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Greening Industrialization in Southern Africa through Digitalization, Infrastructure Development and Regional Integration: Leveraging AfCFTA Implementation

Introduction

1. The Southern African region has high commodity dependence and a low degree of industrialization, inconsistent with structural transformation and sustainable economic development to reduce poverty and increase equity in the region significantly. Most countries in the region, have been unable to sustain manufacturing value added beyond 15% of GDP (World Bank, 2020), noting that structural transformation requires sustained value-added levels circa 25% of GDP, based on evidence of newly industrialized economies of East Asia[1]. For example, between 2016 and 2020, only Eswatini (29%) and Lesotho (16%) had an average manufacturing value added above 15%, while Malawi, Mauritius, Namibia, South Africa and Zimbabwe (ranged between 11 and 13%) and Angola, Botswana and Zambia reported between 6 and 7% manufacturing value added (World Bank, 2022). The high levels of poverty[2] and inequality[3] indicate that economic growth[4] and development have not been inclusive. Furthermore, the limited economic diversification and a narrow export basket mostly comprised of semi-processed commodities undermine the region's resilience to economic, climatic, pandemic or war-driven shocks, impacting the economic fundamentals and worsening vulnerability and poverty. Vulnerability to economic and climate shocks compound each other, especially in developing countries, locking countries into an eco-development trap of permanent disruption, economic precarity and slow productivity growth (UNCTAD, 2021).

2. In the face of global climate change, increasing natural resource degradation and rising environmental pollution, member states in the region have embraced green industrialization– and are pursuing economic growth without externalizing the negative environmental costs of development (Okereke, et al., 2019). Increasing industrialization to drive economic transformation will increase the use of resources, and greening the process contributes to developing a more competitive, resource-efficient, a climate-resilient industrial sector that increases manufacturing value add and creates jobs while preserving environmental resources (ECA, Economic Report on Africa: Greening Africa's Industrialisation, 2016). However, many unanswered questions remain about the feasibility of green industrialization in Southern Africa, particularly regarding sustaining growth and the conditions under which this might best happen. Others suggest that as latecomers to industrialization, African countries have the advantage of not grappling with technology lock-in and associated path-dependencies, which often constrain change (UNEP, 2011).

3. Green industrialization encompasses three closely related concepts: green economy, green growth and green jobs. Based on the United Nations Industrial Development Organization (UNIDO), green industrialization has two main dimensions (a) industries green themselves and (b) green enterprises that offer environmental goods and services. In the first dimension, industries can green themselves by reducing the environmental impacts of industrial processes (decoupling), that is, improvements in the use of materials, energy and water inputs and or a reduction in the release of pollutants concerning product outputs. The second dimension involves establishing new enterprises or expanding existing ones to deliver environmental goods and services (Luken & Clarence-Smith, 2019). Green and inclusive industrialization present a vital pathway to combine sustainable economic growth, more inclusive incomes and an enhanced environment within a broader green economy strategy (ECA, 2016). Attaining inclusive green industrialization requires increases in economic growth and incomes

[1] Between 1950, 1980 and 2005, East and South-East Asia economies MVA as % of GDP on average was 10%, 22% and 24% respectively, with a 6% growth rate over the period. These rates include fast industrializing East Asia economies which at their peak were registering rates of 24 -36% (Chang & Zach, 2019).

[2] Between 2014 and 2019, the poverty headcount ratio at $3.65 a day (2017 PPP) (% of population) ranged from 40% to 89% in the focus countries except in Mauritius which was about 2% (World Bank, 2022).

[3] Between 2014 and 2019, the poverty gap at $3.65 a day (2017 PPP) (%) ranged from 25% to 51% in the focus countries and only Botswana (14%), Namibia (13%) and South Africa (16%) had poverty gap below 20% (World Bank, 2022).

[4] Based on World Development Indicators Data, average GDP annual growth rate between 2010 and 2021 was 3% with individual countries ranging 1.3% to 5% (World Bank, 2022).

together with sustained efforts to advance green transformation, social inclusiveness and management of trade-offs.

4. Africa's current and future industrialization drive is confronted with the issues of green industrialization, digitalization, energy access and affordability, transport logistics and regional integration (Lopes & te Velde, 2021). Supportive policies are essential to building a productive capacity that uses lower cost and clean energy. Also, digitalization can contribute to achieving environmentally and socio-economically sustainable industrialization. For example, digitalization can contribute to the achievement of SDG 9 through the reduction of emissions, enabling decoupling and significant CO_2 savings from the industry while simultaneously raising economic growth and increasing incomes, especially in low and middle-income countries (Sachs, Schmidt-Traub, Mazzucato, Messner, & Rockström, 2019; Matthess & Kunkel, 2020; Kunkel & Tyfield, 2021). Deepening regional integration provisions, investing in complementary infrastructure, building industrial capabilities, and investing in the institutions needed to promote regional trade are critical to accelerating green industrialization.

5. The African Development Bank estimate that Africa requires $130-170 billion per annum in infrastructure investments to power the continent's development aspirations articulated in Agenda 2063 (AfDB, 2018). Further, the region will need to grapple with the drivers of green industrialization that can support faster intra-Africa and global trade to build resilience against multiple shocks. Critically, green infrastructure investments are needed in the region to support a just transition, clean, sustainable energy to power industrialization and enhance private sector development. Given the strong correlation between energy use and economic growth, at least historically, decoupling carbon dioxide emissions from economic development presents a huge challenge for any state. But achieving this objective is even more difficult for developing countries where institutional capacity and innovation systems are weaker (Mulugetta & Urban, 2010; Wakeford, et al., 2017).

6. Digitalization can change established economic development processes, revealing new challenges with respect to the distribution of the welfare gains from industrialization, especially where variability in access to digital infrastructure impacts equality of opportunities, particularly evident in the rural-urban divide in developing countries. On the other hand, making industrialization and digitization environmentally sustainable is essential to simultaneously address 'sustainable industrialization' (SDG 9) and other sustainability goals like climate change mitigation (SDG 13). The political and economic systems should be considered in digitalization and green industrialization efforts to ensure that the ecological harm of industrialization is alleviated rather than worsened by aggregate macro-level growth that might reverse efficiency gains in material resources and energy (Kunkel & Tyfield, 2021).

7. Given the region's potential comparative advantage in agriculture, there is a need for a concerted focus on climate-smart and resilient agriculture, which supports increasing crop yields for food security and sustainable supplies of agro-processed goods for regional and global trade. At the centre of the industrialization drive is the African Continental Free Trade Area (AfCFTA) as a critical framework supporting an increased pace of continental industrialization and, in some cases, re-industrialization. The AfCFTA aims to boost intra-Africa regional trade connecting more than 1 billion people and a combined GDP of more than USD$ 3 trillion[5]. The measures to address trade and non-trade barriers and facilitate intra-Africa regional trade will help create opportunities to develop regional value chains. The growing new regional markets, complemented by improvements in the regional and national policy environment, will also help attract private sector investments and spur innovations that will help transform national and regional economies. Digitalization, infrastructure development, ICT, energy access and regional integration will be key in enhancing the benefits of the AfCFTA among regional member states.

[5] https://au.int/en/ti/cfta/about. Accessed 16 October 2022.

8. The study's main objective was to: (a) conduct an analysis of the current state of green industrialization, digitalization and infrastructure development, (b) undertake a gap analysis of the current industrial policies and frameworks, and (c) identify potential sectors and value chains that could promote green industrialization. The report focuses on the Southern African member states of Angola, Botswana, Eswatini, Lesotho, Malawi, Mauritius, Mozambique, Namibia, South Africa, Zambia, and Zimbabwe. The analyses relied on secondary data compiled through a comprehensive desk research of publicly available national, regional and continental materials.

The state of green industrialization, digitalization, and infrastructure development

Energy

9. The demand for energy in the region continues to grow, driven by increasing demand from the rising population, urbanization, and growing economic activity that demands more energy. The energy challenges experienced in the region include recurrent load shedding and power outages, shocks in oil and gas markets, inefficient energy supply and consumption patterns, limited power generation capacity and lack of interconnectivity of power grids. These challenges significantly affect economic activities and constrain the potential growth of the manufacturing sector. As a result, the region is experiencing high opportunity costs in terms of lost output when businesses and households experience sustained periods without electricity and no alternative energy sources. Alternatively, they incur extra charges if they use other sources like generators.

10. Access to electricity in the focus countries remains a challenge across the region. Figure 1 below shows that only 5 of the 11 focus countries (Botswana, Eswatini, Mauritius, South Africa and Zimbabwe) have at least 50% of their population with access to electricity by 2020. Countries with decent access to electricity, such as South Africa, have been experiencing unreliable power supplies recently.

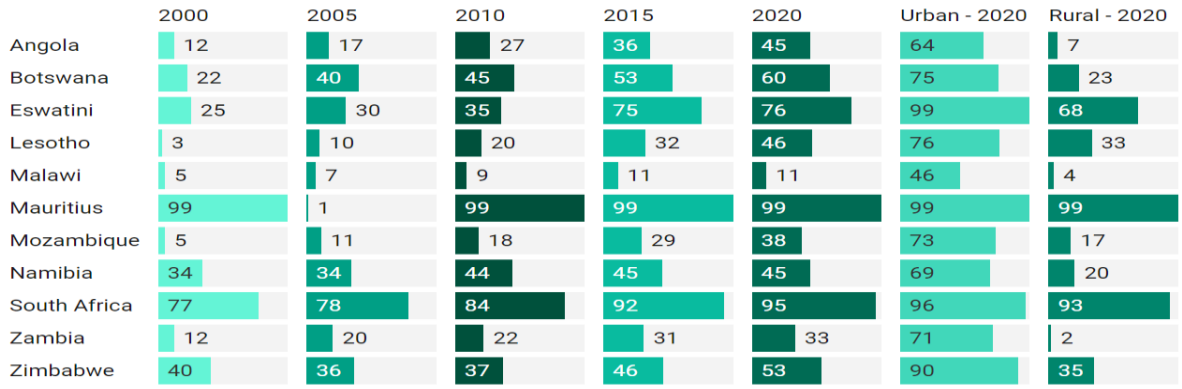

Figure 1: Proportion of the population with access to electricity (%)

Source: Own construction based on date from IEA (2021)

11. An analysis of the share of modern renewables in total final energy consumption showed that only Eswatini and Malawi had at least a 40% share. The growing demand for clean energy sources can help attract increased investments to mainstream modern renewable energy sources in their energy mix. An enabling environment is critical to attracting investments in modern renewable energy sources from the public and private sectors. Increasing the share of modern renewables in the generation energy mix helps contribute to national targets towards reducing emissions while contributing to socio-economic goals.

12. The Southern African Power Pool (SAPP) is a platform for trading in power among the focus countries of this study. Trade under SAPP contributes to regional integration through enhanced energy access in deficit countries and facilitating surplus countries to sell energy across the region through the

interconnectors. The installed capacity of the SAPP (for the focus countries excluding Mauritius) as of March 2021 was 76,470MW with an operating capacity of 61, 047 MW and demand and reserve of 52 148 MW resulting in 8,898 MW excess capacity. The installed capacity energy generation mix is mainly thermal (coal) (59%) followed by hydro-power (24%). Other energy sources include Solar PV and Distillate at 4% and nuclear and wind contributing 3%.

13. The history of new generation capacity between 2010 and 2020 showed that the SAPP was 8,168 MW below the planned capacity of 30,092MW by 2020 (Figure 2). The member states should prioritize investments in new energy infrastructure to keep up with growing demand. Addressing the new generation capacity offers ways for member states to expand the contribution of clean energy sources in the regional pool. Also, consistent infrastructure maintenance is required to avoid supply disruptions. The energy supply disruptions adversely affect all economic sectors and constrain efforts to drive green industrialization.

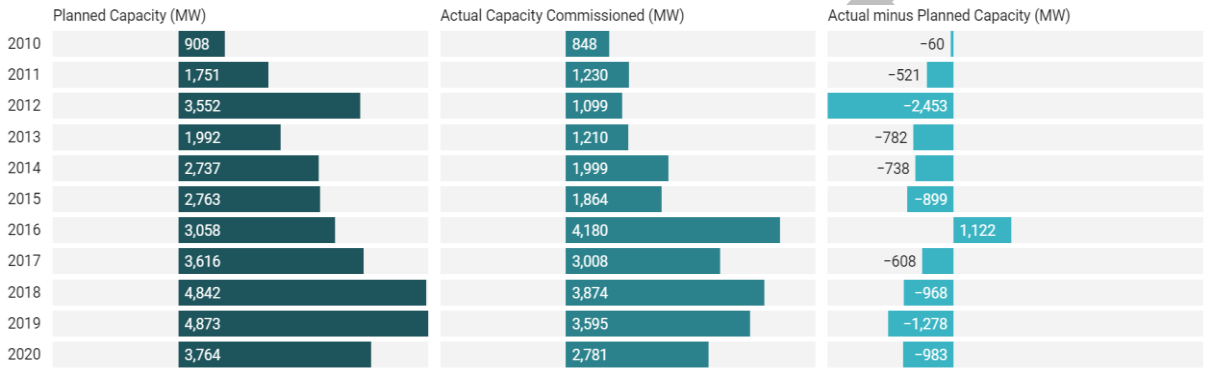

Figure 2: Planned vs actual generation capacity commissioned by SAPP since 2010

Source: Own construction based on data from SAPP (2021)

ICT and Digital Infrastructure

14. *Infrastructure and access:* Broadband penetration helps improve economic growth and job creation by strengthening connections between goods, markets, people, and jobs. The population covered by a mobile cellular network shows that all countries reported at least 85% cellular network coverage except Eswatini (55%). Also, the results for 4G (ultra-broadband internet access) showed that 7 of the 11 focus countries (Botswana, Eswatini, Lesotho, Malawi, Mauritius, South Africa and Zambia) reported at least 50% coverage. The focus countries show high coverage rates of 3G (the first to enable video calls and faster data transfer), similar to mobile cellular network coverage. The wide mobile cellular and 3G coverage open opportunities for improved access to digital innovations (such as digital financial platforms) across the country, including reaching the economically disadvantaged, such as youth and women in remote areas.

15. The penetration of mobile services (number of connections per capita) indicates high mobile broadband and telephone subscriptions and very low numbers for fixed broadband and telephone subscriptions. Botswana (95%), Mauritius (98%) and South Africa (111%) reported high levels of mobile broadband penetration per 100 inhabitants among the focus countries. Angola (20%), Eswatini (18%) and Mozambique (18%) had the lowest mobile broadband subscriptions per 100 inhabitants. The extensive spread of mobile broadband indicates the increasing mobile network services needed for individuals, businesses and governments to get online and connect with local and global digital services connecting to the global digital economy. This also means entrepreneurial youth and women across the region can start new digital businesses or apply digital technologies to improve their businesses, for example, improved access to regional and global markets.

16. *Internet use:* Household internet use remains low in the region, with only three countries (Botswana, Mauritius and South Africa) reporting internet access above 50% in 2020 (Figure 3). The Internet of Things (IoT) connects physical components over the internet. The development of smart systems connected to the internet of things can generate unique opportunities to strategically address challenges associated with the SDGs to attain an equitable, environmentally sustainable and healthy society (Mondejar, et al., 2021). For example, through the IoT, stakeholders can reduce operational expenses, optimize asset maintenance, reduce energy spending, integrate green energy, minimize carbon emissions, comply with regulations and predict consumption and spending (Bradu, et al., 2022; Hossein, Mohammadrezaei, Hunt, & Zakeri, 2020). Also, the internet economy presents leapfrog opportunities to address challenges faced by Africa's fast-growing informal businesses and workers. For instance, improved internet connectivity helps spur innovation and opportunities for small-scale manufacturers (including youth and women). Improved internet connectivity is also important to facilitate market access within and across countries, strengthening regional integration efforts.

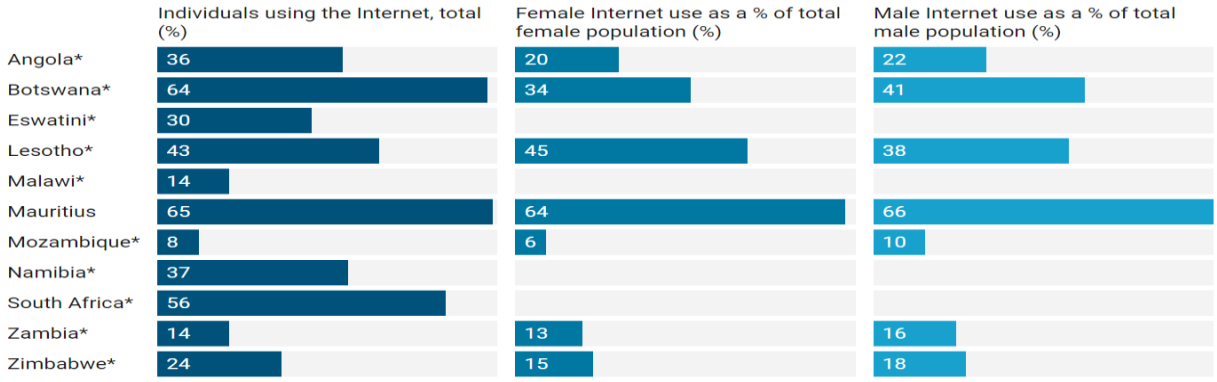

Figure 3: Percentage of the population using the internet (2020)

Source: Own construction based on date from ITU | **Note:** Gaps indicate no data available

17. Investments in digital infrastructure are essential to ensure a competitive regional digital economy for Southern African countries. The increase in investments in subsea and terrestrial fiber-optic infrastructure has contributed to the rapid growth in international internet capacity leading to greater availability and lower price for high-speed transmission capacity (Figure 5). All focus countries are connected directly or through terrestrial fiber systems. The international internet bandwidth for Africa increased by a factor of 10 in the past decade to 12 terabits per second (Tbps), but this is still less than half that of China (36 Tbps), indicating significant room for further growth (Google & IFC, 2020). The ambitious country digital strategies, private sector investments, and a continent-wide effort to reach universal access by 2030 continue to drive digital activity, presenting opportunities for digitalization to contribute to green industrialization in the region. Examples include the application of digitalization in energy efficiency, improving transport and logistics services and financial services across the region.

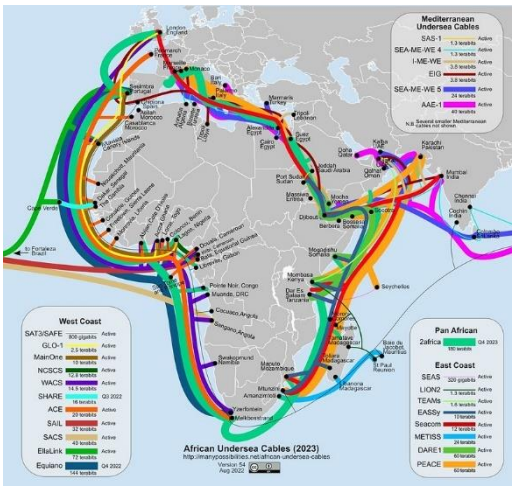

Figure 4: The African undersea cables

Source: "African Undersea Cables," map version 54, ManyPossibilities.net, August 2022 ,https://manypossibilities.net/african-undersea-cables/

Transport and logistics

18. The average cost of trade for the focus countries is high when considered as a percentage of the merchandise value of primary goods (see Figure below). Causes of high trade costs include poor transport infrastructure, non-tariff barriers and weak trade-related services, like trade finance, payments, and logistics (AUC & OECD, 2022). High intra-Africa trade costs affect the development of regional production networks as they compound each time products cross borders. Logistics costs in Africa are estimated to be four times higher than the World average (Plane, 2021). High-trade costs adversely impact the development of regional value chains, and the effect is more severe for backward participation than forward participation (Antràs & De Gortari, 2020). This trend reinforces the commodity-based, extractive industry patterns of trade currently dominating the region and undermining value chain development within and across countries of the region.

Country	Average cost of trade within continent as % of merchandise value, manufactured goods, 2019	Average cost of trade with all countries as % of merchandise value, manufactured goods, 2019	Average cost of trade within continent as % of merchandise value, primary goods, 2019	Average cost of trade with all countries as % of merchandise value, primary goods, 2019
Angola	170	151	266	435
Malawi	147	259	156	261
Mauritius	132	152	215	262
South Africa	84	100	124	154
Zimbabwe	76	262	96	299
Eswatini	66	121	106	148
Namibia	63	143	109	248
Mozambique	62	117	110	247
Botswana	58	138	97	317
Lesotho	44	136	86	137
Zambia	-	-	178	305

Figure 5: International trade costs

Source: Africa's Development Dynamics Key Indicators[6]

19. The logistics performance index[7] measured by trade and transport-related infrastructure quality remains low in the region. For the countries with data, the logistics performance index is low (less than 2.5) in Angola, Lesotho, Malawi, Zambia and Zimbabwe. There are notable decreases in the index for

[6] https://www.compareyourcountry.org/africa-development-dynamics-indicators. Accessed 11 September 2022

[7] The index measures logistics professionals' perception of country's quality of trade and transport related infrastructure (e.g. ports, railroads, roads, information technology), on a rating ranging from 1 (very low) to 5 (very high) (World Bank, 2022).

some countries; for example, Lesotho dropped from 2.12 in 2014 to 1.96 in 2016, and Zimbabwe shows a decline from 2014 (2.25) to 2018 (1.83) (Figure 5). Improvements in transport infrastructure and logistics are important to facilitate regional trade and integration. Enhancing the ease of doing business is critical for green businesses that are either starting up or existing ones that are integrating green industrial processes and applications in their operations. Not least because the cost of 'green transition' for existing businesses is not easily translated to the pricing structure for their products in the short term.

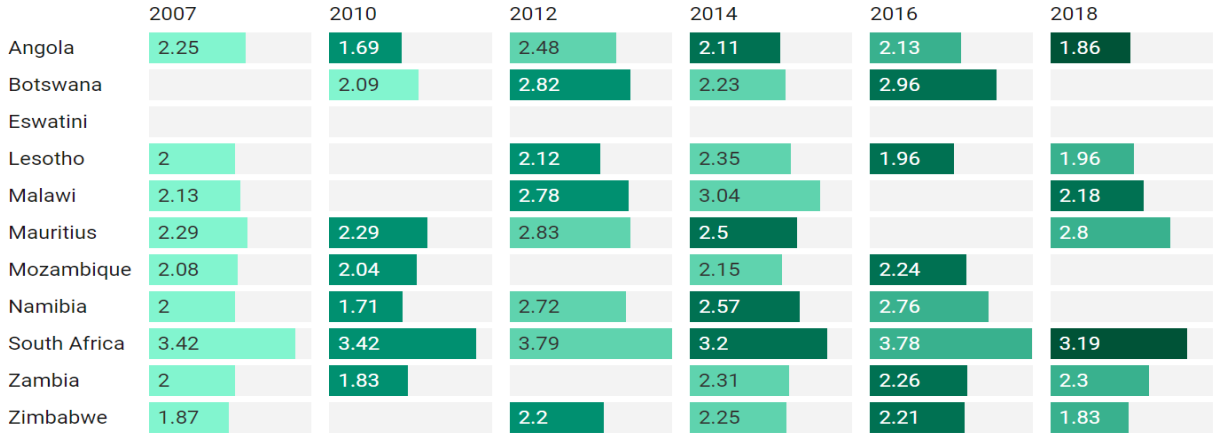

Figure 6: Logistics performance index: Quality of trade and transport-related infrastructure (1=low to 5=high)

20. The African Regional Integration Index (ARII) assesses the regional integration status across countries. The ARII measures the level of integration based on five indices: trade integration, productive integration, macroeconomic integration, infrastructure integration and free movement of people. Figure 2-18 shows that the overall level of integration among the focus countries (0.36) is low. This indicates that more needs to be done to boost intra-regional trade and integration under the AfCFTA. The infrastructural integration index (0.24) is the lowest among the different ARII indices. The regional infrastructural integration index includes the infrastructure development index (transport, electricity, information and communications technology; and water and sanitation), the proportion of intra-regional flights; total regional electricity trade (net) per capita; and the average cost of roaming[8]. Improving regional infrastructure is necessary to facilitate and open opportunities for green industrialisation and increased intra-regional trade and integration under the AfCFTA. For example, energy infrastructure helps ensure adequate electricity supply for the manufacturing sector and digital economy, and transport infrastructure facilitates the movement of goods and services across the region.

[8] Other components of the ARII include: (a) Trade integration measured by the following indicators: level of customs duties on imports, share of intra-regional goods exports (% GDP), share of intra-regional goods imports (% GDP), and share of total intra-regional goods trade. (b) Productive integration includes the share of intra-regional intermediate goods exports (% total intra-regional exports goods); share of intra-regional intermediate goods imports (% total intra-regional imports goods); and merchandise trade complementarity index (total absolute value of the difference between share of imports and share of exports of a member state in an REC). (c) Financial and macroeconomic integration includes regional convertibility of national currencies and inflation rate differential (based on the harmonized consumer price index) (d) Free movement of people includes ratification (or not) of the REC protocol on free movement of persons; proportion of REC member countries whose nationals do not require a visa for entry; and proportion of REC member countries whose nationals are issued with a visa on arrival.

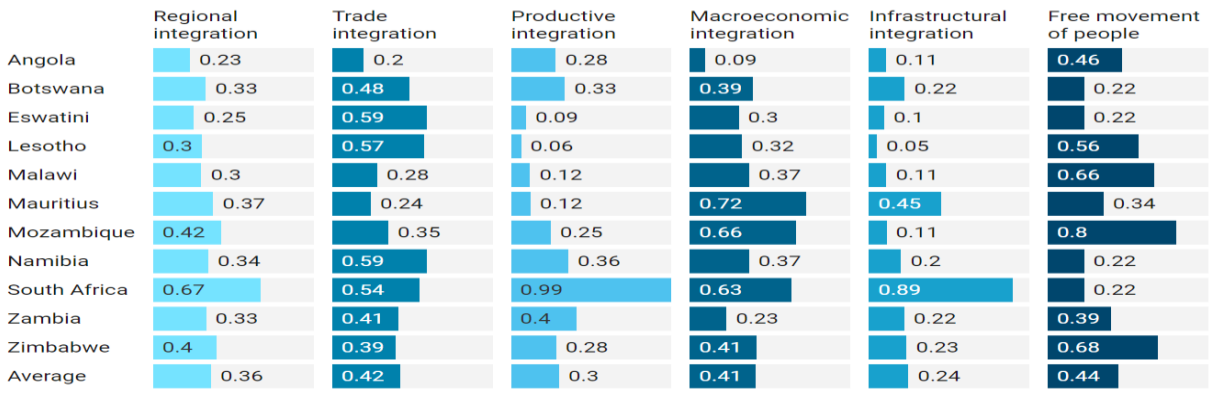

Figure 7: Africa Regional Integration Index for the focus countries (2019)

Source: Own construction based on data from AUC, et al., (2019)

The role of technology, innovation, digitalization, and infrastructure

Technology and innovation

21. Various technologies and innovations alter production and service activities within and across value chains. New opportunities to accelerate innovation and increase value-added content of production are driven by advances in increased applications of robotics, additive manufacturing, data analysis and systems, digital platforms and digital supply chains. These developments in technology and innovations are helping shape the greening of industrialization policies and practice. Of critical importance is just in time, fast manufacturing and critically reduced waste, improved consumption patterns etc.

22. Digitalization presents a broad range of possibilities for the energy sector ranging from increased sustainability of the energy systems, improved access to electricity in remote areas and efficient energy use. For example, the future energy systems in the region should integrate opportunities offered by mini-grid and smart grid innovations to provide affordable, green, clean energy generation and secure and reliable energy sources. Smart grid technologies offer the electrical system opportunities for digitized designs with diverse possibilities to coordinate several energy resources optimally, helping reduce losses during grid transmissions and increase energy efficiency.

23. Green technologies and innovations can help meet the increasing demand for goods and services produced in environmentally friendly settings from production to consumption and the end of their life cycle. Unlike developed countries, which were able to address environmental and developmental challenges in sequence, for African countries and other developing countries, there is increasing pressure to integrate environmental challenges in producing goods and services. Facilitating intra-regional trade through the AfCFTA would be accentuated if regional communities and member states institute standardization, quality assurance and quality management systems that meet international standards, including environmental regulations.

24. Innovations in green manufacturing can enhance private sector participation in developing strategic national and regional value chains. This is important to grow their competitiveness and participation in global value chains creating new opportunities for structural transformation and for creation. For example, digital innovations can enhance efficiency in trade-related logistics, customs and finance and facilitate increases in intra-regional African trade.

25. Also, technologies and innovations embed the integration of the entire product life-cycle from raw material acquisition and manufacturing (and intermediate transformation) stages to the product's end of life (Figure 8). The realization of closed-loop life cycles increases traceability and monitoring of product usage, for example, through the reuse of individual product components and facilitating

partnerships between companies and end-of-life stakeholders (such as recycling companies), easing the integration of remanufacturing of individual parts into the life cycle (Labrunie, 2019; Ardito, Petruzzelli, Panniello, & Garavelli, 2019).

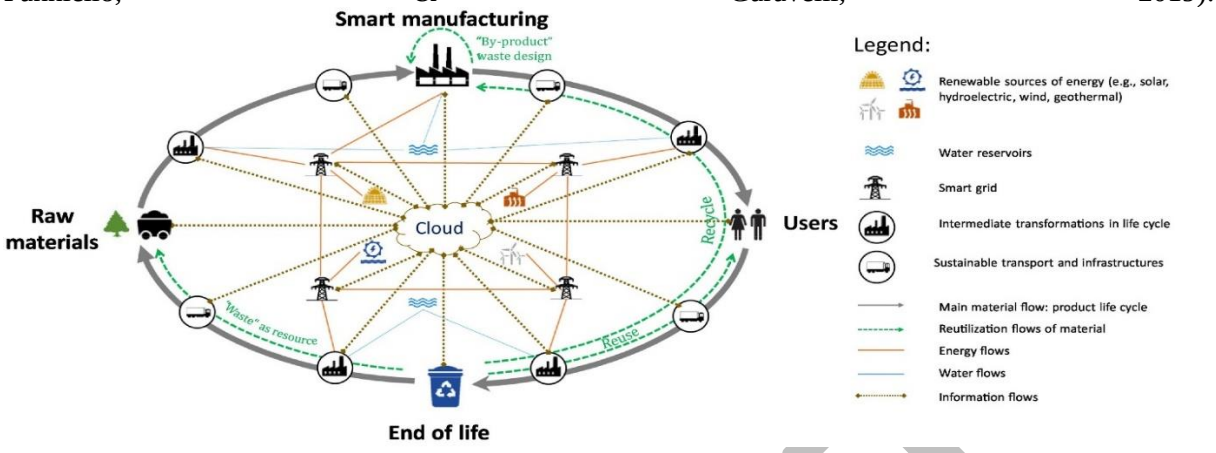

Figure 8: Vision of the product life cycle in 4IR integrated with material, energy, and information flows through digital technologies

Source: (Mondejar, et al., 2021)

26. New technological developments and innovations foster sustainable and environmentally friendly approaches to manufacturing, integrating renewable resources and recycling bio-based materials. Green technology innovations through the application of science to reduce human impacts on the environment can help industries find alternative and sustainable ways of disposing of waste and use more bio-based advanced materials for cheap, safe and eco-friendly products. For example, innovative green supply chain management incorporates environmental considerations into supply chain management, product design, material sourcing and selection, manufacturing, packaging, final product delivery and end-of-life management.

Digitalization

27. Digitalization is having transformative impacts on the economy, society and the planet through the production, use and disposal of hardware (Information and Communication Technologies equipment, data centers, data transmission networks), software, digital technologies and applications ranging from robotics, big data, 3D printing, the Internet of Things, via distributed ledger technologies like blockchain, cloud computing and emerging platforms, to Artificial Intelligence (Liu, et al., 2019; Kunkel & Tyfield, 2021; Mondejar, et al., 2021; Zeufack, et al., 2021). These present opportunities for developing and applying advanced digital technologies to boost productivity, create new jobs and drive green industrialization-led growth in the region.

28. The pandemic contributed to accelerated use and adoption of digital technologies across firms, evidenced by increased demand for good quality virtual communication methods, resilient broadband infrastructure, and greater use of online digital services and products (such as fintech platforms, e-commerce and online work platforms). The main sectors driving the African digital transformation include fintech, e-commerce, agritech, media and entertainment, health tech, food delivery, local transportation and business-to-business (B2B) e-logistics.

29. Digitalization enables entrepreneurs and businesses to rethink business models that are sustainable, impactful and connected to other economic sectors. For example, digitalization has enhanced inclusive finance with significant impacts on economic growth through increased access to financial services that enabled the unbanked to enter formality through retail electronic payment

platforms, virtual savings and credit supply platforms. For example, formal financial services through mobile phones like M-Pesa have transformed access to financial services reaching the underserved, including women (Ndung'u & Signe, 2020). Companies can also design products and trade online, governments are shifting to online platforms to provide public services, and individuals can operate financial services and payments for investments and shopping.

30. Digital technologies and innovations are improving the efficiency of logistics, customs and finances, enhancing cross-border trade and creating new opportunities for small and informal producers (AUC & OECD, Africa's Development Dynamics 2022: Regional Value Chains for a Sustainable Recovery, 2022). The increased use and adoption of digital technologies can empower the poor (including youth and women) with access to information, job opportunities and services improving the inclusiveness of economic growth and development. In the long-term, innovation and implementation of new technologies will lead to increased demand for high-skilled workers in new sectors of economic activity as the demand for low-and medium-skilled workers in traditional sectors decrease (Zeufack, et al., 2021). Therefore, industrialization through digitalization would need to be supported by the development of technical skills and a critical mass of high-skilled workers to scale and continue innovations and implementation and adopt new technologies to local needs and standards. In addition to digital technologies and services creating direct jobs and contributing to national and regional GDP, digitalization has helped address the information asymmetry challenges in financial systems and the labor market increasing efficiency, certainty and security, which are all critical for economic growth and job creation (Ndung'u & Signe, 2020).

31. Digital technologies and applications are increasingly being developed and applied to enhance productivity and efficiency in various socio-economic, industry, environmental, sustainable and climate systems. Improvements in coordination and harmonization of digital policies, regulations and standards across industries and countries are critical to facilitate the scaling up of private sector innovations to grow further intra-Africa regional trade and participation in global value chains.

Infrastructure

32. Regional infrastructure facilitates the establishment of large competitive markets by providing lower-cost energy for all economic sectors (such as industry, agriculture, mining and communications). It also fosters regional integration by facilitating intra and inter-regional trade, and hence capitalizing on the opportunities from the AfCFTA (AfDB & AUC, The Programme for Infrastructure Development in Africa: Transforming Africa through Modern Infrastructure - PIDA Brief Energy, 2013b). Regional infrastructure also fosters regional integration and facilitates intra and inter-regional trade, capitalizing on the AfCFTA. Increased regional integration will also help reduce transaction and operating costs for businesses, further enhancing the competitiveness of the region's goods and services.

33. Addressing the region's infrastructure gap is thus critical for green industrialization, economic growth and sustainable development. Investments in improved and resilient infrastructure foster intra- and inter-regional and international trade, reduce the cost of doing business and enhances the competitiveness of the region within itself and in the global economy, in addition to catalyzing economic transformation and diversification through value addition, industrialization and inclusive and sustainable growth (AfDB & AUC, The Programme for Infrastructure Development in Africa: Transforming Africa through Modern Infrastructure - Closing the Infrastructure Gap Vital for Africa's Transformation, 2013a).

34. Facilitating investments in connective infrastructure in the strategic industrial clusters in the region can help develop the regional value chain and foster private sector participation in green industrialization. Strategic regional corridors have been identified with earmarked regional infrastructure projects. Examples include the Walvis Bay Corridor (covering five SADC countries) and the Maputo Development Corridor (Mozambique-South Africa). Development in road infrastructure

linking these development corridors can significantly improve connectivity, reduce trade costs and improve the attractiveness and competitiveness of private section investments in regional value chains.

The industrialization policies and frameworks

Continental and Regional Policy Frameworks

35. For SADC member states, various regional documents embed elements of green industrialization ranging from SADC protocols, policies and strategies. These include the revised Regional Indicative Development Strategy (RISDP), the Industrialization Strategy and Road Map, the Regional Infrastructure Development Master Plan and other sector-specific protocols. SADC's industrialization policy is encapsulated in the Regional Indicative Strategic Development Plan (RISDP), the SADC Industrialization Strategy and Roadmap, the SADC Industrialization Action Plan, the 2014 SADC Declaration on Regional Infrastructure Development, and the 2019 SADC Protocol on Industry among others. Also, the SADC Regional Green Economy Strategy and Action Plan for Sustainable Development was developed to facilitate a balanced and accelerated attainment of economic wellbeing, social equity and environmental sustainability pillars of sustainable development (SADC, 2015). The Green Economy Strategy and Action Plan identify priority green growth/ industrialisation opportunities across priority sections in the region. The SADC region prioritizes sustainable industrial development, productive competitiveness and supply-side capacity, free movement of goods and services, stability-oriented macroeconomic convergence, financial market integration and monetary cooperation, intra-regional and foreign direct investment, and deepening regional integration.

36. Industrialization is a strategic pillar in the COMESA Medium Term Strategic Framework, 2021-2025. Also, the 2017 COMESA Industrial Policy and Industrialization Strategy (2017-2026) provides a regional framework for the industrial sector in member states. The COMESA Industrialization Strategy (2017-2026) aim to promote investments in green technologies to ensure environmental preservation, climate change adaptation and mitigation. This includes goals to reduce greenhouse gas emissions that require significant investments in appropriate technologies and the design of industry production and processing methods. These developments affect the competitiveness of the industry sector, and green industrialization presents opportunities for member states to meet socio-economic and environmental objectives simultaneously. For example, improvements in resource use efficiency (such as energy efficiency) and other cleaner production initiatives can help improve the competitiveness of regional value chains in global markets while addressing environmental resource challenges.

National Industrial and Industrialization Policy Frameworks

37. Green industrialization presents opportunities for countries to leapfrog from traditional carbon-intensive methods of industrial growth to cleaner, more sustainable patterns that are more competitive. The review of country-level policy frameworks showed that industrial policies do not explicitly elaborate on green industrialization (Table 1). Mauritius and South Africa are the two countries that have a national policy or plan that articulates green industrialisation. Green economy plans, where available, highlighted either green industrialization/ green jobs or green economy as a strategic focus for the country. Furthermore, climate change policies and nationally determined contributions to UNFCCC also show that green industrialization/ green economy/ green jobs are part of efforts to reduce greenhouse emissions. Overall, the reviewed documents highlight the strategic focus on sustainable development, especially those developed after 2015.

Table 1: Consideration of green industrialization in industrial policies and green economy plans

Country	Industrial Policy		Green Economy Policy/Plan/Strategy	
	Year	Consideration of green industrialization	Year	Consideration of green industrialization
Angola	2021			Yes*
Botswana	2014	No		
Eswatini	2015	No	2016	Yes*
Lesotho	2007	No	2021	Yes*
Malawi	2016	No		
Mauritius	2020	Yes	2015 and 2021	Yes
Mozambique	2016	No	2016	Yes
Namibia	2012	No	2012	Yes
South Africa	2018	Yes	2021	Yes
Zambia	2018	No	2022	Yes
Zimbabwe	2019	Yes*		

*Green industrialization mentioned but not articulated in detail | Gaps indicate no information was found

Source: Own assessment based on various country policies and strategies

38. The review showed the limited domestication of the continental and regional policy frameworks on green industrialization. For example, SADC has a clear green industrialization strategy; however, the national industrial policies of the member states do not articulate how they plan to implement the regional priorities. The implementation of regional agreements is delayed as member states ratify them at different times (some taking years) based on different processes. This is also worsened by the lack of capacity to unpack regional statutes and limited appreciation of their role in shaping domestic priorities. Another challenge is although climate change documents elaborate efforts to promote sustainable practices, often green industrialization is not articulated in terms of concrete priorities and actions.

39. The strong commitment, in some cases, is not followed through to implementation due to weak institutions or an unfavorable political environment. One of the challenges has been the lack of resources and weak institutional environments to drive the implementation of the initiatives. This calls for the urgent need to mobilize domestic resources (public and private) to implement green industrialization initiatives, including fostering private sector investments and participation in national and regional value chains strategic to industrial policies. Innovative financial instruments (such as public-private partnerships, blended finance etc.) are required to ensure national and regional green industrialization initiatives are implemented to yield expected socio-economic and environmental goals.

Selected cases of green industrialization experiences in Southern Africa

40. The case studies were selected based on the literature review and evidence demonstrating experiences driving green industrialization. The identified case studies include the Eco-Industrial Parks Programme and the Industrial Energy Efficiency (IEE) Project, both from the National Cleaner Production Centre, South Africa (NCPC-SA), a green hydrogen project in Namibia and a project to support the transition to green and inclusive industrialization of the SADC region through supporting women businesses.

41. *Eco-Industrial Parks Programme:* The National Cleaner Production Centre, South Africa (NCPC-SA)'s Eco-Industrial Parks Programme demonstrates a practical example of efforts to facilitate the transition of industries to a green economy and/or green industrialization. The East London Industrial Development Zone (ELIDZ) – South Africa is an example of the international best practice of the EIP approach. The South African government established the ELIDZ in 2003 to provide a robust catalyst for economic development and diversification in the country. It is part of the government's Special Economic Zones (SEZ) Programme aimed at developing, operating and maintaining modern purpose-built infrastructure and attracting strategic investments. Also, the ELIDZ is one of three EIP parks capacitated by the NCPC-SA through various RECP interventions.

42. **The EIP approach can be adopted in existing or new industrial parks, making it scalable to many settings. Also, the** EIP approach helps develop a conducive business environment that can attract global investments in green technological innovations and applications to drive green industrialization. The EIPs help build global competitiveness for local companies encouraging them to enter regional and global value chains. This helps create new markets for small businesses that generally would face challenges accessing such opportunities.

43. The ELIDZ demonstrates the best practice of driving green industrialization by a sustained commitment to 'green' environmentally sustainable industrial development. The EIP business ecosystem helps decouple environmental impacts from productive economic activities, helping meet socio-economic objectives while addressing environmental challenges from industrial activities. Strict entry criteria in EIP zones are critical to driving green industrial growth and development in the target regions. By only targeting 'clean industries', the ELIDZ has facilitated the development of the renewable energy sector as an alternative to fossil fuel energy.

44. *Industrial Energy Efficiency (IEE) Project*: Established in 2010, the National Cleaner Production Centre, South Africa (NCPC-SA)'s international award-winning Industrial Energy Efficiency (IEE) Project is the largest energy efficiency initiative in South Africa. The IEE Project is a multistakeholder initiative supporting increased and sustained energy efficiency in industrial and selected commercial sectors such as agro-processing, chemicals and liquid fuels; metals processing and engineering; automotives; and mining. The IEE Project promotes the adoption of Energy Management Systems (EnMS), Energy Systems Optimization (ESO), and the Energy Management Standard ISO 50001 Series. The first phase of the IEE Project was from 2010-2015, and the second phase was from 2016-2020. Phase I served as an international pilot project. Based on its experiences, similar EnMS/ESO projects have been established in 16 other developing and emerging countries worldwide. In October 2020, the IEE Project was awarded the highest international accolade for an energy program by the global Association of Energy Engineers (AEE): the International Energy Project of the Year.

45. Cost reduction, improved productivity, and competitiveness from implementing IEE programs can help promote the sustainability of industrial energy efficiency and management systems. The reduced costs and improved productivity and competitiveness from adopting industrial energy efficiency and management systems are key to the sustainability of the IEE project principles. Companies that realize these benefits after adopting the IEE principles have positive incentives to continue improving their energy efficiency.

46. The IEE Project ensured and promoted an improved gender balance within the energy efficiency industry in South Africa. The IEE Project encouraged greater participation of women in energy efficiency through policy engagement, including women in capacity development and participation in leadership, networking and role model initiatives and outreach programs at tertiary institutions.

47. *The Southern Corridor Development initiative: Tsau //Khaeb National Park (Hyphen SCDI) Project*: The Namibian government's strategic focus is to achieve large-scale, low-cost renewable energy development and design models for sustainably maximizing fiscal revenue and local

development in renewable energy investments and green ammonia production. The government conceived the Southern Corridor Development Initiative (SCDI) as the country's first-gigawatt-scale fully vertically integrated green hydrogen project. The SCDI, comprising ~26,000mk2, has the potential to produce up to 3 million tons per annum of green hydrogen.

48. The project will provide a renewable energy capacity of 5GW by 2030 (2GW to be commissioned in January 2027). In addition to green hydrogen, other downstream products include green ammonia and methanol that can be produced in Namibia and exported globally at lower cost than local production. These include support to target off-taker sectors such as fertilizer, shipping and chemicals, with early movers already taking steps to consume clean hydrogen and hydrogen-related products such as synfuels and steel.

49. As part of the local benefits that the Namibian government will audit, the project will create about 15 000 full-time jobs during the four-year construction period, and 90% of these will be Namibians. Also, the project will ensure 20% youth participation, and Hyphen has already started skills development and bursary programs.

Priority sectors to jump-start green industrialization in Southern Africa

50. The ECA (2020) political economy of a green economy report identified the main focus sectors in the transition to a green economy across the continent. The sectors include agriculture, energy, mining, industry and manufacturing, transport infrastructure, construction and green building, water and environment, urban infrastructure development and waste management. Based on the review of regional and country-level policy frameworks and other publications and informed by the focus of this report, the following sectors were selected: agriculture and agro-processing, energy, manufacturing, waste, transport and infrastructure sectors. The selection was also guided by the importance of these sectors to the regional economy and individual countries. Opportunities for green industrialization in each of these sectors are presented below.

Agriculture and agro-processing

51. Agriculture remains an important sector for most countries in the region; for example, at least 60% of the region depends on agriculture for their livelihoods. In addition to making a significant contribution to GDP, a significant proportion of the population in the region depend on the agriculture sector for their livelihoods, and the sector employs about 35% of the region's population. The sector is also an important source of inputs for the manufacturing sector.

52. Many developing countries, especially in sub-Saharan Africa (including in southern Africa), lack a robust agro-industrial sector that can lift millions from poverty and increase global food supply chains (UNIDO, 2022). There is limited value addition in many focus countries, and most products are exported in raw form, particularly in agriculture and mining (COMESA, 2017). There is increasing pressure on agroecosystems from the ever-growing global demand for food, feed, fiber and clean energy. The increasing demand for food, feed and fiber in the region, together with current and projected changes in climate, requires an urgent transition to resource-efficient and high-productivity food production and processing systems.

53. The agriculture sector presents opportunities for green industrialization, given the intensity of resource use in the sector. Fostering a sustainable transformation of the sector offers opportunities to increase productivity, create much-needed employment, and address poverty and the environmental impacts of agricultural activities. Also, embracing sustainable production and consumption in agricultural value chains offers an important entry point to reduce the natural resource footprint and increase the sector's productivity.

54. Digital technologies offer opportunities to scale up the application of sustainable and resource-efficient management practices in food production and processing systems to ensure increased productivity and improved efficiency in resource use. For example, digital technologies and innovations can transform agricultural activities through access to real-time information, such as competitive pricing, disaster mitigation support, disease prevention tips, and monitored crop information for informed decision-making. These will help improve productivity and incomes and increase demand in the region. New startups and entrepreneurs across the continent are increasingly using the Internet of Things to help farmers optimize productivity and reduce waste through data-driven 'precision farming' technologies (Ndung'u & Signe, 2020).

55. Jump-starting green industrialization in the agro-processing sector in the region should upscale various digital technologies and internet of agricultural things-based technologies already being applied in the region and other parts of the continent and world. These will help improve productivity and incomes and increase demand in the region.

Energy sector

56. Access to reliable energy is critical to growing the manufacturing sector, fostering economic transformation and accelerating green industrialization in the region. Access to energy remains a challenge for southern Africa), and millions live without access to electricity. Also, access to modern energy sources is usually costly, insufficient and unreliable (ECA, Political Economy of a Green Economy Transition in Africa, 2020).

57. The region has sufficient energy resources to meet its needs, but they are mainly underdeveloped and unevenly distributed, which calls for the need for regional energy integration. Member states face challenges in maintaining existing energy generation capacity and investing in new generation capacity. Implementing the regional energy sector programs such as the Southern African Power Pool will contribute to savings on electricity production costs through power interconnectors that will integrate the region's power market. This is important to improve access to energy to support manufacturing and trade activities.

58. The transition to less-energy-intensive industries, cleaner technologies and fuels and the implementation of energy efficiency policies will significantly contribute to the reduction in the carbon intensity of the GDP in the region. Extensive investments in green infrastructure and management practices and skills upgrades are critical for the transition to resource and energy-efficient outcomes. Renewable energy sources (mainly bioenergy, geothermal, hydropower, ocean, solar and wind) are the fastest-growing energy sources, with solar and wind energy experiencing rapid growth (IRENA, 2019). Member states have designed and implemented various renewable energy initiatives such as solar water heating, energy-efficient management initiatives etc. Learning from rapidly expanding renewable energy experiences and sustainable energy management practices is critical to driving industrialization in the region.

Manufacturing

59. The focus countries boast abundant natural resources that provide important inputs for the industrial/ manufacturing sector critical for economic transformation. The challenge is many countries in the region are exploiting natural resources and exporting them in their raw form with limited value addition. Despite vast natural resources, countries in the region have inadequate infrastructure that constrains the development of national industries and intra-regional trade. Also, the lack of diversification of national industries remains a major challenge in the manufacturing sector, and the top ten export products are resource-based, generating limited value added for the regional economy.

60. Improvements in the value addition of natural resources within member states will create opportunities for increased incomes and new jobs. This also presents opportunities to invest in green technologies and innovations in the manufacturing sector to ensure the manufactured goods meet minimum international standards to be competitive in global value chains. Furthermore, improving resource efficiency such as energy, water and other raw materials in the manufacturing sector is critical to sustainable use of the limited resources to meet growing demand in the region. Also, mainstreaming sustainable production and manufacturing processes is essential to align with international standards and ensure the manufacturing sector's long-term profitability and social inclusiveness while protecting the environmental resource base.

61. Climate change and extreme events also affect the region's manufacturing sector, impacting main industrial sectors such as construction, food processing, and energy production. In addition, recent events such as cyclones and floods experienced, especially in the eastern parts of the region, disrupt infrastructure (transport, manufacturing, energy etc.), significantly affecting the movement of goods and services (raw materials and finished products) within and across countries. Investments in green industrialization, including green and climate-resilient infrastructure and sustainable production and manufacturing processes, help improve the competitiveness of the region’s products and services in global value chains.

Waste

62. Waste management is critical in fostering green industrialization. The increase in industrial production and consumption due to increasing demand would require improvements in waste management to ensure the benefits from green industrialization are not eroded by waste damage on the environment. For example, the digital rebound discussed above, where e-waste can end up damaging the environment eroding the benefits of digitalization, is not managed properly. Countries have different waste collection and disposal systems, and there are no regional policies or guidelines. At the regional level, SADC recognizes the need to enhance regional cooperation on hazardous chemicals and e-waste management (SADC, 2015).

63. The treatment and disposal of hazardous chemicals and e-waste, as well as the management of municipal solid waste, is a priority in many countries in the region. The growth in industrial production and consumption due to increasing demand would require improvements in waste management to ensure the benefits from green industrialization are not eroded by waste damage to the environment. For example, the digital rebound effects, where e-waste can end up damaging the environment and eroding the benefits of digitalization, are not appropriately managed.

64. Sustainable waste management and disposal are essential in the transition to green industrialization. The reduce, recycle, reduce (3R approach) presents a guiding principle for all actors in the waste management chain. Green investments in waste management, such as recycling plants or waste-to-energy technologies, contribute towards the transition to more sustainable waste management systems. The harmonization of waste management standards and introduction of incentives/disincentives to waste recycling and reduction create enabling conditions for greening the waste sector (SADC, 2015). Designing and implementing sound waste management policies and strategies is essential to promote sustainable development outcomes and support the creation of new sustainable industries.

Transport and infrastructure

65. The development of transport infrastructure is important to ensure efficient, safe and cost-effective transport services that meet the demands of a growing green industrial economy. The dominant mode of transportation in the region is the road for passenger and freight transport. The development of regional transport corridors in the region helps improve efficiency in the transportation of goods and

services within and across countries. This is important for enhancing intra-regional trade and facilitating regional integration.

66. The impacts of climate change and extreme events lead to the deterioration of transport infrastructure affecting its sustainability. This significantly affects the transportation costs of goods and services across the region, negatively affecting intra-regional trade and regional integration efforts. The recent experiences of extreme climatic events in the region, such as cyclones and floods, for example, in Mozambique, Malawi and South Africa earlier in 2022, highlight the urgent need for climate-resilient transport infrastructure. The Intergovernmental Panel on Climate Change (IPCC) sixth assessment report (AR6) states that the evidence shows that there has been an increased intensity and occurrence of observed extreme climate changes such as heavy precipitation, agricultural and ecological droughts, heatwaves, and tropical cyclones since the AR5 (IPCC, 2021). In addition to road transport infrastructure, the region should also ensure developments and improvements of sea ports ensuring they are upgraded with modern green technologies such as digital technologies as well as improvements of infrastructure to be climate-resilient. Seaports are critical for regional and international trade.

67. Also, there are opportunities to diversify transport modes and increase the use of clean energy sources in transport networks. An example is the clean fuel Bus Rapid Transit System for public transportation in the Tshwane Metropolitan City, South Africa. The diversification of regional transport networks helps create new economic opportunities and jobs. Mainstreaming digital and other green technologies in the transport sector would also help improve efficiency and reduce costs and environmental impacts. Such developments improve the competitiveness of regional goods and services in global value chains. Also, increasing access to improved transport infrastructure and services benefits the poor and marginalized in society. This creates opportunities for the marginalized to engage in socio-economic activities that they would have been deprived of due to the lack of transportation infrastructure and services.

68. The costs of investing in required infrastructure in the region are beyond the capacities of governments. Therefore, Public Private Partnerships are required to contribute to financing investments in infrastructure in the region, including those outlined under the Program for Infrastructure Development in Africa (PIDA) (AfDB & AUC, The Programme for Infrastructure Development in Africa: Transforming Africa through Modern Infrastructure - Closing the Infrastructure Gap Vital for Africa's Transformation, 2013a). A clear and transparent regulatory framework is necessary to foster effective PPPs that help deliver the infrastructure gap requirements in the region. There are ongoing efforts for the establishment of regional corridors, including the North-South Corridor (NSC), the main traffic artery linking the Tripartite (COMESA, SADC and EAC) and the conduit to deepen the economic integration of East and Southern Africa (COMESA, 2021).

Potential regional value chains to propel green industrialization

69. The potential regional value chains were identified from the priority sectors and value chains in various regional and national strategies, policies and programs on green growth/ industrialization, climate change adaptation and mitigation, national and regional development plans. These include the 2015 SADC Regional Green Economy Strategy and Action Plan for Sustainable Development and the 2017 COMESA Industrial Policy and Industrialization Strategy (2017-2026). The identified value chains offer opportunities beyond national boundaries and present cross-sectional linkages to entrench regional integration and development.

Global value chain participation

70. Most of the countries in the region participate in global value chains through raw natural resources and agricultural commodities exports. These are inputs into higher-value products produced by others and exported back into the region. Forward participation in value chains is less than 5% for most of the focus countries (see Figure below). On the other hand, backward participation (use of foreign input for domestic processing) is zero in eight of the eleven study countries.

Country	Total backward participation (% of GDP), 2019	Total backward participation within same continent (% of GDP), 2019	Total forward participation (% of GDP), 2019	Total forward participation within same continent (% of GDP), 2019	Total value of national exports originating domestically (% of GDP), 2019
Mauritius	7	0	5	0	14
Lesotho	6	1	2	1	7
South Africa	6	0	9	0	22
Eswatini	4	2	2	2	10
Namibia	3	2	3	2	10
Angola	2	0	10	0	24
Zambia	2	0	6	0	16
Malawi	1	0	3	0	8
Botswana	1	0	2	0	8
Mozambique	1	0	2	0	5
Zimbabwe	0	0	5	0	1

Figure 9: Origin and destination of added value (GVC participation)

Source: Africa's Development Dynamics Key Indicators[9]

71. Strengthening regional production is important to grow domestic markets which can help improve backward participation in value chains and enhance private sector investments to create productive jobs. Enhancing private sector investments is critical in fostering domestic processing and manufacturing at national and regional levels to meet rising demand. Through the development of regional value chains, the region's member states can transform their productive capacities, enhance their competitiveness, diversify their economies and increase their participation in global value chains. Also, developing regional markets helps spur opportunities for many SMEs to participate in the industrialisation process.

Potential green regional value chains

72. *Agro-processing of main agricultural products:* Based on the review above, the potential regional value chains include the agro-processing of agricultural products. The agro-processing industry mainly consists of grain milling, vegetable oil, fruits and vegetable processing, dairy, beverages, nuts, forestry and plantation products, fish and fishery products (COMESA, 2017). Promoting value addition and application of sustainable production and processing of these commodities presents potential opportunities for green industrialization. For example, at the production stage, efficient resource use, such as water management[10], helps reduce the environmental footprint of food production. Sustainable processing practices, such as energy efficiency, can also be applied at the processing stage. Digital technologies can also improve value chain efficiency across markets within and across countries.

73. The growth of the agro-processing sector in the above value chains has the potential to increase incomes and creates jobs. Also, this improves integrated manufacturing and sectoral linkages while diversifying the manufacturing base and product differentiation. Member states should create enabling environments and build capacity for private sector investments (especially SMEs) in processing agricultural products and ensuring that they meet minimum requirements on food safety, animal and plant health.

74. *Renewable energy value chains:* The drive for green industrialization presents opportunities for member states to scale up the use of innovative clean technologies powered by locally available

[9] https://www.compareyourcountry.org/africa-development-dynamics-indicators. Accessed 11 September 2022
[10] Agriculture accounts for about 60-70% of freshwater withdrawals.

renewable energy resources such as solar energy, small-scale hydro-power, biomass and biogas, and wind power. The member states boast abundant untapped energy resources such as hydro power, hydrocarbons, nuclear minerals and renewable energy (solar, wind, geothermal) that are available and affordable when processed. Tapping on these energy resources, especially clean sources, is critical to address the energy challenges impacting the region's manufacturing sector.

75. An example of the renewable energy regional value chain is the Namibian green hydrogen project, the Southern Corridor Development Initiative (SCDI). The SCDI will export green energy into the regional power pool (SAPP), which will be critical in supporting regional industrialization efforts. In addition to exporting green energy, the SCDI initiative will also export green ammonia to regional and global markets. Angola is also exploring green hydrogen, which will also contribute to green energy in the installed generation capacity mix for the region. In March 2022, Sonagol announced plans for developing green hydrogen production as part of Angola's energy transition strategy[11].

76. *Green fertilizer (such as ammonia) value chain:* Renewable energy production, such as green hydrogen, produces downstream products, including green ammonia and methanol. The Namibian green hydrogen project expects to export green ammonia and methanol globally at a lower cost than local production. The experiences from Namibia show how investments in green energy (hydrogen in this case) strengthen linkages with other sectors through clean energy and downstream products. Given the importance of fertilizers in boosting agricultural productivity in the region, green ammonia will help reduce the environmental footprint of food production. The increased share of green ammonia used in food production in the region will also help improve the competitiveness of the region's agricultural products in global markets. In addition, by helping increase agricultural productivity, the green ammonia value chain contributes to strengthening sector linkages by enhancing the availability of raw materials for the agro-processing industry. The growth in the agro-processing sector helps grow national and regional incomes and create jobs while contributing to environmental sustainability goals.

Conclusions and policy recommendations to accelerate green industrialisation

77. The report analysed the current state of green industrialization, digitalization and infrastructure development in Southern Africa. It identified gaps in the current industrial and development policies and frameworks and potential sectors and value chains that could anchor green industrialization. The key findings and policy recommendations of the study are presented below.

Summary of key findings

78. *Energy*: Recurrent load shedding and power outages, shocks in oil and gas markets, inefficient energy supply and consumption patterns, and limited power generation capacity are some of the key challenges facing the region Disruptions in the energy supply impact all economic sectors adversely. Furthermore, the impacts are more severe for vulnerable populations such as women and youth who engage in informal business activities that depend on the main electricity grid and cannot afford alternative sources that might be expensive, such as generators.

79. *ICT and Digital Infrastructure*: ICT and digital infrastructure sectors are growing across member states at different paces. This has facilitated the increasing penetration of ICT and digital technologies that contribute to improving economic growth and job creation by strengthening connections between goods, markets, people, and jobs. However, access to ICT and digital technologies and services varies across countries in the region. Some of the challenges that need to be addressed include improving accessibility ensuring wide coverage of the infrastructure, affordability, especially

[11] https://energycapitalpower.com/sonangol-announces-plans-to-produce-green-hydrogen-in-angola/. Accessed 15 October 2022.

among women and youth and the capacity to benefit from the innovations effectively in the micro, small and medium enterprises.

80. *Transport and logistics*: The poor state of transport infrastructure (such as road infrastructure) and other factors, such as non-tariff barriers and weak logistics, adversely affect the transportation of goods and services across the region. High trade costs negatively affect the development and competitiveness of regional value chains.

81. *Technology and innovation*: Developments in technology and innovations such as robotics, additive manufacturing, data analysis and systems, digital platforms and digital supply chains are shaping production and distribution activities and services within and across value chains. New technologies and innovations are being applied to embed sustainable and environmentally friendly approaches to manufacturing, integrate resource efficiency and implement sustainable ways of disposing waste. These are important innovations to improve the competitiveness and the participation of stakeholders in regional and international value chains

82. *Digitalization*: Digitalization is having transformative impacts on the economy, society and the planet through the production, use and disposal of hardware (Information and Communication Technologies equipment, data centers, data transmission networks), software, digital technologies and applications ranging from robotics, big data, 3D printing, the Internet of Things, via distributed ledger technologies like blockchain, cloud computing and emerging platforms, to Artificial Intelligence

83. The expansion of digitalization, such as applications ranging from robotics, big data, 3D printing, and the Internet of Things, have transformative impacts on the economy, society and the planet. Digital technologies and innovations are improving the efficiency of production, logistics, customs and finances, enhancing cross-border trade and creating new opportunities for small and informal producers. The increased use and adoption of digital technologies can empower the poor (including youth and women) with access to information, job opportunities and services improving the inclusiveness of economic growth and development.

84. *Infrastructure:* The infrastructure deficit (such as in energy, transport, ICT and digital infrastructure) holds back the region's potential to grow and transform into an industrialized region. Addressing the region's infrastructure gap is critical for green industrialization, economic growth and sustainable development.

85. *One of the key observations from the study is that* the national industrial policy frameworks of regional member States do not explicitly elaborate on green industrialization except for the policies in Mauritius and South Africa. The domestication and implementation of regional green industrialization priorities, including those elaborated in SADC and COMESA frameworks at the national level, remains rather weak. However, in some member States, elements of green industrialization/ green growth can be discerned from national policy documents such as climate change plans.

86. Despite the poor green industrialization policy framework and environment, there are green industrialization experiences in Southern Africa which could provide learning points for other member States and could be emulated: The Eco-Industrial Parks Programme and the Industrial Energy Efficiency Project, the green hydrogen project in Namibia and a project to support the transition to green and inclusive industrialization of the SADC region through helping women businesses are some of the more prominent cases. These experiences demonstrate how green industrialization can contribute to developing a more competitive, resource-efficient, and climate-resilient industrial sector that increases manufacturing value add and creates jobs while preserving environmental resources. The key underlying factors to the success of the experiences include a supportive policy environment, development of modern infrastructure (including roads and link to the port etc.) that helped attract private sector investments

87. *The priority regional sectors to jump-start green industrialization in the region include* agriculture and agro-processing, energy, manufacturing, waste, transport and infrastructure. Opportunities in these sectors include integrating sustainable production and consumption practices, improving resource use efficiency to reduce resource footprint, and increasing sector productivity.

88. The potential value chains to anchor green industrialization across the member States include; agro-processing of main agricultural products, renewable energy value chains, and green fertilizer (such as ammonia) value chains. Promoting value addition and application of sustainable production and processing of these value chains presents potential opportunities for green industrialization, the creation of sustainable jobs and reduction in poverty and inequality.

Recommendations

89. To accelerate green industrialization in Southern Africa, Member States should:

1. Maintain and/or upgrade the existing energy generation capacity and promote/facilitate investments in new clean energy infrastructure to ensure an undisrupted supply to all regional citizens and stakeholders. The investment includes expanding the share of clean energy sources in the energy generation mix currently dominated by coal.

2. Create enabling operational environments that attract public and private sector investments in growing the ICT and digital infrastructure sectors, including investment in developing entrepreneurial skills, targeting youth and women to help them engage in business activities in the growing digital economy;

3. Invest in ensuring effective regulation that enables digital infrastructure expansion and makes connectivity affordable, reliable and universal. There is need for policy measures that address barriers to entry, such as restrictive licensing and exclusivity rights and promote competition on a level playing field, such as asymmetric regulation of dominant operators, infrastructure sharing and antitrust enforcement.

4. Design and implement public-private partnerships to address the energy, ICT and transport infrastructure gaps;

5. Design infrastructure that embeds climate-resilience and green technologies;

6. Develop regulatory and legal frameworks to stimulate digital innovations and incentivize the private sector and other partners to contribute to investing in an inclusive and dynamic digital economy. Some of the required investments include growing the digital infrastructure, developing digital skills and entrepreneurship (including among women and youth), digital platforms and digital financial services;

7. Increase investments to maintain existing infrastructure and integrate climate resilience and green technologies into new infrastructure, including enhancing investment in connective infrastructure in the strategic industrial clusters to facilitate the development of regional value chains and foster private sector participation in green industrialization and the export of value-added products in the broader African market under the AfCFTA;

8. Articulate green industrialization in their national industrial policies, including consolidating green industrialization priorities across all national documents and develop concrete action plans for green industrialization as well as allocate and mobilize resources for implementation;

9. Develop effective institutions, capacity, favourable policy environment and mobilize resources (public and private) to operationalize regional and national green industrialization actions, including creating a transparent and predictable policy environment to incentivise private sector investments in green industrialization initiatives and priority value chains through fiscal incentives and other such mechanisms;

10. Scaleup the implementation of green industrialization experiences that have demonstrated positive socio-economic and environmental benefits and share experiences across the region.

11. Ensure a conducive environment that attracts investments in needed infrastructure and capabilities to scale the green industrialisation case studies such as in energy efficiency and renewable energy;

12. Strengthen the domestic and regional regulatory framework concerning Investor State Dispute Settlement (ISDS) provisions which may increasingly come into conflict with environmental, mining rights, tax policies and, indeed, green industrialization priorities of member states.

90. To deepen green industrialization, the private sector should:

1. Continue to proactively invest in technologies to enhance productive and distributive efficiency and facilitate green industrialization, including through investments in clean energy, digital technologies and attendant infrastructure;

2. Share experiences in the application and use of green industrialization technologies, especially how these technologies reduce costs and enhance product competitiveness;

3. Seek opportunities to collaborate on the development and deployment of innovations which support green manufacturing processes.

4. Embrace opportunities to engage in regional and global value chains with green manufacturing focus or linkages, which would assist in driving increased efficiency and competitiveness of MSMEs in the green economy.

91. To facilitate the sharing of experiences and accelerate the adoption of green industrialization, regional economic communities should:

1. Strengthen regional frameworks on the same, set standards for adoption;

2. Provide a platform for the member states and the private sector to share experiences periodically.

3. Configure regional industrialization frameworks to favour green industrialization and the use of clean energy and energy efficiency.

To promote green industrialisation, development partners should:

1. Support the development of green industrialization policy frameworks at regional and national levels.

2. Support domestication, alignment and harmonization of green industrialisation policy frameworks.

3. Provide a platform for the member states and the private sector to share experiences periodically.

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