FOSTERING INDUSTRIAL HUBS FOR ENERGY TRANSITION TECHNOLOGIES IN AFRICA

Harnessing G20 Learnings and Strategic Partnership

SUSTAINABLE ENERGY FOR ALL

GREEN INDUSTRIALIZATION HUB

ACKNOWLEDGEMENTS

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INTRODUCTION

The global energy transition is underway. Renewable power capacity grew by 585 gigawatts (GW) in 2024; the renewables share in the global power sector rose to over 46%, from about 30% in 2015.

The G20 countries[1] (excluding European Union and African Union) accounted for 81% of the global capacity added in 2024. The growth still falls short of the global tripling target of over 11 terawatts (TW) by 2030, with 2024 capacity reaching 4.5 TW (up from 3.4 TW in 2022) (IRENA, 2025). Beyond the power sector, the renewables share in the total final energy consumption grew from 17.6% in 2021 to 17.9% in 2022 (IEA and UNSD, 2025). In the transport sector, global sales of electric vehicles continue to rise, with electric cars accounting for one in every four units sold and electric models comprising nearly half of all bus and two- or three-wheeler sales in 2025 (BNEF, 2025).

The energy transition also offers a significant socioeconomic development opportunity. Jobs in the renewable energy sector grew to 16.2 million in 2023 – up over 18% from the previous year (IRENA and ILO, 2024). Beyond job creation, many countries are looking at the energy transition as an opportunity to build new industries around clean technologies including solar PV modules, batteries and electric vehicles aided by holistic policy making, resource endowments and the motivation to reduce import dependency.

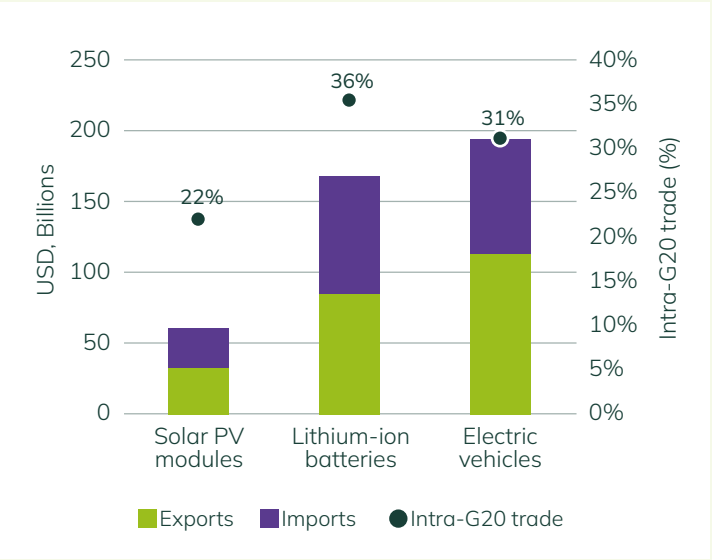
[1] The G20 comprises 19 countries (Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Türkiye, the United Kingdom, and the United States), the European Union, and since 2023, the African Union.

In 2024, G20 countries traded over USD 420 billion worth of modules, batteries and electric vehicles. This represents nearly 75% of all global trade in these technologies, highlighting the role of the G20 countries as both important producers and consumers. G20 countries registered a trade surplus in 2024, with exports accounting for 54% of the total trade. China represented over half of G20 exports, with a particular dominance in both solar PV and lithium-ion battery exports. Clean-energy technologies made up more than 10% of China's economy in 2024, with sales and investments worth USD 1.9 trillion (Myllyvirta, Qin & Qiu, 2025). Intra-G20 trade represents about a quarter of total value, highlighting existing market linkages for these technologies.

FIGURE 1

G20 value of trade in selected technologies

(solar PV modules, batteries and electric vehicles), 2024



SOURCE:
Based on data from UN Comtrade.
HS Codes: 854143 (Solar PV modules); 850760 (Lithium-ion batteries); 870380, 870240 (Electric vehicles)

Supply chains for energy-transition technologies and associated minerals are increasingly an area of concern and opportunity. On the one hand, the concentration across the supply chain – from extraction, processing and refining of energy-transition minerals[2] to manufacturing of intermediate and finished energy transition technologies – remains a vulnerability. Between 2019 and 2023, global supply of minerals including cobalt, lithium and graphite has become increasingly dependent on fewer exporters (UNCTAD, 2025a). In the case of G20 countries, over 90% of imports of cobalt ores and concentrates came from a single source (Democratic Republic of Congo) in 2023. The same figure for graphite was 61% (from China) and 82% for lithium (from Australia). This creates a significant risk of supply disruption and price volatility and can affect efforts to diversify downstream segments of the value chain (IEA, 2025).

Meanwhile, developing countries, in particular resource-rich nations, want to play a stronger role in supply chains and capture greater value through local processing with forward linkages to manufacturing. The traditional "pit-to-port" paradigm of resource extraction needs to make way for greater local beneficiation through refining, smelting and further processing (Barlow & Pai 2025).

[2] Energy-transition minerals refer to naturally occurring substances that find applications in the production of technologies necessary for the transition away from fossil fuels. These include renewable technologies, electric mobility, and energy storage (UNEP, 2024)

The message is increasingly loud and clear. Climate action and industrialization must go hand in hand, requiring stronger collaboration to ensure that supply chains are diversified and benefits more equitably distributed.

South Africa's G20 Presidency takes place against the backdrop of a shake-up in the global trade regime. Increased tariff action is resulting in increased policy uncertainty and downward revisions in global trade outlook (WTO, 2025). Countries are looking to identify new (or reinvigorate existing) engines for economic development, industrialization and job creation. Fiscal and regulatory measures, including export controls on raw minerals and intermediate products, are on the rise. This makes supply chains for energy-transition technologies not just an issue of energy and economic security but also one closely tied to national security, notably for countries dependent on imports. It is timely and opportune that the Presidency has placed prominence on the agenda of industrialization and the need to harness energy transition minerals as an engine for growth and development, particularly in Africa.

The G20 Presidencies of Indonesia, India and Brazil revealed a clear and growing consensus on securing the supply chains for the energy transition. In 2022, Indonesia called for diversification and promotion of value addition in sectors through downstream manufacturing. Building on that, the declarations from India (2023) and Brazil (2024) explicitly noted the need for reliable, sustainable, diversified and responsible supply chains for transition minerals. Those declarations also championed the key development goal of adding value locally through the beneficiation of materials at their source.

While there is no one-size-fits-all solution, successful instances of industrial hubs, including those focused on energy-transition technologies globally, have usually relied on long-term (sometimes decades-long) industrial policy interventions ranging from demand- and supply-side incentives to direct financial support and trade policy interventions. These have translated into domestic firm-level capabilities, millions of jobs and competitiveness of downstream sectors to meet local demands and favourable positioning in global supply chains. G20 countries, too, have adopted vastly different strategies, shaped by their unique economic structures, political priorities and positions in the global value chain.

This report delves deeper into how industrialization hubs around energy-transition technologies[3] can be advanced with a focus on Africa, based on diversity of country contexts including resource endowments and economic structures. Chapter 2 presents the green industrialization opportunity for the continent. Chapter 3 draws on the experiences of G20 countries to addresses the key levers necessary to establish industrialization hubs for energy-transition technologies. The report concludes with recommendations for the G20 to support energy-transition technology industrialization hubs in Africa.

The report builds on activities from SEforALL's Green Industrialization Hub workstream[4], which supports developing countries in establishing local value chains for energy-transition technologies. This work involves state-of-the-art data and analytics, industrial policy design, capacity building, and collaboration and partnerships facilitation.

[3] Several technology solutions contribute to a country's energy-transition roadmap, including solar PV, wind, hydropower, geothermal, green hydrogen and electric mobility, as well as energy efficiency. In referring to industrialization hubs, this brief largely focuses on building local value chains for solar PV, battery and electric vehicles although the ecosystem needs usually cut across technology solutions.

4 For further details: https://www.seforall.org/programmes/un-energy/green-industrialization-hub

CHAPTER TWO

THE GREEN INDUSTRIALIZATION OPPORTUNITY FOR AFRICA

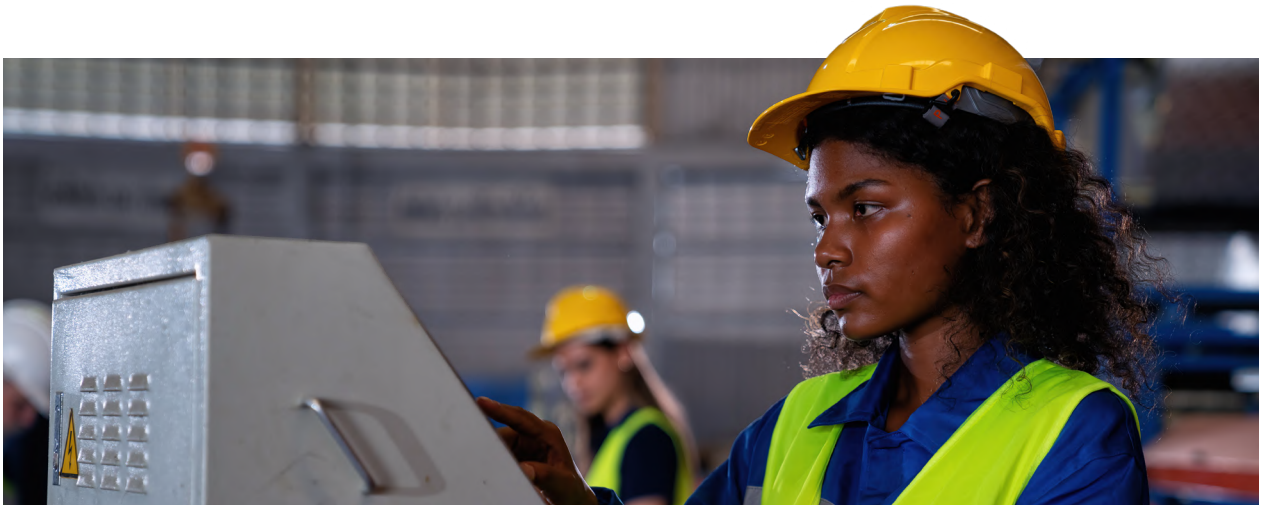
For the African continent, identifying engines of inclusive economic development and job creation is emerging as a key priority. By 2030, half of all new entrants into the global labour force will come from Sub-Saharan Africa, requiring the creation of up to 15 million new jobs annually (IMF, 2024).

The manufacturing sector is particularly critical for employment generation, as well as economic transformation. About 83% of African countries are considered commodity-dependent – a large portion of export earnings come from primary commodities – making them vulnerable to global price fluctuations and economic shocks (UNCTAD, 2022). Manufacturing value added (as a percent of GDP) for Sub-Saharan Africa has largely stagnated over the past two decades, estimated at about 11% in 2023 (World Bank, n.d. b).

The development of the manufacturing sector, in particular for processing and downstream value-added segments, is hampered by the lack of access to reliable and affordable energy supply. National and regional ambitions to expand the adoption of renewable energy are increasingly linked not just to enhance energy supply and access but also to advance industrialization. Several African nationally determined contributions (NDCs) and energy transition plans, including those of South Africa, Nigeria, Morocco, Kenya and Ghana, identify renewables as a driver of industrialization, job creation and economic transformation.

Regional leadership efforts are also underway, most notably through the African Lead-

ers Nairobi Declaration on Climate Change and Call to Action (2023). This declaration commits to undertaking measures to raise the global share of renewable energy financing in Africa to at least 20% by 2030. It also advances green industrialization with an emphasis on adding value to Africa's natural endowments (AfDB, 2023).



The current structure of Sub-Saharan Africa's participation in global value chains is dominated by exports of primary products (forward integration) rather than imports of intermediate goods for further upgrading and export (backward integration) (Abreha et al., 2021). Several resource-rich countries on the continent aspire to pursue greater local minerals beneficiation, as well as develop manufacturing ecosystems that enable greater backward integration. This is particularly relevant given that approximately 30% of the world's mineral reserves, including cobalt, lithium and nickel that are considered essential for the green transition, are found on the African continent (UNECA, 2024a).

The economic benefit of acting can be significant. The case of Democratic Republic of the Congo illustrates that by refining and processing cobalt locally, the country boosted the mineral's unit price nearly three times – from USD 5.8 per kilogram at extraction to USD 16.2 per kilogram after processing – which translated into USD 6 billion in exports in 2022 (UNCTAD, 2024).

The United Nations Secretary General's Panel on Critical Energy Transition Minerals and the recently adopted Africa Green Minerals Strategy (AGMS) underscore the importance of using mineral resources to drive domestic value addition, job creation and regional industrialization, moving beyond Africa's traditional role as a raw material exporter (African Union, 2025a). To help accomplish this, the AGMS proposes four pillars of support: mineral development, people and technological capability, supply chain development, and mineral stewardship.

The continent's reliance on imports for finished renewable energy and energy efficiency technologies, including solar PV modules, batteries and electric vehicles, will only grow as adoption expands driven by growing cost competitiveness, policy support and a thriving domestic private sector. This dependence exposes African countries to external shocks, exchange rate volatility and rising import bills – while limiting local value addition and job creation.

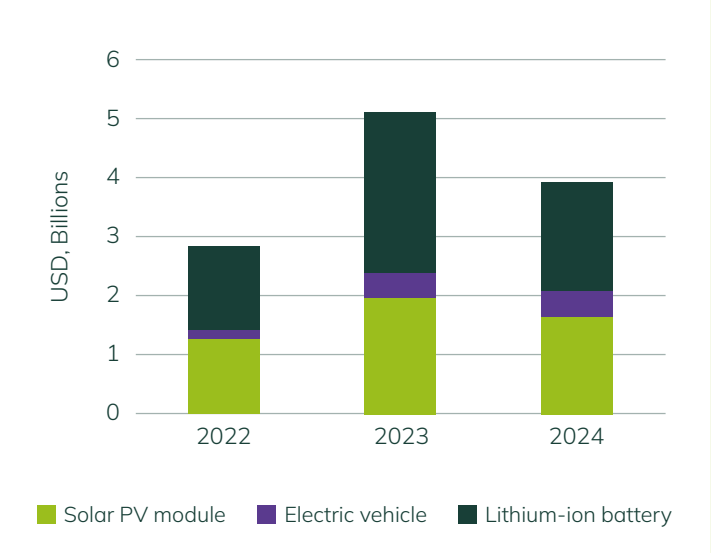
Imports of energy-transition technologies into

Africa are already expanding. Based on UN Comtrade data for solar PV modules, the value of imports rose from more than USD 1.2 billion in 2022 to nearly USD 2 billion in 2023, before falling to USD 1.6 billion in 2024. More than 90% of imports originated from China.

Similarly, imports of lithium-ion batteries surged from USD 450 million in 2020 to an estimated USD 1.8 billion in 2024. China accounted for approximately 75% of these exports in 2024, amounting to USD 1.3 billion. Imports of fully assembled passenger electric vehicles also continue to grow, from over USD 182 million in 2022 to over USD 500 million in 2024. Altogether, the continent imported over USD 12 billion in finished products in the three-year period between 2022 and 2024 (Figure 2). The largest importing countries were South Africa, Nigeria and Kenya.

FIGURE 2

Import value of solar PV modules, assembled electric vehicles and lithium-ion batteries into Africa, 2022-2024



SOURCE:
UN Comtrade Database (n.d.).
Note: Based on HS Codes: 854143, 850760, 870380.

If current trends continue and domestic manufacturing capacities remain underdeveloped, import costs will escalate. This illustrates the large market opportunity for building local supply chains to meet demand. In the case of Sub-Saharan Africa, under current ambitions, total renewables capacity in the power sector is expected to triple to 165 GW by 2030, with nearly 40 GW of solar PV (IEA, 2024a). For the continent, solar PV capacity is planned to rise to 67 GW by 2030. This represents a USD 27 billion market opportunity in the solar PV sector alone between 2025 and 2030, including modules and balance of system components[5]. Total expected demand for lithium-based batteries could reach ~10 GWh from electric two/three-wheelers and battery energy storage solutions by 2030 generating a market opportunity for USD 10-15 billion annually (Manufacturing Africa, 2024).

The opportunity for African countries to build domestic value chains for energy-transition technologies depends on several factors, including resource endowment, existing production capacities, soft and hard infrastructure, and an enabling policy and regulatory environment (SEforALL, 2023). Industrial

[5] Assumes an average of USD 0.13 per watt landed cost for solar PV modules and a 25% share in total system costs between 2025 and 2030.

strategies can identify priority areas to target in the short, medium and long term, taking into consideration domestic demand as well as opportunities to link with regional and global value chains. Success relies heavily on alignment of government policies and context-specific measures based on segment of the value chain in question, demand and differing capabilities across markets (Kaziboni, 2021).

Strategically investing in tailored localization strategies for energy-transition technologies is not only a socioeconomic opportunity – it is also a future-proofing strategy. In an increasingly uncertain global trade environment, localizing parts of the value chain – in instances where it makes the most economic and strategic sense – can increase resilience as well as job creation. Building coherent, more interconnected industrial ecosystems today will ensure that African economies can retain more value and are better equipped to meet future demand while advancing their own development and climate goals.

$266bn

AFRICAN EXPORTS OF RAW AND SEMI-PROCESSED CRITICAL MINERALS (2023)

$4bn

IMPORT VALUE OF SOLAR PV MODULES, BATTERIES AND ELECTRIC VEHICLES (2024)

$27bn

PROJECTED MARKET OPPORTUNITIY FOR SOLAR PV SYSTEMS IN AFRICA (2025-30)

140,000

ANNUAL JOBS IN SOLAR PV ASSEMBLY ALONE (2024-50)

SOURCE: UNCTAD (2025a); UN Comtrade data

CHAPTER THREE

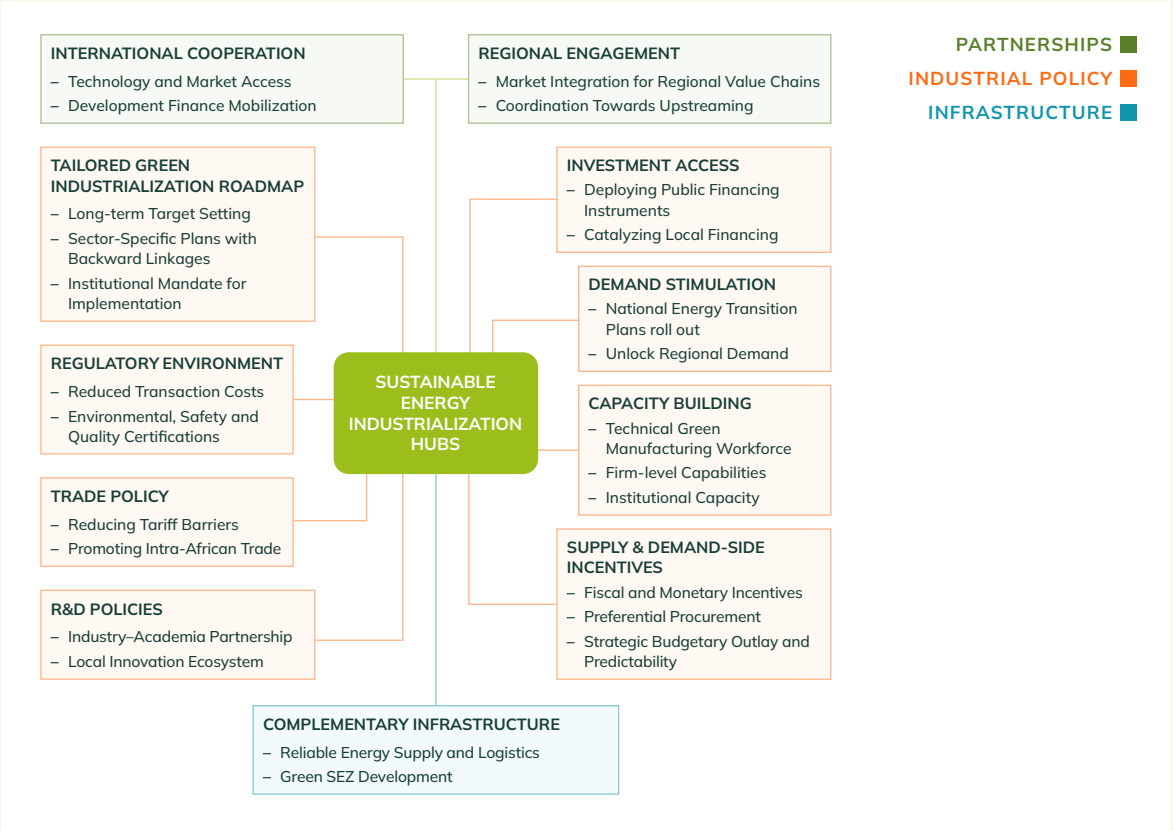
KEY LEVERS TO ESTABLISH INDUSTRIAL HUBS FOR ENERGY-TRANSITION TECHNOLOGIES

Advancing industrialization hubs in Africa for energy-transition technologies requires a coordinated, whole-of-government strategy.

This approach must combine national action with regional and international cooperation across three core domains: industrial policy, infrastructure and partnerships, as illustrated in Figure 3. Success depends on aligning a range of public institutions – governing trade and investment as well as energy, mining and skills development – around a mission-oriented industrial strategy (UCL Institute for Innovation and Public Purpose, 2024) to transform supply chains underpinning decarbonization and development agenda. This section examines key interventions for supporting these hubs, drawing on practical examples and lessons learned from G20 countries.

FIGURE 3

Key areas of action for industralization hubs for energy transition technologies



3.1. DESIGNING AN ENABLING INDUSTRIAL POLICY FRAMEWORK

Industrial policies[6] are critical instruments for developing local industries around emerging sectors, such as energy-transition technologies. These policies strongly influence how effectively countries can move from being technology importers to becoming active participants—and even leaders—in the clean-energy economy.

A robust industrial policy for energy-transition technologies typically involves several interlinked components. These include a coherent national strategy that integrates value-added industry development, public procurement, skills development, research and development, trade and investment facilitation policies. Several G20 countries have successfully deployed industrial policy tools that, when properly sequenced and aligned with long-term goals and political commitment, have enabled them to participate meaningfully in global energy value chains. The converse also has been seen, where industrial policy tools deployed to drive local value addition and job creation have not succeeded, offering important lessons (IBRD/World Bank, 2020). This section discusses the different components and draws on findings from some G20 countries on design and implementation.

[6] Refers to government actions to facilitate a shift in the structure of the economy, encouraging resources to move into sectors that are perceived as desirable for future socioeconomic development (PAGE, 2017)

3.1.1. Tailored green industrialization roadmap

Historically governments have integrated strategic nascent industries identified as key for meeting industrialization objectives within national development plans.

Green Industrialization Roadmaps aligned with National Energy Transition and Investment Plans can direct 'whole-of-government' action and link demand signalling with finance flows across the value chain.

Complementary technology-specific roadmaps (e.g. for solar PV, wind) can identify key value chain opportunities for localization in the short-, medium-, and long-term.

Countries often adopt sector-specific development roadmaps as a multi-faceted tool: to showcase government commitment to deepening domestic supply chains; to identify priority entry points based on local conditions, including existing adjacent industrial capacity and mineral resource availability; and to provide the foundations for financial and nonfinancial interventions to be led by various stakeholders in government, industry and academia.

South Korea offers important lessons from other sectors, including automobile, shipbuilding and electronics. Five-Year Economic and Social Development Plans from the 1960s to 1990s guided the country's transformation through import substitution and export orientation and provided the foundations for interventions to support domestic industry (Byun, 1990). The Plans identified priority sectors such as machinery, shipbuilding, electronics, petrochemicals, iron and steel, nonferrous metals and textiles, for access to credits and foreign exchange, state investment funds, preferential tax treatments and other supportive measures including import protection and entry restrictions (Chang, 1996). The share of manufacturing value-added in GDP grew from about 12% in the early 1960s to nearly 30% by 1990 (World Bank, n.d. a).

In the aerospace sector, Brazil offers the example of Embraer – an industry leader in the manufacturing of regional aircraft. It was born out of a state-owned enterprise established in 1969, with support in the form of guaranteed domestic off-take, research and development grants, access to financing and investments in skilling agencies. In 2024, Brazil launched the Nova Indústria Brasil (NIB) policy to reinforce the country's industrial capacity across multiple sectors up to 2033. Those sectors include agroindustry, automotive, bioeconomy, energy, construction, healthcare and defense (Government of Brazil, 2024a).

On energy-transition technology supply chains, China transitioned from being an export-only industry to meet foreign demand in the early 2000s to catalyzing the world's largest domestic demand-creation programme after 2010, supporting a significant ramp up in local manufacturing of key technologies, including solar PV and wind (Gang, 2015). The 12th Five-Year Plan (2011-2015) set ambitious official targets for renewable-energy capacity, identifying renewables as one of seven strategic emerging industries (Hong et al. 2013). China's 2015 industrial policy aimed to leverage the success in the renewable energy sector in order to transform the country from being a low-cost manufacturer to a high-tech producer. The policy identified 10 strategic industries including electric vehicles (Kenderdine, 2017).

The 14th Five-Year Plan (2021-2025) focuses on resilience to secure access to critical minerals, aiming to control the entire energy-transition value chain from mine to market. China is currently the largest producer of clean-energy technologies and related materials, including steel, aluminium and ammonia, with

backward linkages to key minerals and their processing capacity (IEA, 2024a).

Meanwhile, India's National Solar Mission was launched in 2009, setting a target to reach 20 GW by 2022. This was revised in 2015 to 100 GW by 2022 (PIB, 2015), and to 500 GW of nonfossil fuel-based capacity by 2030 (PIB, 2025a). Supporting domestic manufacturing has been a key priority for the government, with a range of demand- and supply-side incentives deployed over time to support local industry (see Box 2).

The South African Renewable Energy Masterplan (SAREM) was adopted in early 2025 as another example of a holistic green industrialization roadmap anchored on government commitment to develop renewable energy and storage value chains by 2030 (Box 1). It aims to build on earlier efforts and lessons learnt from South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) – for example, on the importance of consistent demand and availability of upstream product supply in-country.

BOX 1

South Africa Renewable Energy Masterplan: An Industrial Policy Roadmap

SAREM exemplifies a comprehensive industrial policy framework aimed at localizing renewable energy value chains, fostering inclusive economic growth and facilitating a just energy transition. Developed through a collaborative process, SAREM is structured around four strategic pillars: catalysing domestic demand, driving industrial development, fostering inclusion and building local capabilities.

A central objective of SAREM is to reduce reliance on imported renewable-energy components by stimulating domestic manufacturing. Between 2014 and 2024, South Africa imported over R180 billion (~USD 10 billion)[7] worth of renewable energy materials, highlighting the need for local production. SAREM aims to address this by promoting the establishment of industrial hubs and Special Economic Zones focused on renewable energy. The aim is to add at least 3GW of renewable energy per year and up to 5GW by 2030, which would also create over 25,000 jobs by 2030.

To build local capabilities, SAREM outlines interventions for skills development and technological innovation. This includes the establishment of training programs and research facilities to enhance the integration of local innovations into existing value chains.

Overall, SAREM represents a strategic approach to industrializing South Africa's renewable energy sector, aligning energy policy with broader economic and social objectives. Its successful implementation could position South Africa as a significant player in the global renewable-energy market while ensuring that the benefits of the energy transition are equitably distributed across society.

SOURCE: DEE, DTIC and DSTI, 2025

[7] Average Rand/Dollar exchange rate for 2024, IRS.gov

Beyond national planning, G20 renewable-energy and energy-efficiency targets provide a useful tool for estimating domestic demand. While perhaps not a broad measure of possible success, these targets may serve as policy signals that enhance market predictability, encourage private sector participation and justify the creation of domestic manufacturing capacity. However, targets must be reinforced with demonstrated consistency in implementation including regulatory stability, transparent procurement frameworks and complementary infrastructure (including grids).

Fostering such demand requires a balanced and consistent approach, grounded in coherent planning and long-term visibility. One effective model is the development of Energy Transition and Investment Plans (ETIPs) – national strategies that combine sector-level modelling with concrete investment pathways (SEforALL, n.d.). Developed by SEforALL in close collaboration with governments, ETIPs articulate how countries will build the energy systems needed to achieve net-zero emissions while prioritizing socioeconomic development.

These plans identify specific technological priorities and quantify the types of finance required – public, private or concessional – enabling countries to engage credibly with investors and development institutions. Countries such as Barbados, Ghana, Kenya, Nigeria and Sierra Leone have already benefitted from such planning processes, with additional efforts underway across Africa, Asia and the Caribbean.

3.1.2. Demand- and supply-side measures

Successful renewable energy value chain development requires a coordinated mix of demand-side and supply-side policies.

While large markets like China and India have leveraged domestic demand to scale local value chains, smaller economies can also succeed by integrating into regional and global supply chains, provided they ensure market access and competitive production environments.

Successful industrialization strategies hinge on policy coherence. Examples show that when incentives, infrastructure, and institutional support are aligned, countries can catalyze investment, accelerate technology adoption, and create long-term green jobs.

Demand-side and supply-side measures are essential components of an industrial-policy toolbox that seeks to build and localize renewable energy-value chains. They work in tandem—demand-side incentives generate market certainty and drive uptake of technologies, while supply-side measures build the industrial capabilities needed to meet that demand competitively. Several G20 countries have successfully used these measures to catalyze market development, support domestic manufacturing, foster innovation and position themselves in global supply chains for energy-transition technologies.

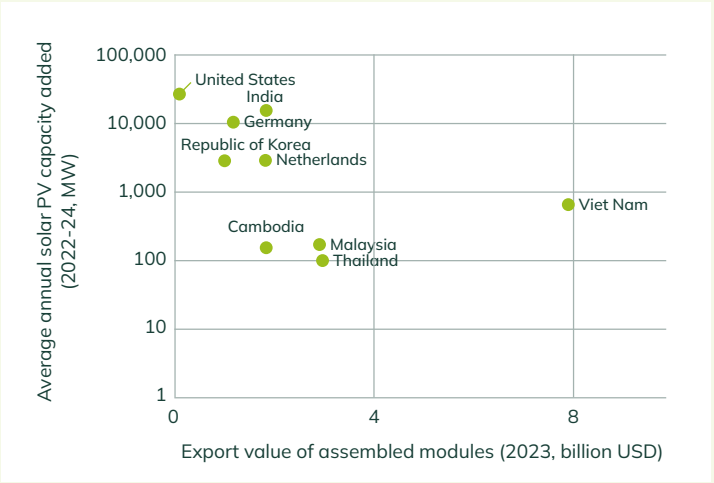
There is no one-size-fits-all solution, however, with the right mix of demand- and supply-side measures varying greatly from context to context, depending on local market size, existing industrial base, resource endowments and access to regional and global value chains. Successful examples usually are found in countries with a sufficiently large domestic market that demand-side policies can unlock and generate economies of scale to meet local demand and anchor for exports, as has been the case for China and India in the area of solar PV modules.

Demand-side measures target end users and create market pull to stimulate demand for energy-transition technologies and services. These may include incentives such as subsidies or tax rebates, local content requirements embedded in public procurement programmes, environmental regulations and penalties, import constraints and price control mechanisms (Lebdioui, 2024). Domestic procurement programmes could represent an important source of demand for local manufacturers. However, such programmes must be anchored on well-established targets based on existing market conditions and provide a long-term predictable environment while shaping technology supply markets – for instance, through standards setting.

Countries with smaller domestic markets are not precluded from building local value chains for energy-transition technologies. Countries have deployed industrial-policy tools to build a largely export-oriented industry facilitated by access to larger regional or global markets (Ibid). As illustrated in Figure 4, several Southeast Asian countries – among the largest solar PV module exporters in the world – are markets with relatively low domestic demand.

FIGURE 4

National demand and export value of solar PV modules, by selected country



SOURCE:
Solar PV capacity data based on IRENA (2025) and national export value based on UN Comtrade data for HS Code 854143

The ability to tap into export-market opportunities is determined by several factors, including trade agreements, domestic capabilities, geographic proximity and transportation costs. Facilitating intraregional trade can play an important role in aggregating demand and developing regional value chains through increased trade in intermediate goods and services (see section 3.1.3 on Trade Policy for a detailed discussion). Market diversification and strategic planning are essential to mitigate risks of heavy dependence on a single market.

Demand-side measures must be accompanied by supply-side incentives that impact the competitiveness of local assembly and manufacturing vis-à-vis imports, the development of firm-level capabilities, the import and diffusion of technology, research and development, and skilling in high value-added industries. Supply-side policies could include sales requirements, efficiency/emissions standards (e.g. targeting vehicles) and manufacturing incentives (e.g. fiscal incentives targeting input raw material and equipment) (RMI, 2024).

G20 countries have extensively deployed various supply-side policies to support the development of local manufacturing ecosystems for solar PV, batteries, electric vehicles and other energy-transition technologies.

China, for instance, used a blend of low-interest loans from state banks, export credit guarantees and land access incentives to develop its solar PV and battery-manufacturing base. Through industrial clustering, it concentrated firms in specific regions, generating economies of scale and fostering a vertically integrated supply chain. The United States, through the Inflation Reduction Act, provided tax credits for the production and sale of eligible clean-energy components including those for solar, wind and battery technologies, as well as for the processing of applicable critical minerals. India has utilized a combination of Production-Linked Incentives and the Approved List of Models and Manufacturers (ALMM) interventions to support investments in building vertically-integrated value chains for solar PV modules (Box 2).

BOX 2

India's Production Linked Incentives for Solar Manufacturing

India's Production Linked Incentive (PLI) Scheme for High Efficiency Solar PV Modules is a supply-side support programme aimed at developing a fully integrated value chain for high-efficiency solar PV modules including cells, wafers, ingots and polysilicon. Announced in 2021 and spread over two tranches, the total budget outlay is USD 2.8 billion (INR 24,000 Crore) (Ministry of New and Renewable Energy, 2025). Direct budgetary transfers are provided to manufacturers selected through a bidding process.

The bid selection criteria and subsidy disbursement were overseen by national agencies tasked with promoting clean-energy uptake. Key features of the PLI implementation process includes (Ministry of New & Renewable Energy, 2021; Ministry of New & Renewable Energy, 2022):

- Preference is given to manufacturers proposing fully integrated manufacturing from polysilicon to module, and larger capacities of 4 GW or above.
- Disbursement of PLI is on annual basis of sales over 5 years from commissioning.
- To ensure that the solar PV manufacturing industry is market competitive after five years, the PLI rate is higher in the beginning and lower towards the end of the five-year period.

In April 2021, the first tranche was launched with an outlay of USD 526 million (INR 4,500 crore). Three companies were awarded a total of 8,737 MW of integrated manufacturing capacity. This was followed by a larger tranche in March 2023, with an outlay of USD 2.3 billion (INR 19,500 crore). Eleven companies were allocated 39,600 MW of capacity, with phased operational targets through 2026. This tranche is expected to bring in over USD 10.8 billion (INR 93,000 crore) in investments and generate over 100,000 jobs (Ministry of Power, 2023).

By 2030, capacity across each segment of the solar PV value chain is expected to rise relative to 2025: module (80 GW to 160 GW); cell (15 GW to 120 GW); wafer (6 GW to 100 GW); and polysilicon (6 GW to 100 GW) (NSEFI, 2025). Imports of solar equipment fell by 66% from 2022 to 2024 and exports reached USD 2 billion in 2024, primarily to the United States. The success of this model also has led to the rollout of similar PLI schemes for other clean-energy technologies, such as advanced battery manufacturing and green hydrogen production.

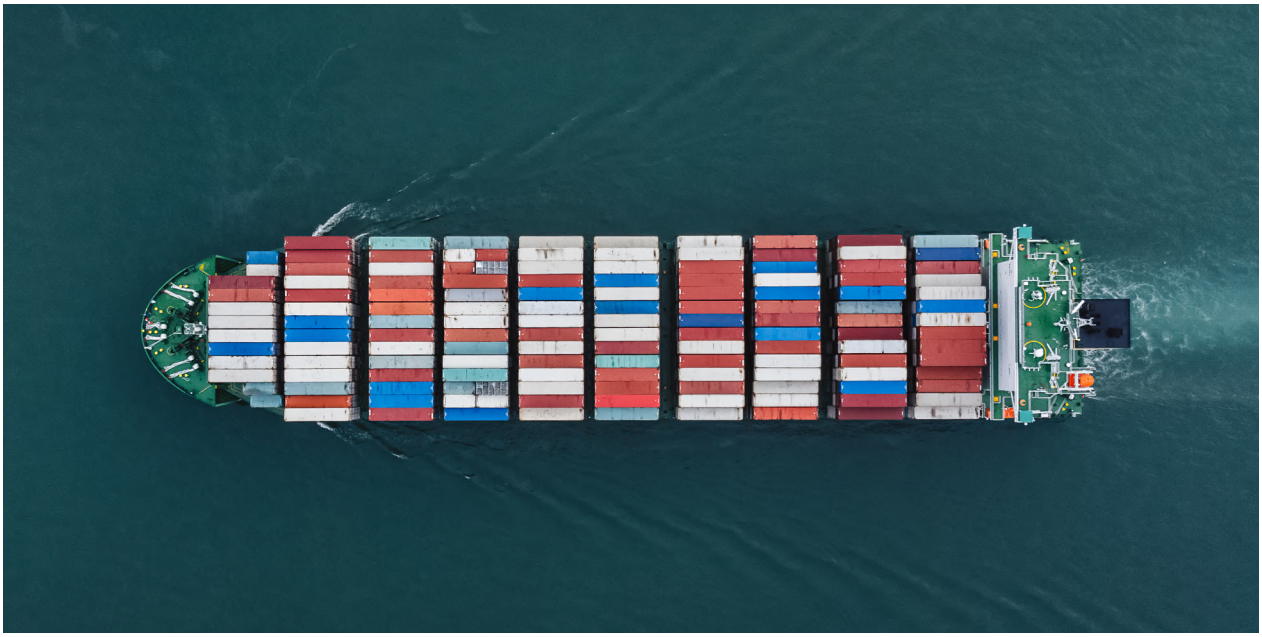
Supply-side support also could include grants for capital equipment or preferential financing for firms meeting local content and skills development criteria. An example is the Brazilian Development Bank's (BNDES) lending model for wind energy under the Programme of Incentives for Alternative Electricity Sources (PROINFA). G20 countries also have emphasized research and development as well as workforce development as supply-side enablers (discussed further later). Experience demonstrates that when these tools are coordinated rather than applied in isolation, they can more effectively support domestic-industry development (Box 3).

BOX 3

Türkiye High-Technology Investment Program

In 2024, Türkiye announced the High-Technology Investment Program (HIT-30), committing USD 30 billion in incentives to further strengthen the country's position as an exporter of emerging technologies. The program targets key sectors including electric mobility, battery production, semiconductor manufacturing and green-energy technology. For instance, aligned with its ambition to become a regional hub for battery production, the government is offering USD 4.5 billion to attract international investors. In the electric mobility sector, a USD 5 billion incentive package is offered to raise Türkiye's production capacity to at least 1 million units annually. Grants are offered to establish solar-cell manufacturing and to support component production for the wind sector. The program also aims to assist companies' research and development activities by supporting 50% of staff expense for five years and offering tax exemption and investment site allocation.

SOURCE: Türkiye Investment Office, 2024



3.1.3. Trade policy

Clean energy supply chains are deeply trade-dependent.

Strategic trade policy—through calibrated tariffs, regional trade integration, and investment incentives—can unlock domestic manufacturing potential, especially in developing countries seeking to move beyond raw material exports.

The international trade regime must reform to provide the policy space for developing countries to foster domestic industries and achieve structural transformation.

Clean-technology supply chains are highly dependent on trade, and will continue to be in the future, with implications for both net importers and net exporters. The value of trade in clean technologies, including solar PV, batteries and electric vehicles, is expected to grow from over USD 260 billion in 2024 to USD 575 billion by 2035 – around 50% more than the current value of global trade in natural gas (IEA, 2024b).

Trade policies are a fundamental lever in building new domestic economic sectors including those related to energy-transition technologies. The policies play an important role in facilitating access to input goods, technologies, expertise and capital; supporting domestic market creation; and unlocking access to regional and global markets for finished and intermediate goods. They also help build an enabling ecosystem to attract foreign investments and technology, incentivize local production and protect nascent industries. Trade policy instruments traditionally can be divided into tariff measures (e.g. import duties, antidumping duties) and nontariff measures (e.g. technical barriers such as standards, export quotas and conformity assessment procedures). The scope of trade policies is growing to also include trade in services, intellectual property rights and investment measures.

The current structure of trade in energy-transition technologies and associated minerals perpetuates the resource curse and economic dependencies that hinder the industrialization ambitions of developing countries. For instance, Sub-Saharan Africa's participation in global value chains is still dominated by

exports of primary products (forward integration) rather than imports of intermediate goods for further upgrading and export (backward integration) (Abreha et al., 2021).

Current trends point to a reinforcement of the current structures and concentration of the means of production in selected countries/regions, while other countries remain relegated to being suppliers of raw materials and/or consumers of high-value manufactured goods at intermediate and final stages. While global investments in clean-technology manufacturing rose 50% between 2022 and 2023 – reaching USD 235 billion – China accounted for nearly three-quarters of the total, with the United States, the European Union, India, Japan, Korea and Southeast Asia accounting for the rest. There were virtually no investments in Africa (IEA, 2024b).

A more nuanced approach of strategic trade is necessary for developing countries to break the cycle of dependency. This involves the calibrated use of trade policy as a tool of industrial strategy, carefully designed and implemented along with complementary national policies to foster domestic capacity and demand over time (Spencer and Brander 2008).

A crucial first step is to move from raw material extraction and export (i.e. pit to port) towards local beneficiation (for resource-rich countries) and/or local assembly and later-stage manufacturing in strategically identified sectors and/or for specialized products where local demand is not sufficient. One way this can be facilitated via trade policy is by strategically structuring tariff regimes. For example, lowering tariffs on intermediate goods – the components and subassemblies needed for manufacturing – can reduce input costs for domestic firms and make local assembly economically viable. This allows countries to gain a foothold in the value chain, create demand for technical skills and build a foundation for deeper industrial capabilities.

While there is no single blueprint for success in developing sustainable-energy industrialization hubs, access to stable, long-term demand – whether domestic or in export markets – is the most potent catalyst for attracting manufacturing investment. In this context, trade policy also has a key role to play in addressing the market-sizing challenge. Many developing countries, particularly in Africa and Latin America, are currently not large enough as individual markets to support the economies of scale required for competitive manufacturing.

Therefore, bilateral and multilateral trade agreements are crucial to access markets and to facilitate backward and forward linkages for input and finished products and services. In 2023, more than half of global trade took place between countries that had some form of trade agreements or preferential access (UNCTAD, 2025b). Africa needs both regional and intercontinental trade agreements to build market linkages for intermediate and finished goods, as it seeks to create domestic value chains for energy-transition technologies.

This is crucial given that African countries continue to trade with the rest of the world more than among themselves. Intra-African merchandise trade as a share of global trade declined from 14.5% in 2021 to 13.7% in 2022 (UNECA, 2024b). Merchandise trade within Association of Southeast Asian Nations (ASEAN) and European Union nations stood at 22% and 58% in 2022, respectively (Adjutor, Bena & Ganem, 2024; ASEAN, 2024).

Regional trade agreements, including the African Continental Free Trade Area (AfCFTA), and subregional economic communities – for instance, the ECOWAS Trade Liberalization Scheme and the Southern African Customs Union (SACU), can create more integrated markets. This allows aggregation of demand and development of value chains leveraging

mineral resources and production capacities. Over 62% of South Africa's exports of renewable-energy components in 2024 were exports to the Southern African Development Community (SADC) free trade area (GreenCape, 2025a).

Regional trade agreements also can support the creation of regional supply chains by progressively reducing intraregional tariffs on intermediate goods, taking into consideration national mineral resources and production capacities. Estimates indicate that every 10% increase in regional trade in intermediary products correlates with a nearly 4% increase in manufacturing employment (Van der Nest, 2025). A more integrated African supply chain also strengthens the collective bargaining power for more favourable and diversified trade agreements with external partners through intercontinental trade agreements.

Along with tariff measures, nontariff measures – including instruments such as quotas, price controls, royalties, standards and customs, and shipment inspection requirements – are increasingly being adopted to support local value-chain development. Export restrictions on industrial raw materials increased more than five-fold between 2009 and 2023 (OECD, 2025). One of the most recent export-control measures was introduced by China on rare earth elements and magnets in 2023. Indonesia banned export of unprocessed nickel ores in 2020 – an example of measures to attract investment in local processing and refining, with forward linkages to midstream and downstream manufacturing (ADB et al, 2023) (Box 4).

BOX 4

Indonesia's downstreaming policy: the case of nickel

Indonesia possesses the largest nickel reserves globally, accounting for 42% of global reserves and 51% of mine production as of 2023 (IEEFA, 2024). In 2020, under the industrial policy of hilirisasi (downstreaming), the government banned the export of primary ore to increase local value added. By attracting foreign investments in domestic refining, boosting export value, creating jobs and facilitating technology transfer, this policy strategically positioned Indonesia in global value chains for electric vehicles and batteries.

The "stick" of the export ban was complemented by "carrots" in the form of fiscal incentives to attract the necessary investment. This triggered several international firms – predominantly from China and South Korea – to set up onshore processing facilities to secure supply chains. Investments in mineral processing and manufacturing grew from USD 3.6 billion in 2019 to USD 11 billion in 2022. The total value added from nickel production leaped from USD 1.4 billion in 2020 to nearly USD 35 billion by 2023, a more than 20-fold increase. Exports of raw nickel ore have largely ceased, replaced by exports of high-value processed nickel products such as ferronickel, nickel pig iron, nickel matte and notably nickel sulphate, which is a critical input for battery manufacturing (Figure 5).

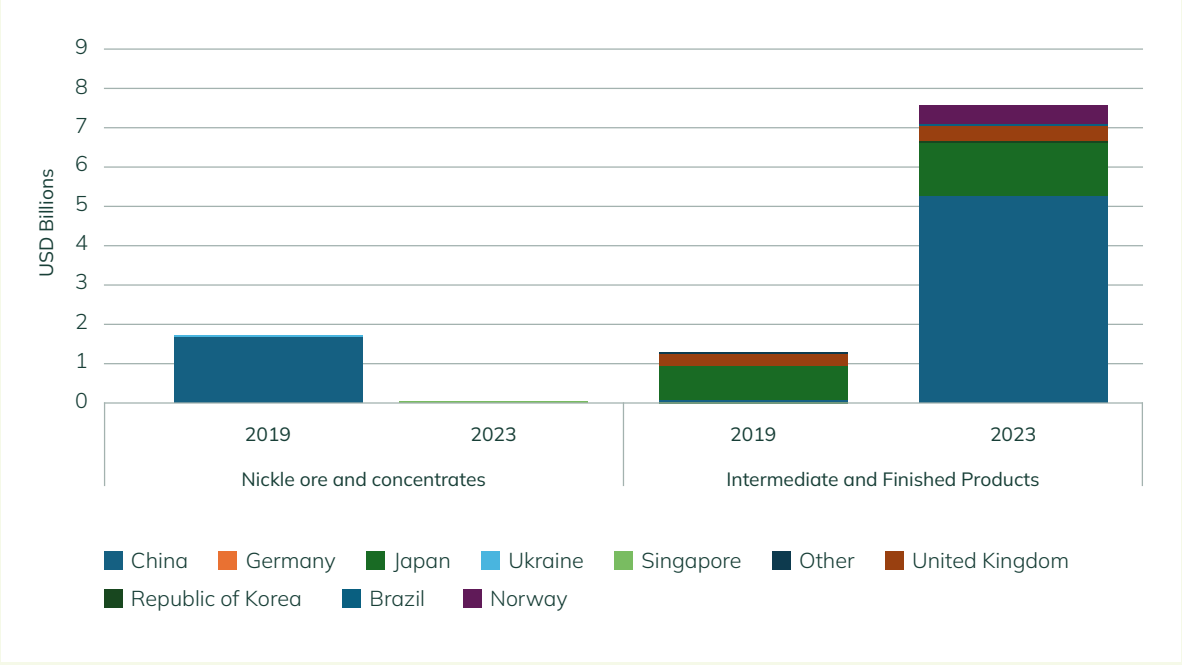
Indonesia's downstreaming policy has delivered positive economic outcomes but also involved key challenges. First, Indonesia's export curbs on raw minerals prompted

World Trade Organization (WTO) disputes, raising critical questions about how developing countries can balance trade rules with industrialization goals through industrial policy. The second challenge involves distributing value-added gains, which has been complex given the dominance of largely foreign-owned smelting operations and efforts to empower local mining firms and the state. The third challenge involves ensuring robust forward linkages and market access for intermediate and finished products while incorporating environmental and social externalities. This remains essential for sustainable development.

Indonesia is also extending downstreaming efforts to copper, leveraging strong global electrification demand and significant investments in domestic processing capacity.

FIGURE 5

Export value of nickel ores and concentrates and associated products by export market, 2019 and 2023 SOURCE: UN Comtrade



Nontariff barriers[8] also impose costs for intraregional trade that can be significant. Addressing nontariff barriers in Africa, for instance, could bring three to four times more gains than those expected from eliminating intra-African tariffs (UNCTAD, 2021). Transparency and traceability are key, especially in the upstream components of the value chains involving critical energy-transition minerals and intermediate products.

Like many industrialized countries, developing countries that strive to build domestic sustainable energy-industrialization hubs turn to a suite of industrial policy tools to nurture nascent

[8] Nontariff barriers can take the form of government laws, regulations, policies or administrative procedures that increase costs or restrict imports beyond tariffs and duties. These often protect domestic industries or achieve policy goals such as health, safety or environmental protection.

industries. These can include local content regulations, financial support and trade controls. This often results in a conflict with the international trade regime's core principles of nondiscrimination – most-favoured nation (treating all trading partners equally) and national treatment (treating foreign goods, services and firms no less favourably than domestic ones). It also faces challenges under the Government Procurement Accord (GPA) at the WTO.

The rules-based and non-discriminatory multilateral trade system should be leveraged so that emerging economies, including mineral-rich ones, can increase their access to investments and processing technologies to add more value locally while accounting for a significant burden of debt faced by many (United Nations, 2024). This includes instruments, such as the Special and Differential Treatment, designed to provide developing and least-developed countries with flexibility and preferential treatment.

There is an urgent need to promote dialogue on reconciling international trade regulations with climate action, particularly in the context of industrialization goals of developing countries. As countries move to cut emissions to achieve their Paris Agreement commitments, trade policy continues to come to the fore among the broader reforms of the international system in general. The Bridgetown Initiative is important in addressing reform of the international financial architecture as it relates to development finance. It challenges the status quo of how developed countries support developing countries through development finance for climate-related activities.

The G20 could represent an effective platform to identify and pilot mutually beneficial partnerships and trade arrangements that integrate Africa's ambitions to develop local value chains for energy-transition technologies. The G20 is an important trade partner for the African continent vis-à-vis energy-transition technologies. Over 90% of imports into Africa for selected technologies (solar PV modules, batteries and electric vehicles) originated from G20 countries (excluding South Africa). The value reached nearly USD 4 billion in 2024 – with more than half from China. The G20 countries are also major importers of Africa's primary commodities, including energy-transition minerals such as cobalt, copper and rare earths.

3.1.4. Research and development policies and technology access

The development of industrialization hubs for minerals beneficiation and clean energy manufacturing requires access to technology, skilled labour, and innovation ecosystems.

North-South and South-South cooperation – facilitated through platforms like the G20 – are essential to bridge the clean technology innovation gap.

Purpose-built Centres of Excellence demonstrate the potential to drive research, patent development, and innovation in critical mineral processing and energy technologies.

Industrialization hubs to support countries' ambitions to develop local minerals beneficiation, midstream processing and component-level manufacturing involve substantial technology-intensive processes. Achieving this requires significant investment in local skills enhancement, increased access to state-of-the-art technologies including manufacturing equipment, and know-how to enable diffusion and the development of a local ecosystem.

Many developing countries face challenges in accessing and acquiring technologies such as through trade, foreign direct investment, licensing or movement of people, and then innovating and adapting towards endogenous technology development (Yu, 2023). Several factors contribute to this challenge, including inadequate local skills, economic and financing constraints, institutional capacities, and protectionist approaches by countries and institutions holding capabilities and patents. The technology gap adversely affects efforts by developing countries to accelerate production, deployment and maintenance of climate technologies while addressing development and industrialization imperatives.

Technology development and transfer as a means of implementation and climate action is articulated in the Paris Agreement and in nationally determined contributions. Institutions such as the Technology Mechanism facilitate technology transfer for climate action linked to country-specific technology needs assessments and action plans. North-South and South-South international collaborations have an important role to play, and G20 could serve as a key forum. It could facilitate partnerships and engagement to address key barriers and strengthen technology access and local innovation systems in developing countries. This would support deepening of value chains for key energy-transition technologies.

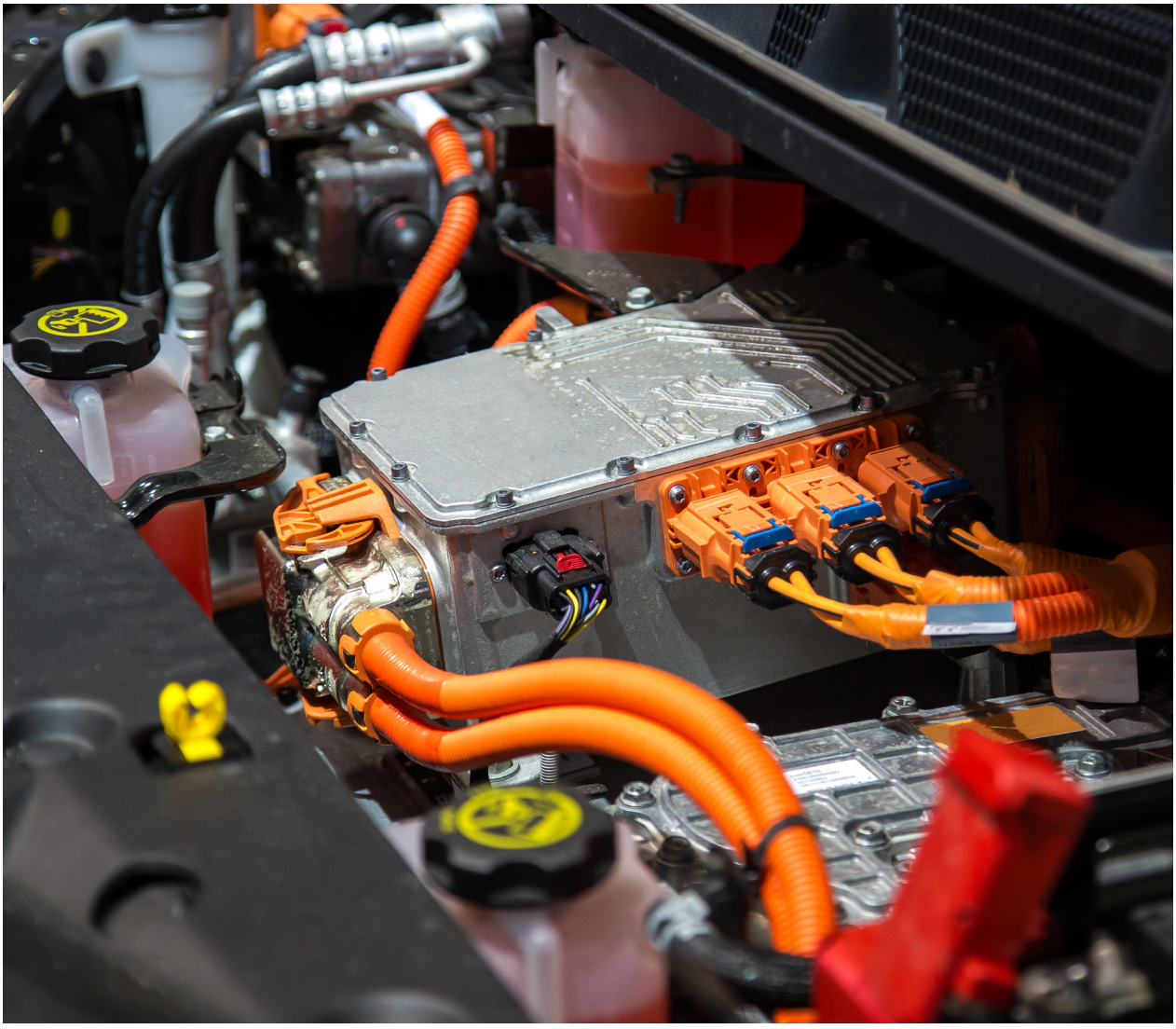
G20 countries owned approximately 91% of the patents granted under the Patent Cooperation Treaty (PCT) in environmental technology (solar, wind, hydro, geothermal, fuel cell and waste management) between 2000 and 2021. Five G20 countries (China, Japan, the United States, the Republic of Korea and Germany) account for about 85% of those patents (CEEW, 2023).

The G20 Strategy to Promote Open Innovation Cooperation, adopted in 2024 under the Brazilian Presidency, emphasized the importance of fostering knowledge exchange; strengthening international cooperation on science, technology and innovation; and facilitating the voluntary transfer of technologies on mutually agreed terms to address global crises and achieve the 2030 Agenda for Sustainable Development (Government of Brazil, 2024b). Mobilizing the tools and mechanisms for such exchange will be crucial for the implementation of the strategy.

G20 countries also continue to deploy public financing for research and development

activities. In July 2025, the European Commission announced grant investment of EUR 852 million to support six projects aimed at strengthening Europe's capabilities in battery cell production for electric vehicles. The funding is part of a broader initiative to strengthen Europe's battery value chain with up to EUR 3 billion in financial support (European Commission, 2025).

Centres of Excellence are playing a critical role in coordinating and mobilizing actions and resources to meet urgent research and development and innovation needs in the sector. In Australia, for instance, the ARC Centre of Excellence for Enabling Eco-Efficient Beneficiation of Minerals (COEMinerals) is a publicly funded national research centre launched in 2020. The Centre, comprising nine universities, aims to drive research and innovation to address key industry challenges associated with mineral beneficiation, enhanced recovery of rare earth minerals and the reduced environmental impact of mineral processing (COEMinerals, n.d.). India's National Critical Minerals Mission (NCMM), launched in 2025, has set specific targets for developing patents across critical mineral value chains and establishing Centres of Excellence for advanced research and technological development in the sector (PIB, 2025b). These Centres of Excellence could also serve as important conduits for cooperation among G20 countries on research and development and technology access.



3.1.5. Regulatory environment

> **Transparent, consistent, and predictable policy and regulatory frameworks are critical to attracting long-term investment in mineral beneficiation and industrial development.**
>
> **Unlocking regional value chains and scaling investments in renewable energy manufacturing will require continuing efforts to address non-tariff trade barriers, including harmonisation of technical standards and certification systems.**

A stable, transparent and predictable regulatory environment is a prerequisite for attracting the long-term investment demanded by domestic mineral processing and refining, as well as by manufacturing. This includes regulations governing permitting and licensing; land acquisition; environmental, social and governance standards; industry operations; testing and certification of products; and other areas.

In many regions, weak governance and inconsistent or unclear regulatory frameworks and processes are significant deterrents for investors. The risk that contracts may not be honoured or that the fiscal regime could change abruptly shortens investment horizons and favours short-term extraction over long-term industrial development.

The process of mining and refining critical minerals can have significant environmental consequences, including water depletion and pollution, land degradation and the generation of hazardous waste. Social impacts can be equally profound, including the displacement of local communities, risks to human health and the potential for labour-rights abuses.

Managing these risks responsibly requires robust environmental, human-rights and labour regulations; strong enforcement capacity; and inclusive frameworks for community engagement. Several standards now exist, including the Initiative for Responsible Mining Assurance (IRMA), which provides a comprehensive standard covering social and environmental performance at industrial-scale mine sites. The International Council on Mining and Metals (ICMM) promotes mining principles that define best-practice environmental, social and governance requirements for mining and metals companies. The Extractive Industries Transparency Initiative (EITI) promotes transparency and accountability in the oil, gas and mining sectors. It involves multi-stakeholder oversight and requires disclosure of information along the extractive value chain, from extraction to revenue management.

Specifically at the community level, community benefit agreements (CBAs) are another key instrument, usually embedded within mining codes. The agreements are relevant for mining communities and are considered an important tool for creating project support; establishing benefits and compensation for project-impacted communities; and mitigating negative impacts from the mines (Barlow, Shalya & Pai, 2025).

Looking to the downstream segments of the value chain, regulations around traceability, performance standards, testing and certification and end-of-life management are also critical. Harmonization of regulations and standards reduces compliance costs, facilitates cross-border trade and allows regional value chains to form and thrive. The G20's support for energy transition industrialization hubs in developing countries must therefore be intrinsically linked to its support for these vital regulatory measures and regional integration efforts.

3.1.6. Skills development

Renewables manufacturing can support job creation objectives with over 146 000 jobs annually in solar PV assembly alone.

Industry-academia collaboration is crucial for curriculum upgrade and reskilling efforts to meet the technical and non-technical skills demands of clean energy industries.

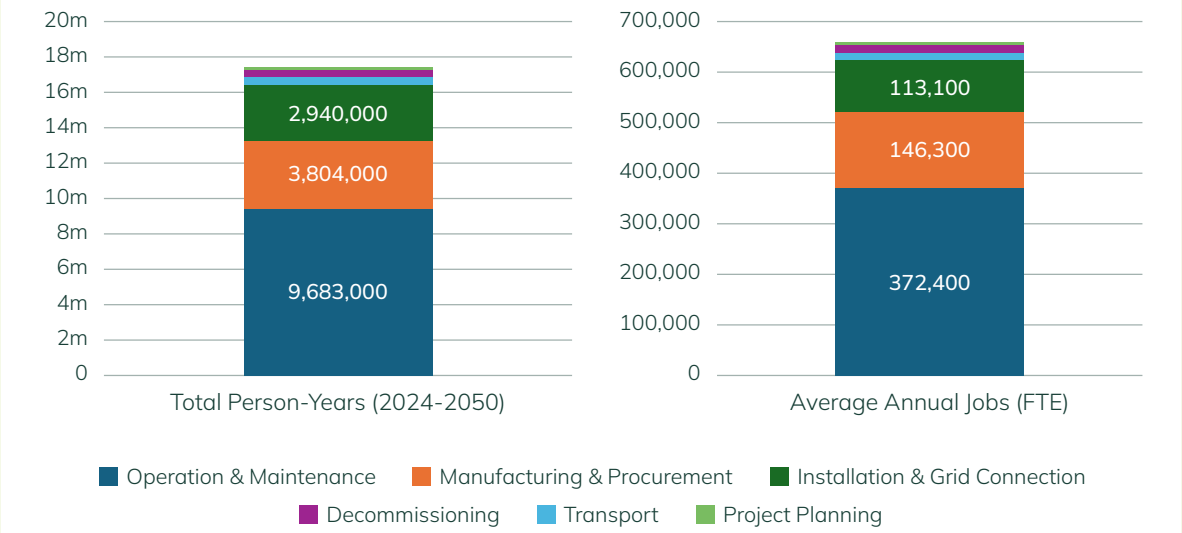
Government support through policy, funding, and regulatory frameworks towards regional harmonization will be critical to scale and sustain green workforce development.

Jobs in Africa's renewable energy sector could grow from 0.3 million in 2023 to over 4 million by 2030 and over 8 million by 2050 (IRENA and AfDB, 2022). The solar PV sector alone could employ 3.3 million people by 2050. While the majority of the jobs are in construction and installation (42%), the manufacturing segment is the second-largest component (35%). Scaling-up capacity from over 15 GW in 2024 to 962 GW by 2050[9] offers an employment generation potential of nearly 4 million person-years of labour. This translates into over 146,000 jobs annually in the manufacturing sector alone (Figure 6).

[9] Based on IRENA estimations for 2050. Analysis undertaken by PowerShift Africa (2024) finds that under a 100% renewable energy plan, installed renewables capacity will need to reach about 306 GW by 2030, compared to 80 GW in 2023, and should reach 3,500 GW by 2050 (of which just over 2,600 GW would be from solar photovoltaics).

FIGURE 6

Job creation opportunity in the solar PV value chain in Africa, total person-years and average annual jobs (FTE), 2024-2050



SOURCE: Analysis based on IRENA (2017)

For the energy transition to contribute to employment in Africa, the workforce needs to be trained with adequate technical and nontechnical skills and be ready to take the occupations that will be required (IRENA and AfDB, 2022). In the electric mobility sector, for instance, the needed skills vary, focusing on electrical, chemical and software engineering. As a comparison, mechanical and materials-related skills are needed for internal combustion engines. Power train production and assembly will require changes in the workforce profile, in areas such as diagnostics, operation and maintenance. The linkage between automation and digitalization with EV transition also creates a surge in demand for highly skilled workers in fields such as engineering, computer science, coding and intricate data analysis (ILO, 2024).

The upstream and midstream of the value chain involves sophisticated and often proprietary technologies for extracting and refining minerals. Access to this technology is a major hurdle, as is the availability of a workforce with the requisite metallurgical engineering and technical skills. Therefore, efforts to attract investments in mineral processing and refining needs to go hand in hand with STEM (science, technology, engineering and mathematics) skilling (African Union, 2025a).

Interventions are needed across the following key domains to address the skills needs of emerging manufacturing sectors:

- **Curriculum Update:** Educational and vocational training programs must be updated to reflect the specific requirements of solar PV, battery and EV manufacturing, as well as upstream and midstream sectors. This includes integrating modules on topics such as silicon-wafer production, lithium-ion cell chemistry, battery-management systems and EV powertrain assembly. Capacity must be built in local institutions through industry-aligned curricula and train-the-

trainers programmes to scale up training delivery as the sector expands.

- **Fostering Industry-Academia-Government Collaboration:** With industry taking a leadership role in setting up local assembly and manufacturing facilities, partnerships between industry and educational and training institutions need to be supported. These partnerships can identify key skills gaps; design curricula; establish joint research and development centers; and create apprenticeship and internship programs to build a skills pipeline.
- **Upskilling and Reskilling the Workforce:** Targeted programs providing a just transition framework are essential to retrain and upskill workers from traditional sectors for new green jobs. An assessment of job roles in the automobile sector, for instance, finds that over 70% of all roles are in manufacturing and service/repair (iFOREST, 2024). The new job roles in the EV ecosystem are about 5% higher than in the internal combustion engine (ICE) vehicle ecosystem; however, the new roles are qualitatively different, requiring higher skills and education levels (iFOREST, 2024). Short-term modular courses and on-the-job training can facilitate a rapid and effective transition. Partnerships with industry groups and associations of repairers will be crucial to aggregate demand and deliver specific opportunities for reskilling.
- **Standardization and Certification:** The development of globally recognized standards and certifications for skills in renewable-energy manufacturing will enhance the quality of the workforce and facilitate labor mobility. Standardized credentials give employers confidence in the capabilities of their staff and offer workers a clear pathway for career progression. Harmonization of qualifications and skills certification across regions can enable comparability and movement of qualified labor to support sector growth and development.

Governments play a pivotal role in creating an enabling environment for skills development. Internal skills development can be resource intensive for small players, so they require investments in large-scale training programs led by academic and vocational institutes (WRI, 2022). This includes making grant funding available for training programs and associated infrastructure; offering financial incentives for companies to invest in workforce development; and establishing national and regional skills strategies for the green economy (AfDB, 2024) (Box 5). Policies that promote diversity and inclusion are also vital to ensure that the benefits of the clean-energy transition are shared by all segments of society.

As an integral part of the implementation phase of SAREM, PowerUp was launched in 2025 as a digital skills facilitation platform connecting industry and academia. Its goal is to address the disconnect that exists between industry needs and educational training, with a focus on the renewable-energy sector (GreenCape, 2025b).

Skill building is also an important tool to ensure inclusion and equitable benefits sharing among local communities. The Canadian Critical Minerals Strategy, for instance, emphasizes the importance of working with Indigenous communities to ensure they are active partners throughout the value chain of responsible critical minerals development. Canadian government initiatives include the Sectoral Workforce Solutions Program (SWSP), the Indigenous Skills and Employment Training Program (ISET) and the Skills and Partnership Fund (SPF). These initiatives are designed to forecast skills needs, develop

green skills training for workers and expand the Indigenous workforce. They will also support reskilling of workers from other extractive sectors (e.g. oil and gas) for jobs in critical mineral exploration, extraction, processing, manufacturing and recycling (Government of Canada, 2023).

In India, the National Skill Development Corporation (NSDC) has created 36 Sector Skill Councils (SSCs) to drive efforts at a sector level to bridge the gap between industry, labour and academia. The SSCs identify and catalogue the skill needs; create a skill-development plan; determine the skills/competency standards and qualifications; standardize the affiliation, accreditation and certification process of training programmes; and facilitate the trainer programmes. The Automotive Skills Development Council (ASDC), for instance, has developed Qualification Packs and Model Curriculums for key EV-related roles, including assembly technician, operator, and quality control and maintenance worker(ASDC, n.d.). Similarly, the Electronics Sector Skills Council of India (ESSCI) covers key roles related to battery-pack design and assembly, including battery system assembly operator, system design engineer and repair technician (ESSCI, n.d.). The Skill Council for Green Jobs (SCGJ) covers manufacturing skills specific to technologies such as solar PV and electrolysers, including module and cell manufacturing technicians (SCGJ, n.d.).

BOX 5

Reskilling and upskilling workforce for the solar PV value chain: the case of the European Solar Academy

The European Institute of Innovation and Technology (EIT) launched the European Solar Academy in June 2024 to train workers across the entire solar photovoltaic value chain. It aims to reskill and upskill 65,000 workers across the entire solar PV value chain within its first two years.

The European Commission adopted the Net-Zero Industry Act (NZIA) in May 2024 to strengthen the domestic manufacturing capacities of key clean technologies. It sets a benchmark for the manufacturing capacity of strategic net-zero technologies to meet at least 40% of the EU's annual deployment needs by 2030. The NZIA emphasizes investing in education, training and innovation through the establishment of Net-Zero Industry Academies.

To meet the goal of producing 30 GW of solar technologies in the EU by 2030, an estimated additional 50,000 trained workers will be needed in manufacturing. Specific roles include process engineers, technicians and operators to produce ingots, cells and modules. The goal of the academies is to offer more than 40 courses with industry-recognised certifications across the value chain; to certify more than 80 local training providers; and to mobilise a network of industry and workforce partners to deliver courses to learners at scale.

SOURCE: European Commission, 2024; EIT, 2024

3.1.7. Investment mobilization

Mobilizing both domestic capital and international financing is essential to move beyond raw material extraction to higher-value activities like beneficiation and manufacturing.

A significant gap exists in early-stage project funding, requiring greater support from development partners through grants, guarantees, and blended finance to help projects become bankable.

Public financing instruments are critical for attracting capital into nascent green technology sectors and build globally competitive manufacturing hubs.

A scale-up in investments is required to fulfil policy ambitions of developing local value chains around energy-transition minerals and their beneficiation towards manufacturing. Existing investment flows are insufficient in magnitude and are also increasingly concentrated.

In 2024, mining operations in Africa generated approximately USD 50 billion, while mineral refining accounted for an estimated USD 16 billion. Projections indicate overall growth to almost USD 83 billion for both production and refining by 2040 (IEA, 2025). Estimates are that the average annual global investment required for the mining and production of critical minerals (lithium, nickel, copper and cobalt), and for the manufacturing of clean technologies, is nearly four times the investment levels recorded between 2016 and 2021 (UNDESA, 2025).

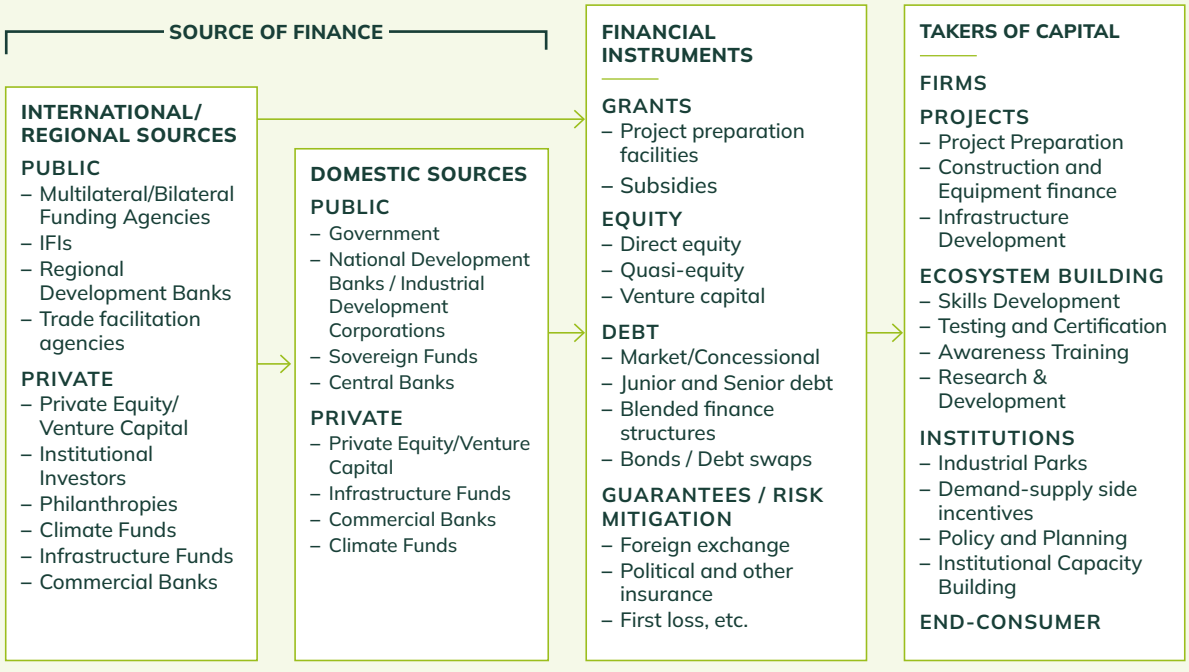
Global investments in clean-technology manufacturing rose by 50% in 2023, reaching USD 235 billion. Over 80% of investments went to solar PV and battery manufacturing, while EV plants accounted for a further 15% (IEA, 2024b). China received nearly three-quarters of the total investment, with the United States, the European Union, India, Japan, Korea and Southeast Asia accounting for most of the remainder. Investments in Africa remain negligible, pointing to the fact that existing investment flows are reinforcing current manufacturing hubs. At the same time, investment in greenfield exploration projects in Africa has been on a decline (AfDB and IGF, 2025).

Many countries face a major constraint because they lack accessible, affordable and appropriately structured capital to support exploration, production, beneficiation, midstream processing projects, associated infrastructure and forward linkages to manufacturing. The combination of high capital cost, limited local-currency financing and exposure of domestic financing institutions, and the inherent volatility of global mineral prices creates significant uncertainty. This affects the financial viability of projects, further deterring investment, while high sovereign debt rates and credit ratings create additional barriers.

The finance gap is evident throughout the growth cycle for projects and enterprises – from project preparation in the pre-feasibility stage to equity and debt access during the construction and operation phase. Ecosystem actors, including governments and development partners, seek greater funding for training; building infrastructure for testing and certification; and strengthening institutional capacity for planning and implementation of industrial policy interventions. Figure 7 illustrates the components of an industrial policy finance toolkit, highlighting the need for a range of instruments anchored on an enabling investment-policy framework.

FIGURE 7

Industrial policy financing toolkit



Public financing is important in supporting sectors that are critical and strategic for a country's industrialization and development goals. This funding is also important to provide the space for nascent industries to establish and grow over time. In this context, project preparation grants, blended finance instruments, concessional loans, public-private partnerships and state-backed investment funds have emerged as powerful tools to support early-stage projects and, in several instances, crowd in private capital.

Yet, international/external public financing for emerging markets and developing countries has become increasingly expensive and harder to mobilize. Support from multilateral development banks and bilateral agencies has proven insufficient – an issue picked up by the Indian G20 Presidency. It commissioned an Independent Expert Group to build the vision of "better, bolder and bigger banks" endorsed in the New Delhi Leaders' Declaration (G20 IEG, 2024).

It is now an urgent policy priority to mobilize domestic resources and build channels for international capital that ensure accessibility for local firms and projects. The combined value of Africa's domestic capital pools is estimated at over USD 4 trillion. This includes over USD 1 trillion in institutional capital (pension funds, insurance companies, sovereign wealth funds and public development banks); USD 2.5 trillion in commercial banking assets; and more than USD 470 billion in external reserves (AFC, 2025).

G20 countries offer useful precedents for deploying public financing instruments to support the development of industrialization hubs around energy-transition technologies. Australia's Critical Minerals Facility is backed by A$4 billion (USD 2.6 billion) in government capital and is managed by its export credit agency. It provides loans, bonds, insurance and guarantees for downstream, upstream and midstream projects including refining of rare earths and battery-precursor materials (Export Finance Australia, 2023). Canada's Critical Minerals Infrastructure Fund (CMIF) provides up to USD 1.5 billion in federal funding until 2030 for clean-energy and transportation-infrastructure projects to enable the sustainable development and expansion of critical minerals (Government of Canada, 2025).

State-owned development finance institutions are increasingly at the forefront of addressing funding needs of strategic sectors (Box 6). South Africa's largest state-owned development finance institution, the Industrial Development Corporation (IDC), delivers a range of financing products. These focus on priority economic sectors, including energy-transition technology value chains. In the specific case of the battery value chain, IDC has invested in projects from recycling to upstream mining and processing (e.g. nickel, manganese, cobalt and copper) and midstream and downstream manufacturing and assembly (e.g. battery pack assembly) (Mohale, 2024).

BOX 6

Deploying public financing for catalyzing local value chains: the case of Brazilian Development Bank

The Brazilian Development Bank (BNDES) has played a fundamental role over the past decades in deploying public-financing instruments to support the development and expansion of strategic industries, which has contributed to the national industrialization agenda. In the late 2000s, BNDES supported the development of a domestic wind industry. It provided long-term financing for projects that sourced a high percentage of key components domestically, including towers, blades and nacelles. Combined with a stream of government-led deployment measures, the policy resulted in major global Original Equipment Manufacturers (OEMs) establishing assembly plants and supply chains in Brazil, which contributed to a vibrant domestic manufacturing base.

Starting in 2024, BNDES has partnered with the Funding Authority for Studies and Projects (FINEP) and the Brazilian Agency for Research and Industrial Innovation (EMBRAPII) has been designated as financing agent for the New Industry Brazil industrial policy. It will be responsible for deploying R$300 billion (USD 56 billion)[10] in financing by 2026. It will use a diversified toolkit of special credit lines, nonrefundable grants and capital market instruments. The USD 1.4 billion Critical Minerals Fund, in partnership with FINEP, will develop Brazil's vast reserves of critical minerals by financing downstream processing and the manufacturing of high-technology components for the global energy transition.

[10] Riyal/USD yearly average exchange rate for 2024, IRS.gov

In addition to financing for infrastructure and production facilities, working capital and export credit are needed to support local suppliers and small and medium-sized enterprises (SMEs) involved in component manufacturing and logistics. Instruments such as export credit guarantees, used extensively by the Japan Bank for International Cooperation (JBIC) and the Export-Import Bank of Korea (KEXIM), reduce the risk exposure of domestic firms entering global supply chains. Regional development banks, including the African Development Bank (AfDB), the Africa Finance Corporation (AFC) and the African Export-Import Bank (Afreximbank), have an important role to play. They support African countries that are establishing competitive positions in energy-transition technology manufacturing, starting with locally sourced and processed minerals. Afreximbank, for instance, has a dedicated funding window under the Industrial Parks and Export Processing Zone Initiative (EPZ), bringing together financial (debt and equity investors/financiers) and nonfinancial stakeholders (i.e. governments, engineering and construction companies, export trading companies, and developers and managers of industrial parks and EPZs). The goal is to support development of hard and soft infrastructure, investment promotion activities, and international market access for goods made in Africa (Afrexim, 2025).

The scarcity of early-stage, pre-feasibility funding for clean technology manufacturing and mineral beneficiation projects exacerbates the challenges of gaining access to financing mentioned earlier. However, developed economies can find ways to partner and support nascent projects in developing economies. Alongside other forms of capital, including from philanthropies, they can provide early-stage grants and guarantees to make funding less risky with blended-finance tools to drive projects from early development to bankability.

The Manufacturing Africa programme, for instance, is an initiative funded by the government of the United Kingdom. Its goal is to transform Africa's manufacturing sector by providing transaction facilitation, capacity building, and expert technical support to African enterprises. Among its other projects, Manufacturing Africa has been supporting efforts to ramp up domestic assembly and manufacturing of lithium-ion batteries, solar PV modules and electric vehicles. This has taken place through early-stage support for commercial due diligence, as well as tax advisory (Canto Systems, 2025).

State-owned enterprises can serve as important catalysts to attract and deploy capital for local value chain development. In Argentina, the state-owned firm Energía Provincial Sociedad del Estado (EPSE) is leading the development of an integrated solar module manufacturing plant from raw quartz to modules, beginning with an assembly capacity of 450 MW (Avramow, 2025). In Indonesia, the state-owned Indonesia Battery Corporation (IBC) has partnered with that country's PT Aneka Tambang Tbk (ANTAM) and China's Contemporary Amperex Technology Co. (CATL). The partners broke ground on a fully-integrated battery project in Karawang on West Java in June 2025. The project involves the entire battery value chain,from nickel mining and processing to producing, manufacturing and recycling battery materials. The battery plant will deliver an annual capacity of 6.9 gigawatt hours (GWh) in the first phase to support national and regional electric mobility and energy-transition ambitions (CATL, 2025).

Innovative financing solutions should increasingly be explored. In some contexts, debt-for- nature swaps could be feasible. In these swaps, resource-rich developing economies with challenging debt sustainability scenarios can restructure their debt if they commit to investing in environmental and conservation initiatives and potentially ring-fencing funds for green industrialization. Within such debt-for-nature swaps, other tools such as green bonds could crowd in additional investments.

Increased cooperation between multilateral development banks (MDBs) and national development banks (NDBs) could facilitate improved access to larger sources of international finance, leveraging the knowledge, competencies and political access of NDBs to local projects and linking these to international financial institutions (IFIs). This can complement the breaking down of sectoral silos that traditionally hamper development finance by not addressing the interconnectedness of development challenges (OECD, 2018). The Africa Green Minerals Strategy proposes establishing an African Green Minerals Value Chain Investment Fund capitalized by foreign mining companies and development finance institutions, among others. The Fund would address the accessibility and cost of financing challenges faced by governments and firms operating in Africa (African Union, 2025a).

3.2 INFRASTRUCTURE AND INDUSTRIAL HUBS

Reliable energy, water, and transport infrastructure are fundamental; without them, even resource-rich regions face high operational costs that erode their manufacturing and value-add competitiveness.

Strategically sited and integrated industrial zones can unlock investment, address infrastructure gaps, and catalyze development of regional value chains.

Scaling up industrial clusters requires adoption of eco-industrial park models to proactively manage environmental and social impacts.

Mineral processing and manufacturing are energy- and resource-intensive activities that require world-class infrastructure. The lack of reliable and affordable electricity, inadequate water management systems, and underdeveloped transportation networks (ports, rail and roads) dramatically increase the operational and market access costs of local value-added projects, undermining their competitiveness. Energy costs, for instance, can constitute up to 10-15% of the total cost of refining minerals (Manufacturing Africa, 2024). Yet, there are significant opportunities for cost reduction in favorable contexts: producing battery precursors in the Democratic Republic of the Congo could be three times cheaper than in the United States or China, thanks to hydroelectric generation and abundant cobalt resources (AFC, 2024).

To address the infrastructure and institutional weaknesses, governments are increasingly adopting a holistic approach. They are promoting industrial parks in areas with exist-

ing or planned complementary infrastructure, and developing greenfield parks with linkages to input resources and connectivity to logistical infrastructure and markets. Industrial parks are designated areas for industrial use, equipped with the necessary infrastructure such as logistical connectivity, power, water and proximity to potential resource inputs. Enterprises based in industrial parks benefit from shared facilities and the proximity to other industrial players, generally operating under the same legal and tax framework as businesses elsewhere in the country.

Within this context, EPZs focus on boosting exports by providing manufacturers with an enabling ecosystem. This includes exemptions from customs duties on imported raw materials and capital goods, streamlined customs procedures, and tax concessions on export profits. While EPZs may source materials locally and focus on exports, import processing zones often import raw materials and sell finished goods domestically (Hodder, 2024). EPZs could be considered precursors to the broader concept of Special Economic Zones (SEZs), which are areas governed by economic laws different from those of the rest of the country. SEZs are designed to attract foreign direct investment (FDI) through a suite of incentives such as tax holidays, repatriation benefits, simplified labour regulations, single-window clearances, and world-class infrastructure.

Reflecting the success of these models, the number of SEZs on the African continent has grown to more than 220, mobilizing over USD 2.6 trillion in investment (UNIDO & AEZO, 2024). The majority are found in Morocco, Nigeria, Egypt, Ethiopia and Kenya (Hodder, 2024). Recently, there has been growth in SEZs focused on green technology, as countries seek investment in local processing and manufacturing of minerals and in energy-transition technologies. Some notable examples from G20 countries include the Atlantis Greentech SEZ in South Africa; the Morowali and Kalimantan industrial parks in Indonesia; and Greenpower Park in the United Kingdom.

As hubs of industrial activities, these also play a crucial role in wider efforts towards industrial decarbonization. They facilitate linkages to the supply and production of low-carbon

Morowali Industrial Park in Indonesia

Artistic impression of Greenpower Park, United Kingdom | Photo: Greenpower Park

fuels, including green hydrogen and ammonia, for hard-to-abate sectors. South Africa, for instance, is actively developing green-hydrogen hubs, including the Boegoebaai Green Hydrogen Cluster in the Northern Cape and the Coega Green Ammonia project. Both are tied to industrial parks to leverage renewable-energy resources and to decarbonize domestic industries, ultimately facilitating exports of low-carbon finished goods.

While the main aim of industrial parks is to promote industry clusters, attract investment, spur job creation and facilitate trade, their concentration of activities can intensify sustainability challenges. This has led to the rising prominence of the eco-industrial park (EIP) concept, which integrates social, economic and environmental quality into the siting, planning, operations, management and decommissioning of parks (UNIDO, 2018). The UNIDO Eco-Industrial Park framework outlines the requirements and performance standards industrial parks must meet to qualify as EIPs (UNIDO, World Bank and GIZ, 2021).

Regional integration initiatives further expand the role of industrial hubs. The proposed transboundary SEZ for battery and electric vehicles on the border of Zambia and the Democratic Republic of the Congo demonstrates how such hubs can help build regional supply chains. This supports market integration and increases intra-African trade in intermediate products and services. The harmonized rules of origin under AfCFTA, and the cumulation rules of origin allow African states to collectively meet value-addition thresholds for preferential tariff treatment, are poised to facilitate regional value chains and enhance competitiveness (UNECA, 2025). To fully tap into the opportunity of industrial parks, several challenges must be overcome, including deficiencies in infrastructure, inconsistencies in regulatory and policy frameworks, and access to affordable financing (Afreximbank, 2024).

3.3 PARTNERSHIPS

Positive examples are emerging of collaboration between G20 countries and other partners to facilitate technology transfer, investment access, and capacity building for green value chain development in developing countries.

Expanding intra-Africa trade in intermediate products could catalyze the development of regional value chains by linking mining, refining, and manufacturing across borders, incentivizing preferential sourcing and boosting market access.

South-south collaboration on technology, investment and skills development for energy transition technologies industrialization hubs offer opportunities to accelerate progress.

International and regional cooperation, as well as South-South partnerships, could help address many of the challenges to developing industrialization hubs around energy-transition technologies in Africa. Through mutually beneficial partnerships, they could address challenges associated with demand, technology and investment access, and resource and institutional capacity gaps.

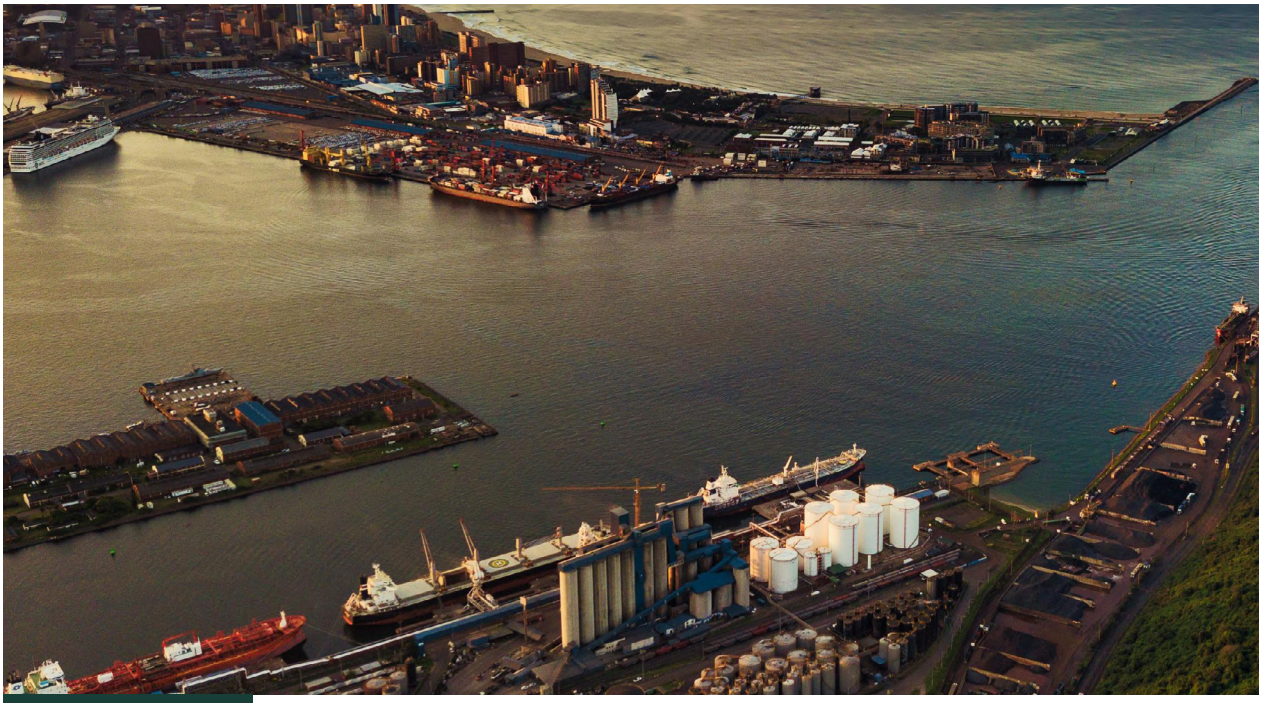
As an example of investment-mobilization partnerships between G20 countries, Brazil and the United Kingdom jointly launched a public call in 2024 to identify proposals for Brazilian low-carbon industrial-hydrogen cluster projects. The goals of these projects are to help deliver the next phase of Brazil's National Hydrogen Strategy; accelerate industrial decarbonisation; and support the delivery of Brazil's national climate and energy-transition goals. The Industry Decarbonisation Program of the Climate Investment Funds (CIF) will be targeted for a first large tranche of concessional funds for projects (UNIDO, 2024).

There are significant exchange opportunities during SEZ development phases – i.e. with SEZs globally and on the African continent. SEZs can facilitate trade between their respective tenants and take advantage of areas in which each hub excels – for example, its production systems and connections to suppliers, resources and customers. Several measures can be taken in this direction in Africa.

AfCFTA aims to dismantle tariffs on intermediate goods, enabling intra-Africa trade by potentially ensuring competitive regional value chains, from mining and refining to manufacturing of intermediate and finished goods. Preferential tariffs linked to rules of origin requirements could compel manufacturers to source from within the region. This would incentivize the creation of a regional supply web; create new market access opportunities for countries exporting minerals and intermediate products to those with stronger downstream linkages; and import back finished components or goods at competitive rates.

The share of Sub-Saharan Africa's intraregional exports of intermediate goods has declined from 32% in 2015 to around 24% in 2023. This suggests that a growing portion of the semi-processed exports are being absorbed by external markets rather than strengthening regional supply chains. Southern Africa is the dominant regional exporter and importer of intermediate goods with a 33% export share and a 50% import share. This reflects the sub-region's relatively advanced industrial base, particularly in metals, machinery and automotive components (Van der Nest, 2025). The Democratic Republic of the Congo is the largest exporter of intermediate goods in Sub-Saharan Africa, with its share in total exports rising from 14% in 2015 to 26% in 2023. This has been driven by the rapid expansion of the country's mineral exports, particularly cobalt and copper (Ibid).

Increasing intra-Africa trade in intermediate products is an important step in unlocking local value chains on the continent. By harmonizing customs procedures and standards, nontariff barriers can be reduced and region-wide demand can be unlocked for key technologies.



CHAPTER FOUR

BUILDING INDUSTRIAL HUBS FOR ENERGY-TRANSITION TECHNOLOGIES IN AFRICA: A G20 ACTION PLAN

Accelerating global energy transition and building industrial hubs for clean technologies in Africa are mutually beneficial objectives. Whether seen through the lens of equity and justice, energy and national security, or resilience and diversification, the importance of linking energy-transition strategies with industrialization goals on the continent is starkly clear.

For resource-rich countries, the traditional pit-to-port paradigm of resource extraction needs to make way for greater local beneficiation through refining, smelting and further processing. As existing manufacturing hubs reinforce their positions through trade and other industrial-policy tools, emerging economies have an opportunity to advocate for and pursue efforts towards building supply chains that are more inclusive and just – and anchored on principles of equitable benefits sharing.

The G20 represents 85% of global GDP, over 75% of trade and about two thirds of the world's population. It is well positioned, as a platform, to ensure that the changing architecture of global energy supply chains integrate developing countries' ambitions to benefit fully from the economic opportunity of the transition. Building on the outcomes of other G20 Presidencies, South Africa's Presidency has a unique opportunity to bring to centre stage the agenda of Africa's green industrialization and offer a blueprint for collective action.

This report proposes areas in which G20 action could advance efforts to develop industrialization hubs for energy-transition technologies in Africa:

Recognize the importance of reconciling energy-transition and industrialization goals for developing economies.

While transitioning to clean energy is vital for global climate goals, it must further strengthen, and not impede, the industrial and socioeconomic development aspirations of developing economies. The G20 New Delhi (2023) and Rio de Janeiro (2024) Leaders' Declarations emphasized the need to support reliable, diversified, sustainable and responsible supply chains for energy transitions, including for critical minerals and materials beneficiated at source as well as semiconductors and related technologies. The G20 Principles for Just and Inclusive Energy Transitions adopted in 2024 further emphasize local value creation and beneficiation at source as key for sustainable and inclusive growth for all.

South Africa's G20 Presidency presents the opportunity to build on the momentum and link this support with tools of implementation including mobilization of financing, technology partnerships and knowledge exchange. Currently under development, the G20 High-Level Principles on Green Industrial Policy for Inclusive Economic Growth, Industrialization, Jobs and Equality and the G20 Critical Minerals Governance Framework will serve as key frameworks to support value addition and fair benefit-sharing in critical value chains for green industrialization.

Develop a G20 roadmap for financing green industrialization in Africa to catalyze concessional financing and innovative blended-finance structures for governments, enterprises and projects along the value chain.

Within a broader framework for financing a just energy transition and infrastructure, attention must be paid to the investment needs for green industrialization programmes. International and local financing institutions, including African sovereign wealth funds with a growing capital holding, have an impor-

tant role to play. They can unlock capital for enterprises and projects working to create greater value in strategic energy-transition sectors including solar PV, batteries, electric vehicles, hydrogen production and energyefficiency technology manufacturing – as well as in complementary infrastructure.

G20 countries can commit to scaling multilateral and bilateral development and climate-finance support, notably early-stage funding dedicated to green industrialization. This can happen through increased grant support for feasibility studies and project preparation activities, guarantees, concessional and blended local currency finance windows/platforms.

Funding also needs to align with national green industrialization strategies. This means moving beyond project-based finance to support broader, long-term industrial policy objectives – for example, concerning logistics, skills, research and development, and certification and testing infrastructure. Such a roadmap also could inform strategic matchmaking, in which countries/finance partners could co-fund important projects on a regional – not just domestic – basis.

Establish a G20 Partnerships for Green Industrialization in Africa Platform to facilitate strategic collaboration and exchange between G20 countries on industrial policy, investment facilitation and trade and skills development.

G20 countries collectively represent a dominating force in global supply chains for energy-transition technologies. A dedicated forum could facilitate strategic engagement among G20 countries on green value chain development, with a focus on beneficiation, technology exchange and equitable benefits sharing. It could offer a blueprint for – and could potentially pilot – mutually beneficial partnerships to optimally integrate priorities on local beneficiation, industrialization, security of supply and diversification.

The rich experience among G20 countries can also be leveraged to facilitate collaboration and to exchange lessons learnt in industrial policy design, capacity building and public-private partnership models for the development of energy-transition industrialization hubs. Such efforts could build on the earlier initiatives, including the Research Innovation and Initiative Gathering, used during Indonesia's G20 Presidency as a forum for G20 members to share best practices and policy models related to sustainable-energy transitions.

Strengthen the voice of reforms in international trade, finance and technology access norms to provide developing countries the green policy space to industrialize.

The G20 can lend its collective political voice and influence to help reconcile existing multilateral trade, finance and technology systems with the goals of accelerated and urgent climate action plus socio-economic development – particularly in developing countries. The current global architecture was not designed for the challenge of a just energy transition and, in some cases, actively constrains the ability of developing countries to build the robust domestic industries they need.

A G20 framework on green industrialization and investments is necessary that recognizes the challenges facing developing countries, and puts mechanisms in place to drive collaboration towards bilateral and multilateral partnerships to deploy financing, facilitate technology transfer and know-how, and formulate win-win trade arrangements at a technology value-chain level. This will augment efforts to build sustainable energy industri-

alization hubs anchored on principles of local beneficiation and equitable benefits sharing.

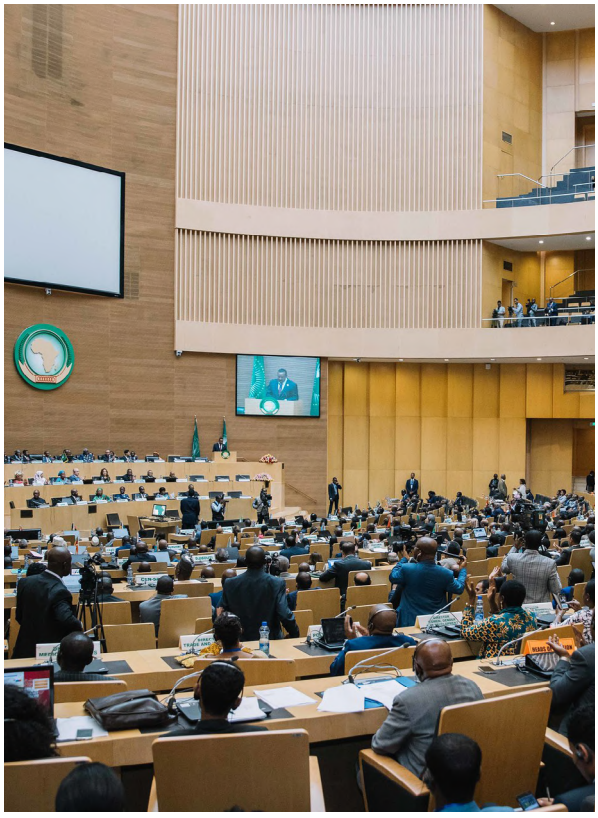
Leveraging strong trade and investment relationships among G20 member states to drive the harmonization and green rules of origin in G20 trade agreements could reward local processing of critical minerals and renewable components. G20 members could re-commit to working hand in hand on the reform agenda of the WTO, with a definite focus on developing countries. That could help developing countries implement targeted industrial policies that support local beneficiation and manufacturing in strategic transition sectors, without those countries facing the risk of punitive measures.

The G20 can drive new models for technology transfer; facilitate nonexclusive licensing agreements on fair terms; and support collaborative research and development to ensure that the tools of the transition are a shared global good – not a source of competitive advantage that deepens inequality. Revitalizing discussions about a Trade-Related Intellectual Property Rights (TRIPS) waiver for green technologies – and building on the lessons learnt during the negotiations and implementation of the TRIPS waiver for the COVID-19 pandemic – would aim toward a TRIPS waiver for trade in green/clean technologies.

In line with the theme of Solidarity, Equality, Sustainability under South Africa's G20 Presidency, the G20 can help level the playing field by strengthening the voice for these reforms. It can ensure that the global energy transition fosters inclusive and sustainable development for all, rather than reinforcing historic economic divides.

Bolster support for intra-African integration and trade and partnership with G20, including leveraging engagement with the African Union and implementation of AfCFTA.

The inclusion of the African Union as a permanent member of the G20 sends an important signal of inclusion and an opportunity for the continent to present a unified voice on key development priorities. Building on the G20 Compact with Africa, which was launched in 2017 under the German Presidency, there is an opportunity for a stronger strategic engagement between the G20 and the African Union. In this case, it will be to mobilize international cooperation to develop more inclusive supply chains for energy-transition technologies, with equitable benefits-sharing and regional integration as key priorities. Such measures can support the implementation of key regional strategies and initiatives, including AfCFTA and Africa's Green Minerals Strategy.



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Sustainable Energy for All has a global mandate to accelerate progress on the energy transition in emerging and developing countries. Hosted by UNOPS, we work at the intersection of energy, climate and development, partnering with governments and organizations worldwide to end energy poverty, double energy efficiency, significantly expand renewable energy and combat climate change.

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