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LONG IN THE MAKING:

Policy insights from the Thai bioeconomy sector

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Highlights:

- While the presence of natural resource endowments and a developed agricultural sector serve as prerequisites, the implementation of innovation and market-shaping industrial policy is essential to achieve value addition in bioproductions
- The current development of the Thai bioeconomy sector has its origins in the innovation initiatives implemented in the early 2000s by the Thai National Innovation Agency (NIA) in collaboration with a few major private and public sector actors.
- The 2017 Bio-Circular-Green (BCG) Strategy marks the mainstreaming, rather than the establishment, of bioproductions as targets for industrial policy in Thailand.
- Value addition in bioproductions has been achieved not just through the BCG Strategy, but through a 20-year constant adaption of policy to the innovation phase and to different levels of technological sophistication, from biofuels to bioplastics, leaving a valuable policy legacy.
- Regulatory, governance and market-shaping reforms are needed for the development of the biotech industry in higher value-added productions, such as biopharmaceuticals.



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1. Research background and objective

Low- and middle-income countries in Africa, Latin America and Asia are increasingly turning to the bioeconomy as a pathway for development (Rodríguez et al. 2019; Virgin et al. 2022). The stated policy objectives seek to bring together environmental sustainability with economic growth, while also benefitting farmers through higher incomes achieved via participation in the structural change process. Adding value to agricultural commodities and bioproductions requires not only a reliable and high-quality supply of feedstock, but also the implementation of comprehensive market-creating and market-shaping policies aimed at conditioning public support to the development of technological capabilities.

In 2017 the Thai Government created the flagship Bio-Circular-Green (BCG) Strategy, to kickstart high value-added productions in the bioeconomy sector through circular practices and green industrial policy. The policy was officially launched through a memorandum of understanding (MoU) signed by major private sector corporations, research centres and public institutions on 23 January 2017. The BCG Strategy was then enshrined in the 20-year development plan, National Strategy 2018–2036, to reach developed country status by 2036. Furthermore, the BCG Strategy was aimed at bringing together biotechnology targeting with environmental issues, such as air and plastic pollution, and social disparity (benefitting northern and north-eastern farmers, at least in its initial intentions).

The BCG Strategy most prominently includes incentives towards investment, particularly FDI. This investment support is disbursed by the Board of Investment, Thailand's professional FDI-attraction agency. The support comprises tax incentives conditioned on the level of the investment's technological sophistication (Mazzucato and Rodrik 2023), for example corporate income tax exemptions, which go from zero to ten years according to seven levels of knowledge intensity.

The BCG package also includes non-tax incentives, such as exemptions on foreign currency regulation, visa facilitation and land ownership rights.

The government directly provides funding for infrastructure, R&D centres and projects, such as the Eastern Economic Corridor of Innovation (EECi) centre in Rayong, and training through the National Science and Technology Development Agency (NSTDA).

Since 2016, biofuel productivity in terms of value-added has increased by 17% and production has reached 11.3 million litres/day for bioethanol and 14 million litres/day for biodiesel, making Thailand among the top ten countries worldwide for biofuel production in 2022 (EECO 2022; Energy Institute 2023a; OIE 2022). More impressively, the year prior to the launch of the BCG Strategy Thailand had no bioplastic production at industrial scale, while in 2019 the country became the world's second-largest producer of PLA (polylactic acid, the most common bioplastic).¹ Since the BCG Strategy was launched, in 2021 Thailand reached 23.6% of global PBS production capacity of PBS (Polybutylene succinate, another common bioplastic), from 2019 to 2021² its bioplastic exports have doubled both in terms of volume and value (PLASTAT 2023), and Thailand's ranking as a major exporter (BOI 2022) is expected to improve even further in 2024 when NatureWorks (a half Thai/half American joint venture) is due to open a new 75000 tonnes PLA plant in the northern province of Nakhon Sawan.

While impressive, these recent achievements represent a continuation of the path towards value addition in the bioeconomy sector which Thailand was already pursuing well before the launch of the BCG Strategy. Thailand's biofuel production showed rapid growth from the mid-2000s until 2015, but has been stagnant since then (Energy Institute 2023b). NatureWorks, as an equal joint venture with Cargill, was established in 2011 and the country's Bio-PBS plant (the world's first) was already under construction in 2015. This policy brief presents the policy origins of bioproduction targeting in Thailand, and shows how policy evolution has adapted along innovation phase and technological

¹ With a production capacity of 75000 tonnes out of 290000 (European Bioplastics 2022; Fortune Business Insights 2021).

² Author's calculation based on EEC (2020), S&P Global (2022) and Statista (2021).

sophistication. The goal is to identify which policies have been successful in achieving the current level of bioeconomy sector development and which reform steps are needed to pursue higher value-added bioproductions, such as biopharmaceuticals.

2. Methodology

The theoretical framework used in this policy brief follows Bouckaert's work in public sector models (2023). The author categorises policy interventions according to three domains: hierarchy, market and network. The hierarchy policy provision ideal type prescribes the need for a professional, hierarchically organised bureaucracy to deliver top-down interventions (including bans or mandates). The market policy provision ideal type sees the market as the sole desirable policy tool, minimising and hollowing out the state machine in favour of private exchange. The network policy provision ideal type stresses horizontal collaboration, mutualistic public-private synergies (Mazzucato 2011) and variable organisation. In reality, most models are hybrid, encompassing characteristics from different ideal types, such as the hierarchy-driven Neo-Weberian State, the market-driven New Public Management and the network-driven New Public Governance (Dunn and Miller 2007; Osborne 2006).

This policy brief references the taxonomy on industrial policy conditionalities developed by Mazzucato and Rodrik (2023). The authors distinguish four dimensions along which policy-makers can shape conditionalities: type of behaviour targeted, conditions negotiability, risks-rewards sharing and measurable criteria. This approach is particularly relevant in the case of Thailand, given that its development path from the 1970s until the 1990s was characterised by FDI attraction with inadequate use of conditionalities, particularly export conditionalities (Studwell 2013), which limited the country's development potential.

This policy brief draws on quantitative and qualitative data from 40 extensive, semi-structured interviews with top executives, high-ranking government officials, major farmers and producers' associations, universities and research centres, including three key individual informants. Quantitative data is drawn from company reports, publicly available databases, public

agencies, producers' associations and international organisations. Policy type prevalence has been itemised into the categories of hierarchy, market and network. The level of policy use is structured into three levels (reflected in the three colour tones in Figure 1 and in the three sizes of the circles in Figure 2).

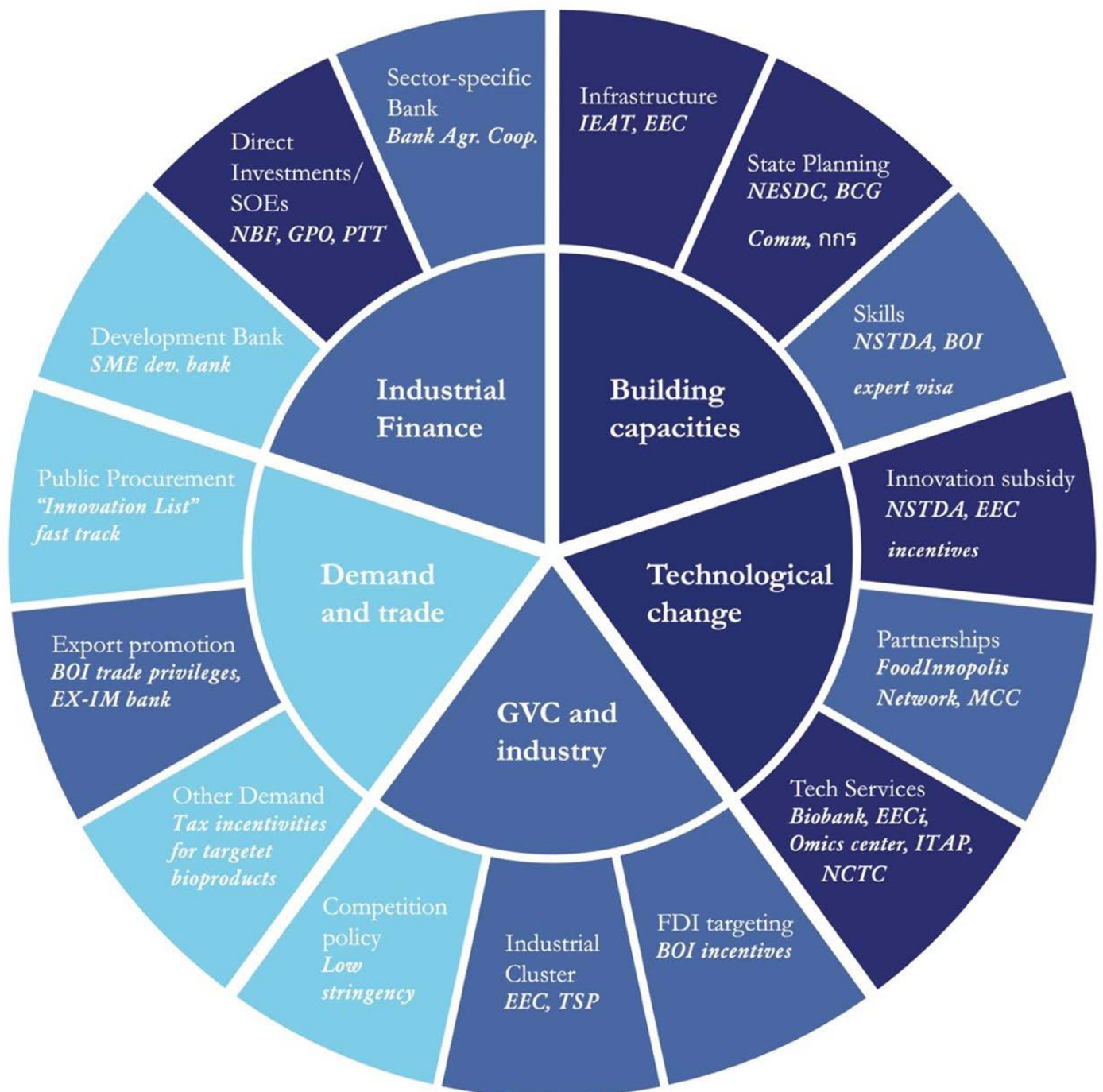
3. Research results and reform insights

The targeting of bioproductions through industrial policy has evolved over time across different levels of technological sophistication. While biofuels have been the subject of various government initiatives for several decades, it was only in the early 2000s that they were prioritised (particularly after the 2003 oil price surge) and only after 2008 did production reach a significant scale (ADB 2009; Kline et al. 2007; Kumar et al. 2013). Biofuels have a relatively low level of technological sophistication, which does not entail complex multi-dimensional interventions, relying instead on hierarchical tools. Production kicked off after hierarchical policies, such as the 'hard' 2% blend mandate in the case of biodiesel (for each diesel unit sold, 2% of it had to be from biofuel) and the 10% target in the case of bioethanol (FAO 2008; Kline et al. 2007).

The start of the push for biofuels coincided with a five-year research project on bioplastics, commissioned in 2002 by the Thai National Innovation Agency (NIA) and started in 2003 (full professor, chemistry, major university, interview, 4 October 2022). The research project, which was given the equivalent of several million US dollars, targeted four areas: upstream productivity for bioplastic feedstocks, technological transfer, technological development (such as in PLA, both within academia and in collaboration with industry), and governance and regulatory reform for bioplastics (including visits to and the study of several European countries' frameworks). In 2005, NIA also promoted the establishment of the Thai Bioplastic Industry Association (TBIA), a network of business actors which has grown from five initial members to over 50, including several world leaders in bioplastic production (a pioneering experience, similar to the European Bio-based Industries Consortium

established in 2013). In the 2010s, biofuels finally lost prevalence in favour of bioplastics (executive director, research, public agency, interview, 15 November 2022). NIA, together with TBIA, designed the National Roadmap for the Development of the Bioplastic Industry 2008–2015. Towards the end of the agreed roadmap timeframe, the first large-scale bioplastic production in the country, specifically BioPBS by PTT MCC, was already in progress.

Figure 1. Current policies in the Thai bioeconomy sector



Source: Author's elaboration. Framework based on Andreoni et al. (2021); Andreoni and Tregenna (2018); and Cingolani (2018).

Against this background and 20 years of experience, the 2017 BCG Strategy was launched. The policy comprised greater use of networks, starting from the format of the MoU with which it was presented. Collaboration with universities was enhanced and most large-scale productions have been carried out by joint ventures. This is in line with global experience in bioplastic technology, which is often spear-headed by technological networking (such as the 2022 CJ-NatureWorks deal on PHA and PLA biotechnology). However, three reforms, **market reform, regulatory reform** and **governance reform**, are urgently needed if Thailand is to successfully enter bioproductions with greater value-added and technological sophistication.

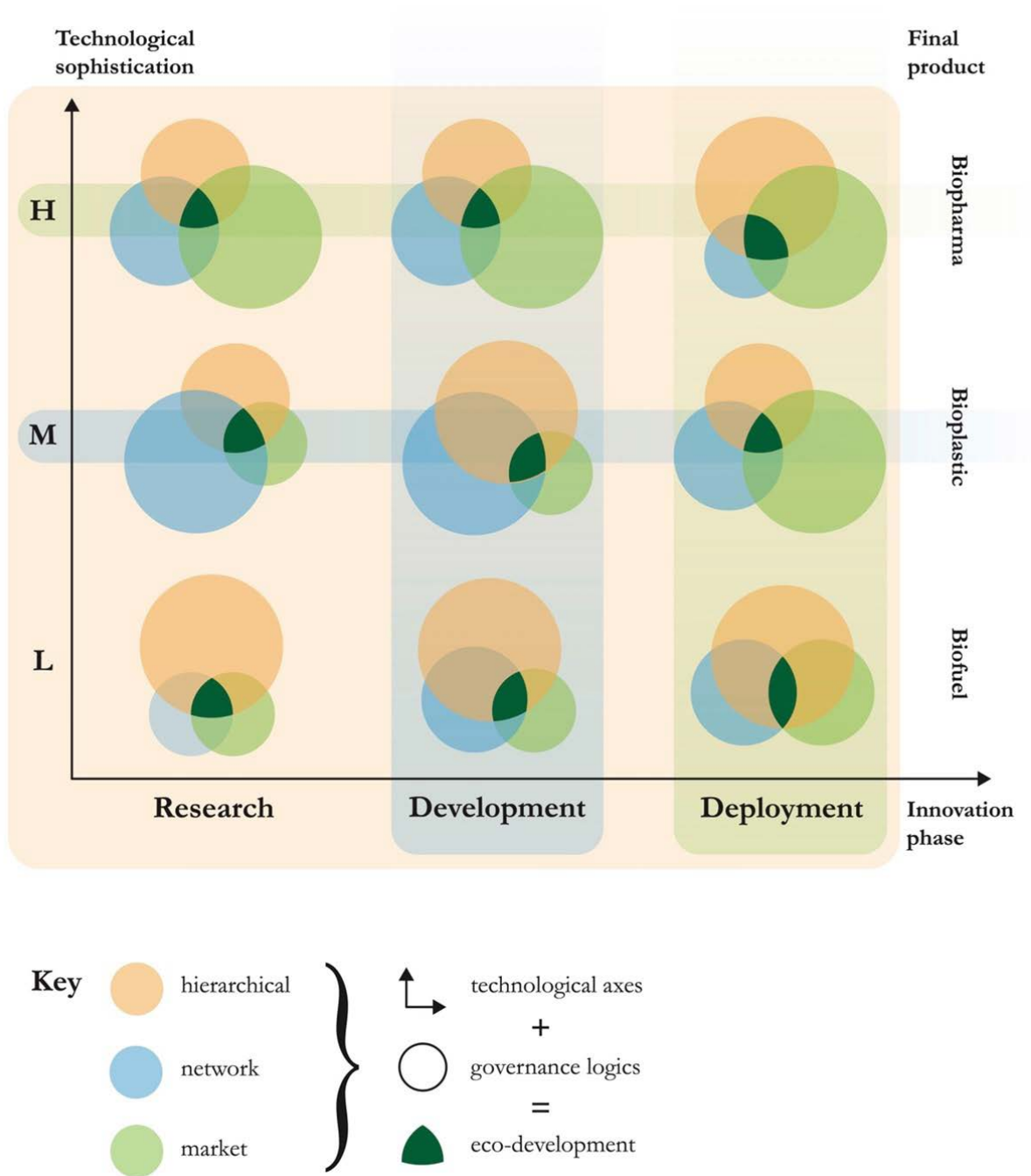
While hierarchical and network interventions have been substantial, the same cannot be said for **market measures**, especially in innovation deployment. Supply and, especially, demand-side policies will have to be strengthened if Thailand is to target bioproductions with high levels of technological sophistication, such as biopharmaceuticals. Strategic public procurement, including green public procurement, still finds relatively low use, despite its potential to kickstart demand and help reach economies of scale. Another obstacle has been the lack of access to finance, with only a handful of major actors being able to break into the sector. If the benefits are to be spread across society, and beyond Bangkok and Rayong, development financing has to be elevated to the required level for capital-intensive bioproductions.

In addition, investment in STEM and hard skills still trails the needs of the biotech sector. In the medium to long term, Thailand is also due to introduce stronger competition to ensure initial protection for infant industry does not translate into parasitic public-private partnerships and rentierism. For sophisticated productions in biopharmaceuticals, relying on internal technological development will likely be insufficient and, at an initial stage, market acquisition strategies by actors with sufficient capital would be favoured, given that the required level of innovation and product complexity is several multiples greater than for bioplastics. These market-based strategies, many no longer defensible, are needed to fundamentally reshape the bioeconomy sector in order to break into higher value-added bioproductions.

Also urgently needed is **regulatory reform**. The Thai FDA's approval process, required for most high value-added bioproductions, is rightly precautionary. However, there are several possible interventions to streamline, clarify and speed up the approval process (for example improving processing capacity through permanent committee members, greater transparency leading to a one-stop presentation of required documents and coordination with other permit-issuing agencies, among others). Furthermore, while Thailand has made fruitful use of hierarchical interventions, these can also be used to indirectly improve environmental quality by requiring best agricultural practices (such as in the RED II and III EU directives), a style of regulatory intervention with space for greater application in the Thai context, with potential for mitigation of bioproduct-related environmental impacts.

Finally, the Thai bioeconomy sector needs **a new governance framework**. While all bioproductions impact the responsibilities of several ministries and government agencies (including research, environment, industry, trade, energy and agriculture), biopharmaceuticals break across an even greater number of competencies, such as public health and welfare, and require closer collaboration and joint decision-making among policy-makers. The governance of inter-ministerial and inter-agency coordination is in dire need of reform. Strengthening the collective principle by enhancing the role of the cabinet should be the starting point. The PM could advocate for a greater number of matters from ministries to be decided and implemented by the cabinet as a whole instead. Another improvement could be found in inter-ministerial committees or agencies, which should not be thought of as simple, often infrequent, meetings where chores are distributed. They should be truly permanent joint processes and institutions, endowed with the legal authority to break down siloed ministries and cut across competencies, including through unified implementation teams directly hired by the inter-ministerial committee or agency and reporting directly to it.

Figure 2. Policy types along innovation phases and across technological sophistication



Source: Author's elaboration.

4. Conclusion and broader implications

The BCG Strategy is a relatively new policy, but, in the Thai context, it is not entirely novel. Rather, it's the continuation of a 20-year path of targeting bioproductions through industrial policy. The current level of bioeconomy sector development in Thailand has been long in the making. Considering the BCG Strategy as the sole reason behind recent economic successes carries the risk of future policy failure, given that the current level of bioeconomy sector development has been achieved through constant policy recalibration and not one-off interventions. Pursuing high-income status through value addition in bioproductions is an effective policy that plays on the country's strengths and capabilities, directing the economy towards sectors, such as advanced materials and biopharmaceuticals, with desirable learning curves and dynamic competition (Reinert 2020). While industrial policy can be reviewed and improved, it deserves long-term thinking and a degree of stability, requiring critical analysis rather than excessive partisanship. New regulatory, governance and market-shaping reforms, some of which are suggested in this policy brief, are needed for the development of the biotech industry in higher value-added productions, such as biopharmaceuticals.

Thailand has avoided its historical mistakes, adopting a moderate amount of conditionalities instead of simple handouts. However, conditionalities have been mostly confined to technological sophistication. Some efforts at achieving additionality and directing investment where it is most geographically needed have been made (such as the Nakhon Sawan bio-hub). However, despite this, the north and north-east still lack the attention that the central region receives; a lost opportunity for strengthening the domestic market, and addressing social and territorial disparities. While too many conditionalities might stifle innovation, there is still moderate space for environmental and social conditionalities (for example, regarding co-benefits in pollution

reduction), especially if the government adopts a focus on outcomes, rather than on how to get there (Mazzucato and Rodrik 2023). For investment in capital-intensive, innovation-intensive (bio) pharmaceutical industry, the government should design reward instruments which take into account the high level of risk, including retaining equity in beneficiaries.

While societal challenges might differ across countries, what governments should aim for is a 'clear vision and a public purpose that guides the collaboration and innovation of both private and public actors in addressing' such challenges (Mazzucato and Rodrik 2023). The BCG Strategy is just one attempt at embedding directionality (whether technological, environmental or social) in industrial policy. Reforming and (re)directing industrial policy is key to development, as available resources and successful strategies vary along the development path (Ang 2017). Reforms should embody the concept of embedded autonomy, typical of developmental states (Evans 1995). They should be embedded in the industrial structures, taking advantage of available capabilities and previous policies, while maintaining autonomy from private interests, critically analysing the inherited policy framework to ensure market discipline, rather than subservience, and thus reshaping the development trajectory.

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