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## Green Industrial Policy and Industrialisation in Africa

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### 1. Introduction

There is a strong rationale and urgency for Africa to pursue a green industrial policy to advance its industrialisation and broader economic transformation. The global competitive landscape is changing. OECD countries spearheaded by the USA are investing in frontier green technologies, with the first-mover advantage in play. However, African countries must catch up in innovation and investment in new sectors. The greening of African economic development is urgent, but there needs to be a consensus on how best to promote this, and it is also not at the centre of policymaking. More evidence of national experiences of pathways to lower carbon industrialisation in Africa and to green

industrial policy is needed. Green growth and carbon-neutral industrialisation are vital for African economic transformation, and green industrial policy is central to achieving these goals. Africa is the smallest contributor to climate change, but the continent most vulnerable to it. Therefore, it must accelerate economic transformation and pursue a green path with limited resources and technological capability.

The design and practice of green industrial policy and decarbonisation pathways are more complex than often thought. Neither the fossil fuel-driven path, nor a 'growing now and cleaning later' approach, is a viable development route for African countries. As advanced countries and emerging economies invest in greening, the accelerated advances in

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green technologies, new green industries, and the changing global competitive landscape will likely affect African countries' positioning and prospects. The greening pathway opens windows of economic and technological opportunity for new industries, driving economic development and accelerating the displacement of existing industries into obsolescence. Various studies show that the accelerated transition to a carbon-neutral economy potentially generates better benefits than delayed transition by developing and developed economies.

The paper examines Africa's challenges arising from and prospects for green industrial policy and industrialisation. Green growth and carbon-neutral industrialisation are vital for African economic transformation, and a sustainable industrial policy is central to achieving these goals. Nevertheless, African countries have to accelerate economic transformation and pursue a green transformation path with limited resources and a low base of technological capability. Furthermore, the design and practice of green industrial policy and decarbonisation pathways are more complex than often thought.

First, the paper presents conceptual perspectives on green industrial policy. It examines the evidence for and lived experience of the progress and challenges of greening African economic development through selected comparative case studies of industrial policy practices.

Furthermore, the paper focuses on three strategic complementary priorities for green industrialisation: (a) developing low-carbon industrial hubs to accelerate decarbonisation and the building of green manufacturing, (b) prioritising the expansion of diverse renewable sources of energy, including hydropower; these sources have strong spillovers and are a significant African endowment, and (c) investing in research and innovation capability from the early stage of development. Furthermore, it argues that

carbon-neutral industrialisation is a protracted and the only prospective path to achieving the dual goals of accelerating structural change and the ambition of net zero emissions. Nonetheless, green growth has a broader scope and necessitates more decisive developmental roles for the state in an increasingly complex and competitive landscape. Policy learning from the continent's experiences and from those emerging economies that pursue green growth could provide valuable lessons to accelerate the process.

Ethiopia has been acknowledged to have rapid economic growth (10.5% for 15 consecutive years), and to pursue an active industrial policy and state-led development. Ethiopia's case studies provide lived experience and evidence of the multiple aspects of executing a green industrial policy, which prioritises green energy, makes considerable investments, and relies on 100% renewable energy at an affordable cost, thereby stimulating the manufacturing sector. Furthermore, the Ethiopian government's experiment with a new generation of low-carbon industrial hubs, and its various efforts to link green energy with building technological capacity, are lived experiences that show the complexity of and tensions in green industrial policy.

Morocco's industrial policy in the last two decades has targeted building a globally competitive automotive industry, building world-class industrial hubs, and experimenting with renewable energy, primarily solar and green hydrogen. South Africa has been at the forefront of research and development and is home to world-class universities. However, it is the most carbon-intensive economy on the continent, with energy a binding constraint on growth and employment creation. Using comparative case studies, the paper provides new empirical evidence and illustrates the challenges and policy issues in pursuing green industrial policy and carbon-neutral industrialisation in Africa.

From the structuralist perspective of development economics, an industrial policy is the government's intervention to accelerate and shape structural change and productive transformation from low to high productivity and from low to high technology. Africa's carbon-neutral industrialisation and green industrial policy underpin three conceptual perspectives: the green growth perspective, the technological revolution and accompanying techno-paradigm shifts, and developmental environmentalism. Green industrial policy should be based not only on a solid foundation of green growth, but also on understanding the long-term direction of the technological revolution. It demands strong political will and the strategic role of the state within a new context. It is also a relatively new but rapidly expanding research sphere – green industrial policy is a government intervention to build a carbon-neutral economy and accelerate structural transformation and economic catch-up. The concept emphasises three aspects that have policy implications. First, structural transformation is at the heart of green industrial policy. Second, the underlying rationale is that green industrial policy essentially comprises government intervention and policies. Third, green industrial policy is about building a carbon-neutral economy and ensuring sustainable resource utilisation.

## 2. Low carbon industrial hubs and green industrial policy

Industrial hubs are essential drivers of green industrial policy, generating benefits through multiple channels. First, industrial hubs can promote a green ecosystem to support the decarbonisation of existing manufacturing firms by introducing stringent environmental standards and adopting technologies and processes in the design and implementation phases. Second, industrial hubs can facilitate the introduction and development of new green technologies and systems, such as renewable energy and hydrogen, at an

industrial scale, serving as green platforms and powering various industries, thereby making manufacturing competitive and energy-efficient. Third, industrial hubs facilitate industrial symbiosis and a circular economy, offering sustainable use of resources and improving productivity. Furthermore, more broadly speaking, industrial hubs can synergise green and sustainable cities, offering additional benefits besides greening economic development.

Eco-industrial parks are broadly defined as industrial hubs that enhance environmental performance, generate productivity and competitiveness gains for firms, and contribute to the decarbonisation of industries. A critical strategy is putting up green infrastructure, including renewable energy and central waste-treatment facilities, along with conducive zoning and land use. Eco-industrial parks promote a circular economy through industrial symbiosis within firms and clusters, and use comprehensive green transformation plans, certification, and performance management. In addition, evidence shows that specialised or sector-based hubs facilitate specialised industrial infrastructure, accelerate investment project execution, and support the application of targeted government investment incentives and government services to specific requirements. The Ethiopian experience shows that, despite challenges, initiating eco-industrial parks by developing new industrial parks offers significant benefits, including a steep learning curve. It also shows that the government's commitment to pursuing eco-industrial parks is critical to ensuring their success despite inter-agency coordination difficulties.

Morocco has pursued a very ambitious industrial hubs strategy for over two decades, aligned with the government's industrial policy and with strategic priorities in automotive and aeronautics, textile and food processing, renewable energy, pharmaceuticals and logistics. Initiatives to green the industrial hubs have been implemented, with a strong pull

from the lead firms and ensuring international compliance. Strict environmental monitoring and recycling initiatives have also been implemented. However, there have been rapidly accelerating shifts in the global automotive industry. Electric vehicles (EVs) have grown fast in recent years, driven by technological advancement, government policies, and rapidly decreasing prices. Their share in the worldwide car market jumped from 5% to 15% between 2019 and 2022. China has emerged as a leading player in EV manufacturing and market share. The European Union will restrict vehicles powered by combustion engines by 2035. The transformation of the future of Morocco's automotive industry is determined by shifting to the production of electric vehicles, with decarbonisation across the whole production system. Similar observations can be made in South Africa's automotive industry.

### 3. Research and innovation capability

The conceptual framework of greening has significant implications for the greening of industrial policy. First, green industrial policy necessitates a stronger focus on research and development (R&D), innovations and technological advancement – far beyond what is found in conventional thinking in industrial policy. Technological innovations in digital and green technologies have a broader scope across all industries and require considerably more funds to boost innovations. They also necessitate integrating policy on science and technology and national innovation systems as the core of the industrial policy framework. Innovation is not limited to breakthrough technologies, but can also relate to a series of incremental improvements and innovations in decarbonising the manufacturing and service sectors.

A key focus of green industrial policy and a driver of green transformation is the development of technological capability and innovation as a leapfrogging strategy in

emerging industries and accelerating decarbonisation for sustained growth in productivity. South Africa has a large number of outstanding research universities and significant research capability, nurtured by a national innovation system. Over half of Africa's top 10 universities are in South Africa, and these research universities lead in science, engineering and technology, including health, computer science and environmental sciences. They are also home to many prime technology and engineering research organisations. The paper reviewed similar initiatives in innovation hubs in developing regions, citing Mauritian experience and efforts in Côte d'Ivoire. The expansion and transformation of Ethiopia's university and TVET systems have contributed to building production capability and promoting investment.

### 4. Renewable energy and green industrial policy

An essential feature of building a green energy and hydroelectric power-centric system has been the sustained complementarity and linkage effects with the manufacturing and construction sector, which contributes to building domestic productive capacity, creating employment, and reducing foreign exchange requirements. First, the expansion of and demand for hydroelectric projects drove the growth of the cement industry and that of other building materials manufacturing, particularly between 1998 and 2015. Second, power generation enabled the expansion of the manufacturing sector and facilitated urbanisation, which was targeted by government policy to give priority to manufacturing industries. Priority was given to industrial parks, industrial projects, an electric-powered railway (Addis–Djibouti export-import corridor) and the Addis Ababa light rail system. The government pursued targeted subsidies for the manufacturing sector, providing below 3 US cents per KWH for over two decades, with an incremental increase to about 4 US cents after 2018. Providing low and

clean electricity became an advantage to attract manufacturing foreign direct investment (FDI) and Western brands as part of the investment incentives. However, manufacturing also puts pressure on utility providers because of a significant expansion in demand from industrial parks and the cement industry and the push for improved quality and reliability. Industrial parks played a critical role in streamlining power provision in concentrated hubs supported by the construction of dedicated substations. This process was characterised by tension and challenges, given shortages and delays in projects, which induced positive actions and improvements.

Ethiopian state-led policy was characterised by a high political commitment, enabling a sustainable energy system and accelerating structural transformation. The strategic priority of the energy sector is reflected in resource allocation and investment, as well as the development of SOEs to spearhead the industry. The entire investment made by the government and private sector made the sector less attractive, given the risks from the long gestation period and scale of the required investment in hydroelectricity power projects. The government's policy determined that the private sector may participate in power generation, but transformation and distribution are under government ownership to ensure access to affordable energy. In contrast to many African countries that have privatised the utility, giving rise to high tariffs, the government made it sustainable and economically facilitated rapid economic growth. Given the political and geopolitical tensions surrounding hydropower projects, the state's role was vital, most notably GERD and other plants. The government improved coordination among the various ministries and agencies, between federal and regional governments, with hands-on robust leadership from the Office of the Prime Minister, using different taskforces and appointing senior board members. The government's leadership

was necessary to mobilise domestic resources for hydroelectric dam construction and prioritise access to foreign finance.

Nonetheless, the execution of policy faced immense challenges and tensions, which became an inherent part of the process – the imbalance between demand and supply, linkage effects demanding timely interventions, and the political nature of the programme. The sector has various weaknesses; the national grid and distribution networks are inefficient, requiring major upgrading, and Ethiopia has only achieved universal access by only 55% of its growing population. Diversifying energy sources is necessary to ensure more reliable sources of energy. Given the constraints in expanding public funds and the high-interest rate for further expansion, an innovative policy is required to attract the private sector into the sector.

Given these considerations, building research capability, strategies and benefits and maximising learning from international benchmarks have become essential. Many African countries can benefit from hydroelectric power, as the continent has significant potential. However, reviewing energy policies and roadmaps and integrating them into the green industrial policy framework is essential for achieving green growth.

Green hydrogen is new to Africa, and the current hydrogen production in South Africa and Morocco is based primarily on natural gas and coal. Furthermore, various investment initiatives have been announced since 2021, mainly to supply to the European market. South Africa and Namibia have also been at the forefront of investment in green hydrogen and hydrogen-based fuels. There are additional potential players in the production and export of green hydrogen across the continent's Eastern, Northern, Western and Southern regions. However, most of these projects are at the early stage of feasibility studies or



announcements, showing the uncertainty in the direction and scope of green hydrogen. The available technologies for green hydrogen still need to be economical, but the technology will likely advance in the coming decades. There are real concerns about the recent agreements (between Egypt, Morocco and Namibia) on green hydrogen because it could pose a risk of ‘cannibalisation’, with countries neglecting their energy needs, generating benefits for Europe and diminishing the scope of Africa’s manufacturing capability. There is inadequate evidence suggesting a commitment to developing an integrated manufacturing capacity and supply chains. This message reinforces the need for a proactive green industrial policy that focuses on expanding the domestic manufacturing sector and capitalising on the value-added benefits of the green hydrogen platform.

### **5. Synthesis and comparative insights: Implications for policymaking**

Drawing from structuralist development economies, evolutionary economics and lived experience, this paper emphasises the urgency of green industrial policy and industrialisation in Africa to show that carbon-neutral industrialisation is the only viable path. First, it underlines that degrowth, or ‘brown growth’, is a dead end. Africa is a latecomer with limited investment in industrialisation, and developing its new carbon-neutral capability is economical and sustainable, and necessitates a green industrial policy. Such green industrial policy should generate high growth, accelerate economic transformation, and be embedded in economic diversification and productive transformation. Second, it is unlikely that green industrial policy will accelerate economic transformation, as it is not driven by exports, allowing more extensive market access and enabling international learning and productivity gains. Africa will go through massive urbanisation and demographic growth in the next three decades, with significant implications for green industrial policy, and the

creation of huge markets, productive capacity and employment as a primary aim. Hence, green industrial policy has twin goals: ensuring economic transformation and building a carbon-neutral economy. An earlier pursuit of green growth is obviously more economical, given the urgency of achieving the net-zero targets.

Third, for a successful green industrial policy, a longer-term perspective is essential, particularly regarding the dynamics of technological change, to guide the deliberate selection of technologies, invest in winning and new industries, and not invest in obsolescence. Understanding technological directions is essential to pursuing a green growth strategy involving leapfrogging strategies into new green industries. However, this leapfrogging opportunity will be more likely for a few countries that have invested in innovation and industrial capacity. The green industrial policy must also be based on decarbonising existing and mature industries to ensure that such sectors are gradually transformed into green ones. Hence, combining the decarbonisation of existing industries and leapfrogging strategies go hand in hand. A green industrial policy embedded in production and innovation is more effective in accelerating economic transformation, rather than policies based on the exchange of market mechanisms or carbon trade.

National economies in Africa have divergent economic structures requiring different strategies and policies. For instance, as a generalisation, we could identify four major economies – oil-based, resource-rich, carbon-intensive and resource-poor economies – that face different challenges and prospects. Although there is a significant opportunity for policy learning, the industrial structure, political economy, and potential for linkage effects give rise to uneven outcomes and necessitate industrial policies that reflect national peculiarities and sectoral features. Different sectors require different industrial policy designs. Furthermore, ending the

subsidies to fossil fuel industries is an important policy instrument, clearing the way for clean and new energy and green industries.

The paper's focus on three cases is based on the imperative that green industrial policy requires a broader scope for intervention. Unlike the conventional industrial policy, green energy is central to carbon-neutral industrialisation and energy security, as shown in the Ethiopian and Moroccan cases. Universal access to electricity should not be seen solely from the perspectives of poverty reduction and the SDGs, but also in terms of how it serves as a demand to develop productive capacity. Having energy as a national strategy is vital for the growth and competitiveness of the manufacturing sector. However, the energy path selected will be different for different African countries. Developing new energy hubs and green hydrogen should be guided primarily from the perspective of developing industrial capacity and innovation capability, and not for 'procuring' energy. South Africa's case is an example of such an outstanding opportunity that could be lost despite enormous demand, industrial capacity, and investment in R&D over the last twenty years. As the cases show, this is a work in progress requiring significant policy focus to ensure the strategy is successful.

International best practice shows that low-carbon industrial hubs are one of the critical elements of green industrial policy, providing an industrial ecosystem but pulling the decarbonisation process. The initiatives taken in Morocco and Ethiopia indicate the potential of green industrial policy, although it requires additional investment and policy instruments. However, low-carbon industrial hubs must ensure the growth of linkage effects, verticality, domestic capability and economies of scale. It is essential to ensure that industrial parks are designed to ensure productivity

gains, inter-firm learning, and linkages. Decarbonisation and performance improvements must be strengthened at the industry, industrial hub and firm level.

Technological advancements and innovation have accelerated increasingly in the last few decades. Experience in emerging economies, such as China, shows that investing in R&D should start early, and R&D expenditure must grow over time. South Africa's commitment to scientific R&D is a positive lesson for all African countries. The research should focus on strategic priority sectors, commercialisation, and attracting international talent, while containing the brain drain is critical. R&D capacity will likely have a limited effect if it is not integrated tightly with the development of the manufacturing sector. In this process, innovation hubs facilitate the boost of innovation capability, and transforming the university and technical school system is possible in many African countries. These complementary policies are conducive to attracting productive investment.

The reviewed cases clearly show that carbon-neutral industrialisation and green industrial policy have significant benefits and are attainable in African countries. It also shows that government interventions and the development state have the opportunity for policy learning, focusing on emerging economies that could be considered close to African countries as comparators and benchmarks. However, designing and implementing a successful green industrial policy is more challenging than applying conventional policy, as it requires dealing with urgency and uncertainties, policy interfaces, and readiness to experiment and change policy as needed. Research that assists policy learning and the quality and performance of green industrial policy are essential.

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