising the use of policy packages, or strategies, to reach industrial policy objectives.

The variety of industrial policy instruments is linked to the many externalities or market failures they aim to correct. The industrial strategy has inherited from this diversity. Industrial strategies are often focused on subsets of the economy that governments deem deserving or needing support. Criscuolo et al. (2022a) distinguish four non-mutually exclusive types of selection criteria: sectoral, mission-oriented, technology-focused, and place-based strategies (Table 1).

✓ means relevant; ✓✓ means especially relevant

Source: Criscuolo et al. (2022a)

Mission-oriented strategies have recently attracted a lot of attention. Larrue (2021) defines mission-oriented innovation strategies as a "co-ordinated package of research and innovation policy and regulatory measures tailored specifically to address well-defined objectives related to a societal challenge, in a defined timeframe. These measures can span different stages of the innovation cycle from research to demonstration and market deployment, mix supply-push and demand-pull instruments, and cut across various policy fields, sectors, and disciplines." Even though this definition is designed for innovation policies, it is straightforward to extend it to industrial strategies more generally.

The missions pursued range from more targeted interventions, such as the ones in "ARPA"-type challenges (Azoulay et al. 2019), the fight against selected public health issues or moonshots, to green strategies, in which emission targets or resource efficiency objectives apply to a vast range of industries through several policy instruments.

The four types of strategies differ by their objectives (e.g., regional development for place-based policies, or steering the direction of growth for mission-oriented policies), but may in some instances overlap.

For instance, mission-oriented strategies are likely to include technology-focused or sectoral policies. Several green technologies can be considered "general-purpose technologies" (Barbieri et al. 2020; Nomaler and Verspagen 2019), and are often the target of specific technology-focused industrial strategies (see the example of green hydrogen below). Conversely, technology-focused strategies may also include sectoral or mission-oriented policies. For instance, some actions of AI strategies are motivated by the will to preserve human rights and democratic values (OECD 2019). In fact, technology-focused strategies can be viewed as solution-led pathways whereas mission-oriented strategies are rather problem-led pathways (Wanzenböck et al. 2019). Many strategies are in fact hybrid, in the sense that they integrate both technology-focused and mission-oriented elements.

In the same vein, place-based strategies can also be sectoral, mission-oriented, or technology-focused, as soon as Marshallian externalities are expected to take place at the sectoral or at the technology level.

In practice, designing coherent industrial strategies is not an easy task especially when aiming to achieve significant structural change and the diffusion of disruptive innovations. This is because phasing out existing support measures to old technologies (e.g., fossil fuels) and balancing between more reachable short-term objectives and longer-term paradigm shifts might be challenging, because of both efficiency and political economy concerns. In the same vein, the design of industrial strategies also requires to steer to some extent innovation and investment, while ensuring that support to firms remains "additional", and does not crowd out private investment.

2.2.2 Mission-Oriented Strategies Are Needed to Achieve Carbon Neutrality

Mission-oriented strategies are becoming increasingly popular to address societal challenges, achieve Sustainable Development Goals (OECD 2021), and accelerate the green transition.

This is high on governments' agendas as, despite the urgent need for low-carbon innovation, the current pace of innovation is not in line with the challenge of carbon neutrality. Over the past decade, climate-related frontier innovation, measured as the share of patent filings in climate-related technologies relative to all technology areas, has slowed down (Cervantes et al. 2023). At the same time, technologies that are currently at the demonstration or prototype phase are needed for half of the global reductions in energy-related CO_2 emissions through 2050 (IEA 2021). Even when technologies necessary to reach net zero emissions already exist, their cost needs to be reduced in order to compete with carbon-based alternatives and to be deployed rapidly and at scale (IPCC 2022).

Several barriers and market failures discourage low-carbon innovation and can justify the use of mission-oriented strategies:

- Large environmental externalities. Mission-oriented innovation yields social benefits that are inherently linked to the issue that they are aimed at tackling (Rodrik 2014). The literature on mission-oriented strategies often claims that these strategies do not only support economic growth but also its direction. In other terms, there are paths in economic growth that are preferable to others because they provide a higher level of well-being in the long term (Wanzenböck et al. 2019), avoiding technology lock-in and path dependence (Aghion 2019). In a Schumpeterian framework where firms innovate to create new markets, mission-oriented industrial strategies can incentivise or catalyse firms to search in selected directions (Cantner and Vannuccini 2018).

- Significant knowledge externalities, which appear to be larger than average for green innovation and therefore justify specific support (Dechezleprêtre et al. 2014; Rubin et al. 2015).
- Coordination failures, which may be particularly severe when a mission requires simultaneous investments occurring in different industries (Altenburg and Rodrik 2017). This is likely to be the case when dealing with the green transition, for instance, the promotion of a thriving circular economy (OECD 2020).
- Regulatory uncertainty/imperfect commitment. Firms' investment decisions rely on their discounted benefits over a long time span. If regulatory uncertainty casts doubt on the ability to recover the costs of the investment, it may hamper innovation (Popp et al. 2010), especially with imperfect capital markets that are not able to price and share this risk. For instance, in low-carbon transition strategies, governments need to set a clear carbon price trajectory for the private sector to invest in low-carbon productive capital—see Anderson et al. (2021). However, their commitment to the carbon price trajectory can be perceived as imperfect, as governments can still renege on their promises, or be overturned by elections. In such cases, targeted industrial policy may be needed, on top of the traditional demand-side policy measures (Harstad 2020).

This complex set of market failures and policy objectives calls for a carefully designed strategy relying on a consistent and articulated group of policy instruments, corresponding to the definition of mission-oriented industrial strategies (Larrue 2021; Criscuolo et al. 2022a). Mission-oriented strategies differ from other types of strategies in that they are "transformation-oriented" (Weber and Rohracher 2012), i.e., they address the direction of innovation rather than its level and need coordination across policy domains and across stakeholders (consumers, government, research institutions, etc.). They therefore include, alongside investment incentives, several policy instruments in the demand side. This whole-of-government approach and the complex architecture needed for the success of mission-oriented strategies require a strong governance.

Governance instruments are used as coordination mechanisms, both at the national and supranational levels. At the supranational level, they contribute to setting common expectations for stakeholders, including consumers, and include international co-ordination (e.g., IPCC, COPs). At the national level, green strategies often include several sub-strategies, in which many stakeholders are involved (e.g., mainstreaming sustainability in all EU policies, 2050 Zero Carbon Cities in Japan)—see also Matsumoto et al. (2019). Some strategies, although not many, include monitoring and evaluation mechanisms.

The remainder of this section now illustrates this conceptual framework with two examples. First, the example of "technology-focused" green hydrogen strategies exemplifies the complementarities between policy instruments, while the second example emphasises the importance of directing technical change in mission-oriented strategies, using the example of the green transition of the Dutch manufacturing sector.

2.2.3 Leveraging Complementarities Between Industrial Policy Instruments: The Case of Green Hydrogen Strategies

Most net-zero emission scenarios agree that green hydrogen will play a pivotal role in decarbonisation at the 2050 horizon. However, in 2021, the production of green hydrogen (from water and renewable electricity through electrolysis) was still about 3 times more expensive than grey hydrogen (made out of natural gas through steam reforming), even under the most favourable conditions.

A number of countries have published National Hydrogen Strategies, which contain ambitious hydrogen production targets at the 2030 horizon and can be considered as a technology-focused industrial strategy. These strategies rely more on financial support for the deployment of new large electrolysers than on direct support for innovation. The consequences of the focus of public support on the deployment stage are evident in the skewness of firms' recent filings of intellectual property rights towards commercialisation rather than innovation protection. Indeed, while patenting activity on hydrogen production technologies is growing at a very slow pace, the number of hydrogen trademarks recently took off, suggesting that companies are focusing on commercialisation rather than on innovation, and are anticipating a growing hydrogen market pulled by government incentives.

Given the important and growing need of technological innovations, e.g., to lower the cost of producing green hydrogen, countries willing to support hydrogen should take advantage of the complementarities described in the conceptual framework laid out above (see Fig. 1) and implement an industrial strategy relying on a wide set of instruments including R&D support, financial instruments, competition and trade policy, supply of renewable electricity, carbon taxation and sound regulations supporting the following priorities (see Cammeraat et al. (2022) for more details):

Ensure targeted support to R&D in green hydrogen and demonstration projects. Targeted R&D support instruments are required, as horizontal R&D support is not sufficient to stimulate innovation in technologies characterised by significant uncertainty. Large-scale demonstration projects are also needed to reduce costs through economies of scale, economies of scope, and learning-by-doing. Financial instruments (including public loans or guarantees and government venture capital) could efficiently de-risk demonstration projects and crowd in private money. Targeted support to R&D in green hydrogen primarily hinges on the above-mentioned "within" policy instruments, but its effect can be magnified by coupling them with "between" measures, in particular sound competition and low barriers to entry, to ensure that knowledge can flow across new and established firms and that newcomers can benefit from publicly funded R&D and demonstration projects. This is particularly important as the hydrogen sector tends to be highly concentrated. Sound governance, especially cooperation and coordination not only within but also between countries plays a key role to favour knowledge diffusion.

Ensure a sufficient supply of renewable energy where possible and encourage the creation of an international hydrogen market. Making green hydrogen competitive will require a significant decrease in the cost and a significant increase in the supply of renewable electricity. Countries endowed with low renewable energy resources should therefore consider importing green hydrogen from countries with abundant renewable energy. Agreeing on common international standards would reduce investors' uncertainty and facilitate the creation of such an international market for hydrogen. This priority would again rely on a combination of "within" (guaranteed and affordable access to renewable energy), "between" (technical standards allowing trade of green hydrogen), and "governance" (international cooperation to ensure interoperability of hydrogen standards) instruments.

Establish clear carbon price trajectories to provide investors with the right incentives. Adequate carbon pricing would make green hydrogen more competitive, contribute to a cost-efficient decarbonisation, and could provide revenue to finance R&D support to green hydrogen. Deployment incentives might be needed, on top of carbon pricing, to cover the price difference with fossil fuel-based alternatives in the medium run, but a combination of strong R&D support and clear carbon pricing trajectories could well be sufficient. Carbon Contracts-for-Difference (CCfD), which are experimented in Germany for the production of green hydrogen and consists in forward-contracts on the price of abated greenhouse gases, can decrease uncertainty for investors. This priority would mainly rely on demand-side instruments (carbon pricing), potentially supplemented with "within" investment incentives, focusing mainly on innovation support (Fig. 1).

Reduce uncertainties for investors through regulatory action and standardisation. Strong government signals are required regarding the potential role of green hydrogen, infrastructure investments ("within" instrument)—often a pre-requisite for the adoption of hydrogen—and regulatory standards (e.g., on guarantees of origin, hydrogen purity, equipment specifications, blending into the gas grid—demand-side instrument). Low-carbon hydrogen certificates similar to the ones currently in place on the renewable energy market could be introduced.

This analysis demonstrates how the conceptual framework laid out in this paper can help design more efficient industrial strategies. The above-mentioned priorities exemplify how all categories of industrial policy instruments ("within", "between", "demand", and "governance") are important in the design of the strategy and may be mutually reinforcing.

2.2.4 Targeted Industrial Strategies Can Direct Technological Change and Growth…

To further understand the usefulness of relying on the framework presented above to analyse the effectiveness of industrial strategies, we report on the analysis of the Dutch industrial decarbonisation strategy (Anderson et al. 2021), that focuses on the complementarities between three of the main pillars of the strategy: a carbon levy on top of the European Emissions Trading Scheme (ETS), to ensure an ambitious and predictable carbon cost trajectory; significant incentives to the energy sector and industry (SDE++) that reduce the cost of adopting lower-emission technologies; and framework conditions such as the creation of new infrastructure, for example, pipelines to bring hydrogen to the main industrial centres.

Analysing all these instruments together enables identifying levers for improving industrial policies aimed at decarbonising the Dutch industry. For certain other technologies further away from the market, such as hydrogen, which is likely to be needed to decarbonise Dutch heavy industries, the Netherlands was investing in the corresponding infrastructure, but the incentives were largely insufficient. This suggests either investing in more upstream phases to reduce costs, or to increase the grant to encourage the development and demonstration of less mature technologies.

The design of the main Dutch incentive scheme, the SDE++, was not spurring the development of less mature technologies. Indeed, the SDE++ scheme allocated incentives to project applicants in increasing order of support requirement per tonne of CO_2 reduction in a tender open to a large range of low-carbon technologies, such as carbon capture

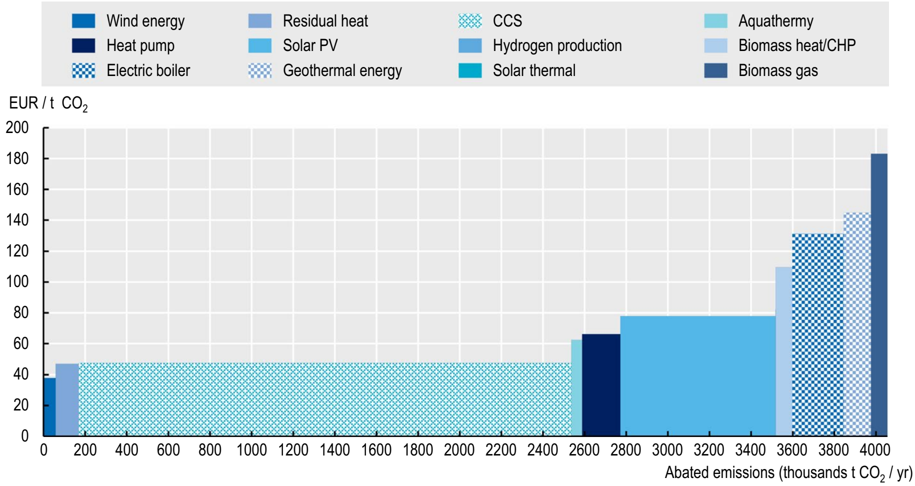

Fig. 2 CCS might crowd out less mature technologies from the SDE++. SDE++ demand curve in first tender. Note: Areas represent the expected payment based on RVO's (Rijksdienst voor Ondernemend Nederland—Netherlands Enterprise Agency) long-term prices; actual pay-out will depend on market prices and RVO's grant decision. Category CCS includes "blue hydrogen"; category hydrogen production is "green hydrogen". Amount tendered to categories hydrogen production and solar thermal barely visible. Source: Anderson et al. (2021) based on RVO data

and storage (CCS), electric boilers, heat pumps, waste heat or green hydrogen production. SDE++ allocated abatement incentives on a pure cost-efficiency basis as all requests were pooled in one single tender. This tended to favour close-to-the-market technologies (Fig. 2), for which the revenue shortfall with respect to business-as-usual technologies is small and which can therefore bid at lower costs. This gap was amplified by the EU ETS and the Dutch carbon levy, which already provide a significant incentive for some firms to reduce their carbon emissions. Therefore, the design of the SDE++ made the scheme less relevant to support technologies that are still at an earlier stage of development, such as hydrogen. Put differently, the SDE++ traded off the promotion of less mature technologies for short-term cost efficiency, thereby potentially compromising long-term cost efficiency.

Anderson et al. (2021) argued that reforming the design of the SDE++ to allow for separate tenders across technologies, production processes, or TRL, could promote investment in emerging low-carbon technologies instead of solely favouring low-cost options.

2.2.5 …But Have to Be Handled with Care

Even if targeted support to innovation is key for mission-oriented industrial strategies, economists, be they sceptics or supportive of targeted industrial policy, usually point out three main pitfalls in such interventions.

Access to Information The success of a targeted industrial strategy relies on the ability of governments to pick the right target. It requires gathering a vast amount of information on the expected returns, risks, spillovers, and other market failures for each project (Pack and Saggi 2006). Some argue that this information is not available (be it for the government or for any other actor) and others that it may be easier to access for businesses than for the government. This argument is particularly important for economies at the technological frontier with policy projects related to emerging and uncertain technologies, whereas it is looser for countries trying to catch up to this frontier and benefiting from the experience and knowledge of first movers.

Capture and Rent-Seeking Capture and rent-seeking can happen ex-ante and/or ex-post.

Ex-ante capture and rent-seeking are due to the asymmetric information between public and private sectors, and the consequent risk of competition and lobbying between policy projects for being picked (Romer 1993), with two consequences. First, resources may be wasted in the lobbying process (Bhagwati 1982). Second, the outcome of the lobbying game is not necessarily efficient and may favour the most organised projects, precisely the ones that are less affected by coordination failures (Goldberg and Maggi 1999; Ades and Di Tella 1997).

This capture effect may be reinforced when picking firms rather than policy projects, be it for grants, venture capital investments, or even participation in coordination fora. First, the government may be biased in favour of incumbents, which are easier to identify. Second, it may be inclined to pick losers, in an attempt to smooth adjustment costs.

Ex-post, the literature questions the ability to stop projects that are ailing (both at the level of the policy and at the firm level). Rodrik (2008) stresses that successful experiences of industrial policy in East Asia relied on both carrots (tax credits and incentives) and sticks. In contrast, these sticks were lacking in other targeted industrial policy experiences, such as in Latin America during the 1950–1980 period.

General Equilibrium Effects When supporting a specific sector or technology, one reduces the availability of public funds, researchers, and capital for other sectors and technologies, thus, indirectly, affecting their performance.

General equilibrium effects within sectors and potential implications for resource reallocation and creative destruction dynamics might also need to be taken into account. The unintended effects on this dynamics might be twofold: while supporting the development of new technologies or business models might implicitly disadvantage players with obsolete technologies and older capital, new players coming into a market might find it more difficult to navigate the industrial policy landscape. These general equilibrium effects reinforce the need for an appropriate selection of the sectors and technologies.

Therefore, when designing targeted interventions, it is important to (Criscuolo et al. 2022a):

- **Ensure that horizontal interventions are not sufficient to reach the same objectives**. More generally, horizontal policy instruments can usefully complement targeted policy instruments within a strategy to achieve a given objective. For instance, to limit negative general equilibrium effects, strategies need to include instruments favouring access to inputs (both at the targeted and horizontal levels). It can be particularly useful to ensure that the necessary skills can be provided in sufficient quantities. Additional attention may need to be given to possible losers of policy interventions, for example by smoothing transitions from obsolete technologies.

- **Make explicit the rationale behind the strategy and ensure that policymakers can rely on the relevant technical and business knowledge**. Governments have a strong role to play in tackling societal challenges, and asymmetry of information could be limited for mission-oriented strategies.
- **Pay particular attention to the governance of the strategy** to limit the risk of capture and attenuate information asymmetries (Paic and Viros 2019; Romer 1993; Warwick 2013). Otherwise, targeted strategies may hinder competition and therefore innovation. In particular, it is necessary to:

  - Favour their inclusiveness, notably by ensuring that young firms and start-ups are solicited to participate and that, to the extent possible, the specifications are technology-neutral and do not discriminate between domestic and foreign firms;
  - Plan at inception scheduled assessments and evaluations;
  - Allow for failure and plan a regular refit of the instruments and the strategy. Removing or retargeting industrial policy instruments brings important political economy challenges.

More work is needed on best practices for the design of targeted strategies and the identification of the rights targets. The "ARPA" model (Advance Research Project Agency from the US Department of Defence) is usually presented as close to best practices in terms of governance (Azoulay et al. 2019; Rodrik and Sabel 2019; Larrue 2021). In particular, the agile organisational structure, the promotion of risk-taking and the capacity of allowing a rapid withdrawal of ailing projects seem to be key features of the model's success. This governance, as highlighted in the framework, also plays a crucial role for success: in ARPA it is based on the role and the talent of the programme managers, whose academic reputation is supposed to limit the asymmetry of information and to reduce the capture risk. It complies with the three principles of embeddedness, discipline, and accountability (Rodrik 2008, 2014). While these are interesting and relevant examples, the evidence remains mainly anecdotal or based on technical assessments (GAO 2015; Committee on Evaluation of the Advanced Research Projects Agency-Energy (ARPA-E) et al. 2017). Therefore, despite the numerous challenges and hurdles, a quantitative evaluation of general equilibrium effects, of the role of policies' design and governance system would be required.

3 Quantifying Industrial Strategies

The conceptual framework described above is not only useful to design and analyse industrial strategies but is also the basis for the measurement framework, landscaping, and benchmarking of industrial strategies across countries carried out in the QuIS project (http://oe.cd/quis).

The first subsection summarises the salient points of the QuIS methodology, detailed in Criscuolo et al. (2022c). The second subsection describes the main results on 9 OECD countries, while the last subsection zooms in on support to the green transition.

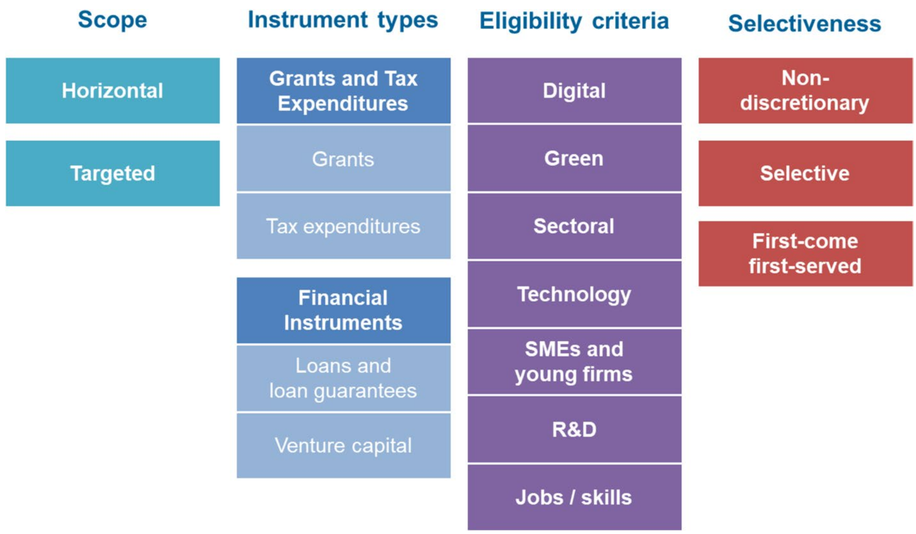

Fig. 3 Categorisation of industrial policies used in QuIS. Note: Eligibility criteria are not mutually exclusive, and some policies do not match any of the criteria. Source: Criscuolo et al. (2022c)

3.1 A Harmonised Methodology to Quantify Industrial Strategies

The first step that needs to be taken when measuring industrial strategies is developing an agreed methodology to compare across countries industrial policy expenditures, defined as direct support extended by the public sector to businesses, aimed at promoting investment (including digitalisation and cleaner production), improving competitiveness, or supporting economic development. Given the complexity of the exercise, only a subset of the industrial policy instruments included in the taxonomy laid out in Fig. 1 are covered in the quantification. These instruments are tax expenditures, grants, government venture capital, loans, and guarantees (Fig. 3).

Financial instruments, defined as the provision of loans, loan guarantees, or equity investments by government entities, are measured through the so-called notional amounts method, which measures the amount of financing (or guarantees) provided by public entities. This measure was chosen as it is the most widely available across countries. However, amounts obtained with this method are not directly comparable with grants and tax expenditures, so the two types of instruments are recorded and analysed separately.

QuIS data identify sectoral industrial policies, industrial policies supporting R&D, jobs and skills, the green transition, SMEs and young firms, technology-focused policies, and industrial policies supporting digital technologies (Fig. 3). All these criteria are defined in Criscuolo et al. (2022c). Importantly, the criteria are not mutually exclusive. For instance, a policy supporting R&D for SMEs will be simultaneously tagged in both categories (R&D and SMEs and young firms).

Support to the private sector granted through the intermediary of public agencies (e.g., innovation agencies or development banks, state-owned energy providers) or local authorities is included in the scope, as soon as they provide direct support to firms.

Policy instruments targeting agriculture are excluded from the scope of this report as, in some countries, a substantial part of agricultural support takes the form of market price

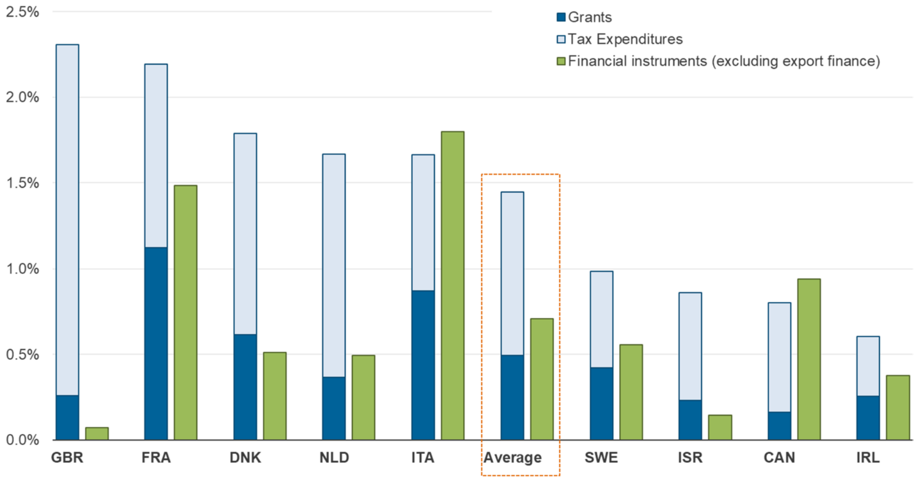

Fig. 4 Grants, tax expenditures, and financial instruments in % of GDP, 2021. Note: Structural domestic and EU policies (i.e., excluding COVID emergency measures). Source: Authors' calculations based on the QuIS database (Criscuolo et al. 2023)

support that is not covered in budgetary spending numbers and could bias the comparisons. The OECD provides measures of agricultural support taking into account the different dimensions of support.[1]

The project focuses on industrial policy instruments with annual expenditures higher than 0.002% of GDP. It aims to compare industrial strategies and main industrial policy orientations across countries, rather than to build an exhaustive compendium of policy instruments. The use of a relative measure allows adapting this threshold to the size, and the level of economic development, of the country.

The QuIS database currently includes 9 countries (Canada, Denmark, France, Ireland, Israel, Italy, the Netherlands, Sweden, and the UK) and also covers EU-level industrial policy expenditures for the participating countries, when relevant. It tracks approximately 1050 policy instruments per year, for a total of 3152 observations across the 2019–2021 period. The data gathered for each country were sent to the member states for additional checks and validation. The database, as well as country notes detailing the main characteristics of each country's industrial strategy, are downloadable from http://oe.cd/quis.

3.2 Industrial Policies Are Sizeable and Dominated by a Sectoral Approach, Even Though Strategies Differ Significantly Across Countries

On average, industrial policy grants and tax expenditures represent 1.4% of GDP in 2021 (Fig. 4). There is considerable heterogeneity across countries with industrial policy grants and tax expenditures: they represent 2.3% in the UK and 2.2% in France, compared to 0.6% in Ireland and 0.8% of GDP in Canada.

[1] https://www.oecd.org/agriculture/topics/agricultural-policy-monitoring-and-evaluation/

Financial instruments (excluding export finance) account for 0.7% of GDP in 2021 (Fig. 4). Loans are the most prevalent financial instrument across the countries considered, representing 0.33% of GDP, on average. The largest non-export loan scheme is provided by the *European Investment Bank* to Italian firms (0.37% of Italian GDP), while the second largest is the loans provided by Bpifrance to French firms (0.28% of French GDP). Guarantees represent on average 0.23% of GDP. Italy is the only country in the sample where guarantees (1.2% of GDP) is the largest form of financial support (1.7% of GDP), with its largest guarantee being the "*Fondo di Garanzia per le PMI (FGPMI)*" provided to SMEs (0.74% of GDP).[2] Venture capital accounts for 0.09% of GDP on average. France is the country using these schemes more intensively, with the "*Bpifrance—Investissement hors PIA*" (0.15% of French GDP) being the largest programme.

While some countries, such as France and Italy have both grants and tax expenditures and financial instruments above average, other countries have a particular focus on tax expenditures (the UK) or financial instruments (Canada).

An analysis of the composition of grants and tax expenditures further allows focusing on countries' priorities. Financial instruments are mostly horizontal support, with 16% on average supporting SMEs and young firms, while the other criteria rarely apply to financial instruments.

Figure 5 shows the distribution of grants and tax expenditures by eligibility criteria for the participating countries (as a percentage of total support through grants and tax expenditures in 2021). A number of stylised facts can be observed in this figure. First, sectoral support is the most prevalent, with on average 29% of support through grants and tax expenditures. Second, countries give a relatively high importance to industrial policies focused on R&D, the green transition, jobs and skills, and SMEs and young firms, which represent respectively 19.2%, 15.4%, 14.0%, and 11.5% of grants and tax expenditures, on average. Other industrial policies such as the ones supporting the digital transition (2.9%) and specific technologies (6.8%) receive less support on average.

Industrial policies not fulfilling any eligibility criteria are pervasive in the countries of the sample and represent 24.6% of the support through grants and tax expenditures, on average. These policies tend to be tax incentives in the form of reductions and rebates, notably around energy expenditures and capital investment. Countries such as Israel, the UK, and Denmark use these schemes intensively, where they represent 1.0%, 0.9%, and 0.7% of GDP, respectively. Some examples are the Danish electricity tax deduction (0.65% of GDP) and the capital allowance scheme in the UK (0.59% of GDP).

Beyond the overall preference for sectoral policies, industrial strategies are structurally different across countries. Table 2 shows the two criteria (except the sectoral criterion, given its pervasive importance across countries, and to which we get back below) where each country allocated the most of its industrial policy grants and tax expenditures.

As a percentage of GDP, sectoral support through grants and tax expenditures accounts for 0.41% of GDP on average. The countries using these instruments more intensively are France, Italy, and Denmark. In France, the main sectoral instruments are the "*Soutien aux énergies renouvelables électriques*" (0.23% of GDP) and the "*Soutien à la production d'électricité dans les zones non interconnectées au réseau métropolitain*" (0.09% of GDP), both consisting in subsidised contracts for renewable energy production, the former

[2] The fund also played a key role in the COVID-19 policy toolkit of Italy. In 2019, the scheme was worth 0.74% of GDP. In the database, the same share of GDP is attributed to the structural component in 2020 and 2021, while the rest of the expenditure is attributed to Covid-related support.

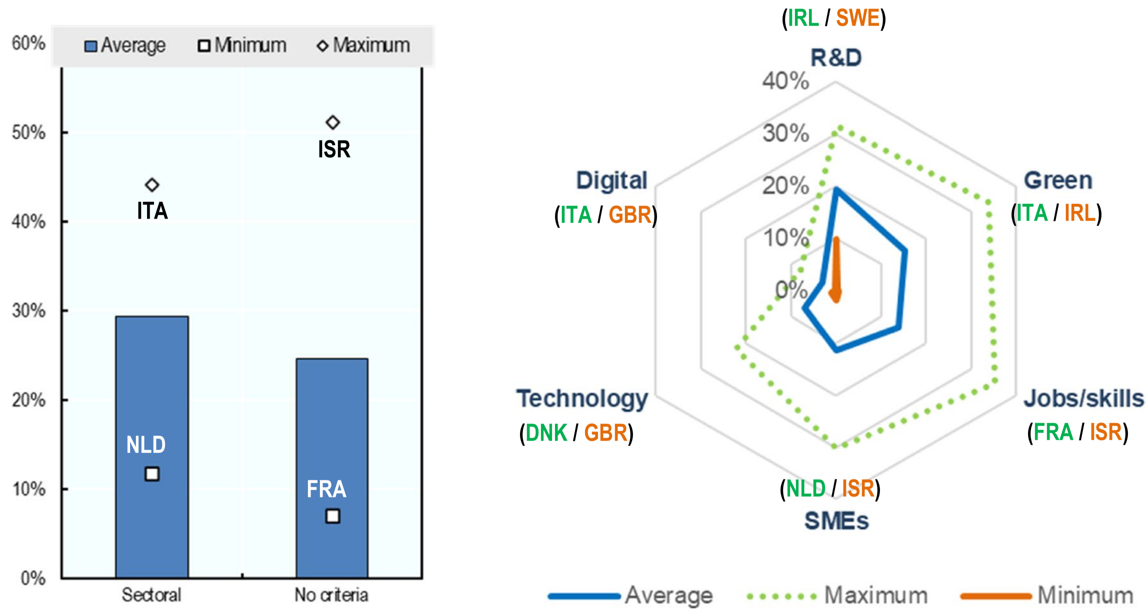

Fig. 5 Grants and tax expenditures by eligibility criteria in 2021, as % of total support through grants and tax expenditures. Note: Structural domestic and EU policies (i.e., excluding COVID emergency measures). Categories are not mutually exclusive, as policies can be tagged in several categories. Additionally, some policies do not fulfil any of these eligibility criteria (see left panel). Source: Author's calculations based on the QuIS database (Criscuolo et al. 2023)

Table 2 Criteria with the highest amount of grants and tax expenditures by country, 2021

Country	R&D	Jobs/skills	Green	SMEs and young firms	Technology	Digital
Canada	◊	◊				
Denmark			◊		◊	
France		◊	◊			
Ireland	◊				◊	
Israel	◊		◊			
Italy			◊		◊	
Netherlands	◊			◊		
Sweden		◊	◊			
UK		◊		◊		

These are the top two criteria by industrial policy expenditures on grants and tax expenditure instruments in absolute terms at the country level (excluding the sectoral criteria), it is not relative to the benchmark and does not indicate a lack of spending in other criteria

Source: Authors' analysis based on the QuIS database (Criscuolo et al. 2023)

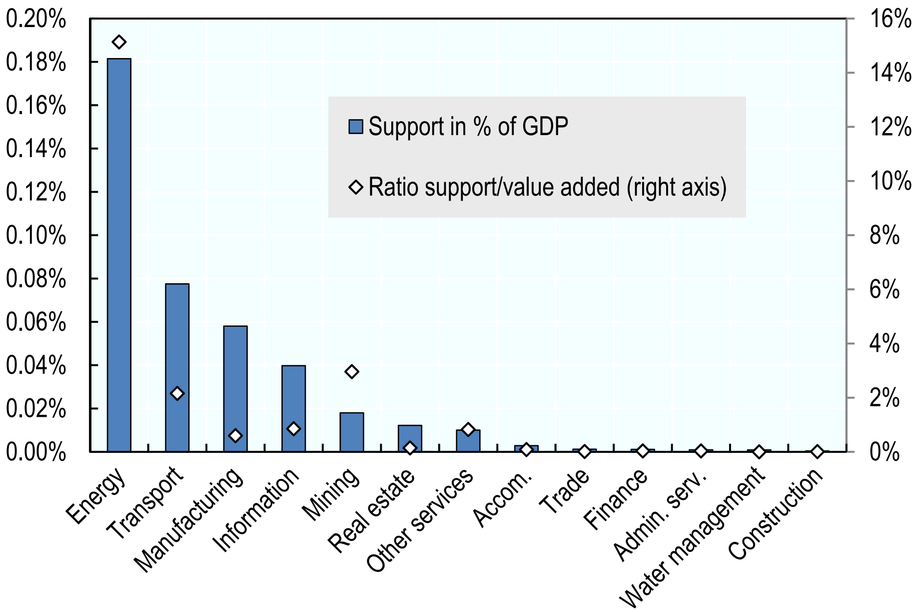

Fig. 6 The most supported sectors are energy, transport, and manufacturing. Sectoral grants and tax expenditures by sector in 2021, average across countries. Note: Policy instruments targeting agriculture are excluded from the scope of the report. Source: Authors' calculations based on the QuIS and STAN databases (Criscuolo et al. 2023)

provided to mainland France and the latter to the French overseas territories. In Italy, the main sectoral schemes are the feed-in-tariffs for energy produced with photovoltaic technologies (0.18% of GDP) and for other renewable energy sources ("*Impianti FER qualificati IAFR – TO & RD*") (0.10% of GDP). In Denmark, the two largest sectoral schemes are grants for wind turbine electricity (0.16% of GDP) and for renewable energy plants (0.10% of GDP), both supporting the energy sector.

Countries focus their sectoral support on three specific sectors (Fig. 6): Energy (0.18% of GDP), Transport (0.08% of GDP) and Manufacturing (0.06% of GDP). When considering sector size by calculating the ratio of support to sectoral value added, the difference between the support to those sectors and all others, as well as the difference among these same sectors, are magnified, with Energy receiving support equivalent to 15.4% of its value added, way higher than for Transport (2.2% of GDP) and Manufacturing (0.6% of GDP).

The main instruments targeting the energy sector are the aforementioned incentivised contracts for renewable energy production in France, feed-in-tariffs in Italy and grants in Denmark.

A significant share of support to transport is provided through fuel tax rebates or exemptions. For instance, Italy provides tax incentives on excise duty of diesel for land transport (0.08% of GDP) and on fuel taxes for shipping (0.03% of GDP). Denmark grants tax exemptions on fuels used by ships and ferries (0.04% of GDP) and trains (0.02% of GDP); and France relies on tax deductions for fuels used by land transport (0.06% of GDP). Besides fuel tax breaks, the largest instruments are tax exemptions on labour costs in the shipping industry provided by Denmark and Sweden (0.04% and 0.02% of GDP, respectively), followed by schemes that replace corporate income tax by a tonnage tax for shipping companies provided by France and Denmark (0.01% and 0.03% of GDP).

France is the country providing the highest support to manufacturing (0.27% of GDP). The most significant instruments supporting manufacturing in France include grants and tax expenditures reducing the cost of energy[3] (0.10% of GDP) and a mix of instruments targeting specific sub-sectors[4] (0.07% of GDP). With much less support to manufacturing, the UK is the second country in the list (0.07% of GDP), with tax expenditures such as the "*Industrial Relief Scheme*" (0.05% of GDP) for excise duty on oil used in manufacturing (e.g., solvents, lubricants, in the production of products such as paints) and tax exemptions for inputs used in metallurgical processes (0.01% of GDP).

3.3 Green Industrial Policies Are Growing, and Primarily Target the Energy Sector

The countries that resort most to green industrial policies are Italy, Denmark, and France, where they represent 0.56%, 0.54%, and 0.37% of GDP, respectively (Fig. 7). Other countries such as Canada and Ireland[5] spend less than the rest on green instruments (0.077% and 0.002% of GDP, respectively).

In recent years, industrial policy support to the green transition has increased, on average, from 0.22% to 0.24% of GDP between 2019 and 2021 in the participating countries.

[3] The main instrument being a reduced tax rate on electricity for energy-intensive industries (0.04% of GDP).

[4] The main instrument being a grant for R&D in the civil aerospace sector (*R&D dans le domaine de l'aéronautique civile – CORAC* – 0.04% of GDP).

[5] For Ireland, although green industrial policy expenditures are lower than in the benchmark in 2021 (0.002% vs 0.28% of GDP), it might significantly increase in upcoming years due to the new "*Renewable Electricity Support Scheme (RESS)*", which provides a price-premium to renewable electricity producers if the strike price settled in auctions is consistently higher than the market price and generates an obligation to pay if the opposite holds. This instrument has the potential for becoming key in the Irish green transition, given the high amount of support budgeted (0.5% of GDP).

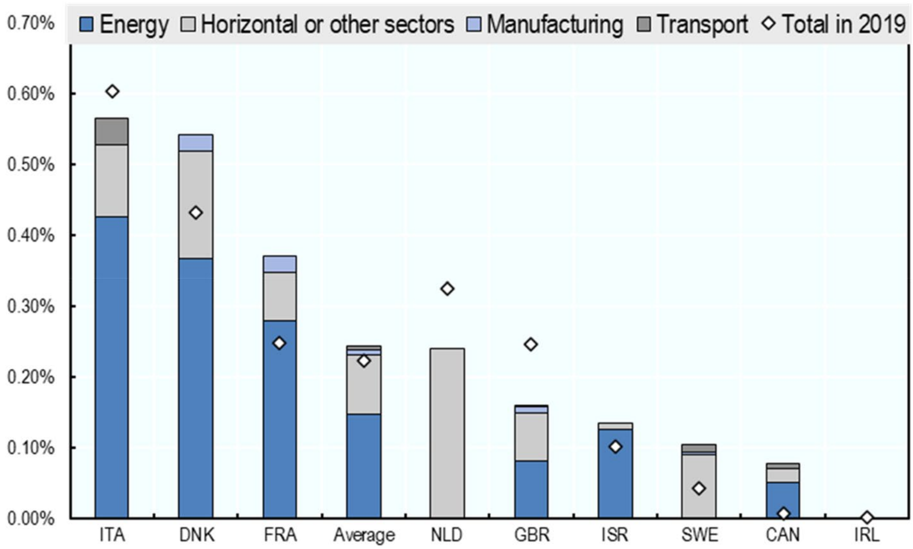

Fig. 7 Most green industrial policies are either targeting the energy sector or non-sectoral. Green grants and tax expenditures by sector in 2021, % of GDP. Note: "Non-sectoral and others" includes support that is not targeted to a given sector or targets a sector, which is not energy nor manufacturing, or transport. Source: Authors' calculations based on the QuIS database (Criscuolo et al. 2023)

The only exceptions to the increasing trend of green support are Italy, the Netherlands, and the UK. In Italy, the slight decrease in green support over the years can be attributed to the increase in energy prices, which led to a lower support share of the feed-in-tariff schemes for renewable energy production.[6] In the Netherlands, the temporary reduction due to the change from the SDE+ grants to the new SDE++ format[7] (from 0.16% of GDP to 0.06%), was partly compensated by the increased expenditure in some schemes, such as the tax deduction on zero-emission cars used by businesses (from 0.04% of GDP to 0.06%) and the *Sustainable energy investment subsidy ("ISDE")* (from 0.01% of GDP to 0.02%). In the UK, two large instruments decreased from 2019 to 2021 due to rising energy prices: the *Contracts for Difference* scheme that provides grants to renewable energy contracts (from 0.08 to 0.01% of GDP)[8] and the *Feed-In Tariffs* scheme for renewable electricity (from 0.07 to 0.05% of GDP).

On average, countries rely more on green grants (Fig. 7) while green tax expenditures are important in the Netherlands, where they represent 0.10% of GDP (vs 0.17% of GDP

[6] In those schemes, the support share is proportional to the difference between a pre-determined strike price and the market price.

[7] SDE++, once fully in place, should be larger than SDE+.

[8] With Contracts for Difference, firms may also pay public bodies when energy prices are high enough. For instance, the Irish "Renewable Electricity Support Scheme (RESS)" has the potential to become the largest industrial policy instrument in Ireland, with a budget of EUR 2 billion per year (the first RESS projects were approved in 2020). However, in 2021, RESS payments were negative (companies had to pay the Public Service Obligation (PSO) fund) because the market price for electricity in 2021 was higher than the project's strike price. In QuIS, policy instruments are only considered when they provide support to firms, and not when companies repay the government.

in grants). This predominance of grants is coherent with the targeted nature of green industrial policies, which tend to support the green transition in specific sectors such as energy[9] (but also manufacturing and transport) and through specific technologies (e.g., wind turbines, technologies to upgrade biogas, green hydrogen, etc.). Some of the largest grants are the Italian feed-in-tariff scheme for energy produced with photovoltaic technologies (0.18% of GDP), French grants financing purchase contracts of renewable electricity[10] (0.23% of GDP) and Danish grants supporting wind turbine electricity[11] (0.16% of GDP). The largest tax expenditures are the Dutch tax deduction on zero-emission cars used in businesses (0.06% of GDP) and the Danish electricity tax exemption for renewable energy from biomass[12] (0.06% of GDP).

Most countries rely on sectoral green strategies. For instance, Italy, Denmark, and France focus their green support on the decarbonisation of the energy sector (0.42%, 0.37%, and 0.28% of GDP, respectively), by promoting the production and distribution of renewable energy, while other countries like the Netherlands and Sweden rely on horizontal green support for the whole business sector. The UK uses a mixed strategy by providing to a similar extent green support to the energy sector and through non-sectoral instruments.

The largest instruments supporting the whole business sector are a tax deduction on zero-emission cars used by businesses ("*IB/LB Korting op de bijtelling voor nulemissieauto's*", 0.58% of GDP) and the new *Stimulation of sustainable energy production and climate transition policy* ("*SDE++*", 0.55% of GDP), both in the Netherlands. It is worth noting that the *SDE+ +* programme was originally focused on the energy sector (SDE+ at that time) and was expanded to manufacturing in 2021, following the 2019 Climate Agreement.

Some green industrial policies also target transport and manufacturing. Green support to transport is more common in Italy and Sweden, with the main programme being the Italian grants supporting the use of biomethane in transport ("*Promozione dell'uso del biometano e degli altri biocarburanti avanzati nel settore dei trasporti*") (0.04% of GDP). Policies supporting the decarbonisation of manufacturing are more common in Denmark and France, with the main programmes being the grants based on energy savings in Denmark (0.02% of GDP) and the French grants supporting the adoption of biofuels to produce heat in manufacturing processes (0.01% of GDP).

Finally, the increase in green industrial policy expenditures drove the growth of technology-focused policies, from 0.09 to 0.13% of GDP between 2019 and 2021, on average, with 80% of this expenditure being green in 2021. This increase was more pronounced in France, Italy, and Denmark, where technology-focused policies grew by 0.09, 0.05, and 0.05 pp of GDP, respectively.

The countries spending the most on technology-focused industrial policies in 2021 are Denmark and Italy (0.40% and 0.29% of GDP, respectively), with most of those schemes being green (0.37% of GDP in Denmark and 0.28% in Italy). In this regard, Denmark relies

9 This corresponds to section D of the ISIC classification. Mining and extraction activities are recoded separately (section B of the ISIC classification).

10 Electricity providers have an obligation to purchase from selected renewable electricity producers and are compensated for the extra cost it represents.

11 The support is given in the form of a price supplement to wind electricity providers, which is either a fixed amount per produced kWh or the difference between a fixed amount and the market price.

12 Fuels produced from biomass are exempted from the energy taxes typically paid by businesses for the use of fossil fuels.

on instruments such as grants for wind turbine electricity (0.16% of GDP) and upgrading or purification of biogas (0.10% of GDP), and tax exemptions for renewable energy from biomass (0.06% of GDP); while Italy relies on schemes such as the feed-in-tariff for energy produced with photovoltaic technologies (0.18% of GDP), grants supporting the use of biomethane in transport (0.04% of GDP) and the *Important Project of Common European Interest (IPCEI)* grants supporting investment in batteries to store renewable energy[13] (0.06% of GDP).

4 Conclusion

In this paper, we presented a framework, a methodology, and a quantification exercise to better understand and compare industrial strategies across countries and over time. These should be considered the first steps in what is a long journey toward a full understanding of the development and deployment of industrial strategies, and to ensure their transparencies and their effectiveness. There is still a long way to go, but we hope this paper is going in the right direction to get us started.

The quantification shows that industrial strategies are undergoing significant changes linked to achieving new and “non-traditional” goals they are meant to address, such as the green transition but also inclusive growth, strategic autonomy, and global value chain resilience. Some important changes in priorities of industrial strategies are already apparent from the QuIS data on the 2019–2021 period and are expected to gain further traction. In particular, the growth of green and technology-specific industrial policies is likely to continue as most countries have recently committed to increase their support to the green transition, in particular by supporting firms. Some of these schemes are focused on key emerging green technologies, which are required to achieve carbon neutrality in 2050 (e.g., hydrogen, batteries). But other technology-specific schemes are likely to emerge in the coming years related to strategic autonomy and GVC resilience, for instance in the field of semiconductors, digital or pharmaceutical technologies.

While their goals may be new, the challenges affecting industrial strategies are well-known. With more targeted interventions, the efficiency of industrial policies crucially hinges on the ability of governments to pick the right targets, which requires to gain access to relevant information, avoid capture and rent-seeking, and limit general equilibrium effects. In addition, some of the recently announced industrial policies might have detrimental effects on the level-playing field, and some consider these initiatives as a new form of protectionism. Finally, while green industrial policy is growing, our analysis confirms the existence of significant support to the use of fossil fuels by businesses (OECD 2018), notably in the transport sector.

Given the importance of achieving climate neutrality targets by 2050, and the mounting public investment to reach this goal (Aulie et al. 2023), quantification efforts such as QuIS might ultimately help linking green industrial strategies to their impact on structural change and the climate neutrality targets.

More broadly, achieving effective industrial strategies requires devoting more attention than ever to.

[13] *“Fondo IPCEI Batterie I”* and “*Fondo IPCEI Batterie 2*”. This is an instrument provided by the Italian government, without EU funding.

- Policy design, relying on best practices and ensuring that industrial strategies contain complementary instruments,
- International coordination to avoid transforming support to green technologies and to more resilient supply chains into a negative sum game at the global level,
- Policy evaluation, to ensure the tools are fit for purpose and changed in due time when warranted.

Regarding policy design, some extensions of the work may be easier, such as the inclusion of some demand-side policies, e.g., public procurement, or covering more countries; some may be more difficult. A better understanding of the interaction, not only across different policy measures within the industrial strategy toolkit, but also with other policy domains (financial, monetary, labour, etc.) would require, as a start, adapting the framework presented here, and collecting additional data. Even if insightful in-depth analyses of countries' strategies can be drawn from the analysis of QuIS data,[14] having this even broader view of policies would further improve our understanding of policy priorities across countries.

But policy design must also rely on rigorous policy evaluation. Ultimately, the goal should be to evaluate the effectiveness of industrial strategies as part of the broader toolkit of policy makers to ensure resilient sustainable, and inclusive growth. Criscuolo et al. (2022b) provide a synoptic view of the available empirical evidence on industrial policy instruments and their complementarities and trade-offs. Despite a growing body of evidence, a strong push on evaluation is urgently required. There is still limited and inconclusive evidence for many questions, including the effectiveness of the targeted and demand-side instruments, the complementarities between policy instruments, which are often bundled together in industrial strategies, and the effects of industrial policy on resilience, inclusiveness, and the environmental and social performance of firms.

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Data Availability The QuIS data (2023 vintage) is available at http://oe.cd/quis.

Declarations

Disclaimer The opinions expressed and arguments employed herein are those of the authors and do not necessarily reflect the official views of the OECD or of its member countries.

[14] See the 9 country notes available at http://oe.cd/quis.

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