UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION
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INDUSTRIAL DEVELOPMENT REPORT 2026

THE FUTURE OF INDUSTRIALIZATION

Building future-ready industries for sustainable development

FULL REPORT

About UNIDO

The United Nations Industrial Development Organization (UNIDO) is a specialized agency of the United Nations with a unique mandate to promote, dynamize and accelerate sustainable economic and industrial development.

Our mandate is reflected in Sustainable Development Goal (SDG) 9: "Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation", but UNIDO's activities contribute to all the SDGs.

UNIDO's vision is a world without poverty and hunger, where industry drives low-emission economies, improves living standards, and preserves the environment for present and future generations, leaving no one behind.

UNIDO provides support to its Member States through four mandated functions: technical cooperation; action-oriented research and policy-advisory services; normative standards-related activities; and fostering partnerships for knowledge and technology transfer.

Our work is concentrated on three focus areas: ending hunger by supporting sustainable food systems with modern agri-tech and agribusiness; tackling climate change by using renewable energy and energy efficiency to reduce industrial greenhouse gas emissions; and supporting sustainable supply chains so that developing country producers get a fair deal and scarce resources are preserved.

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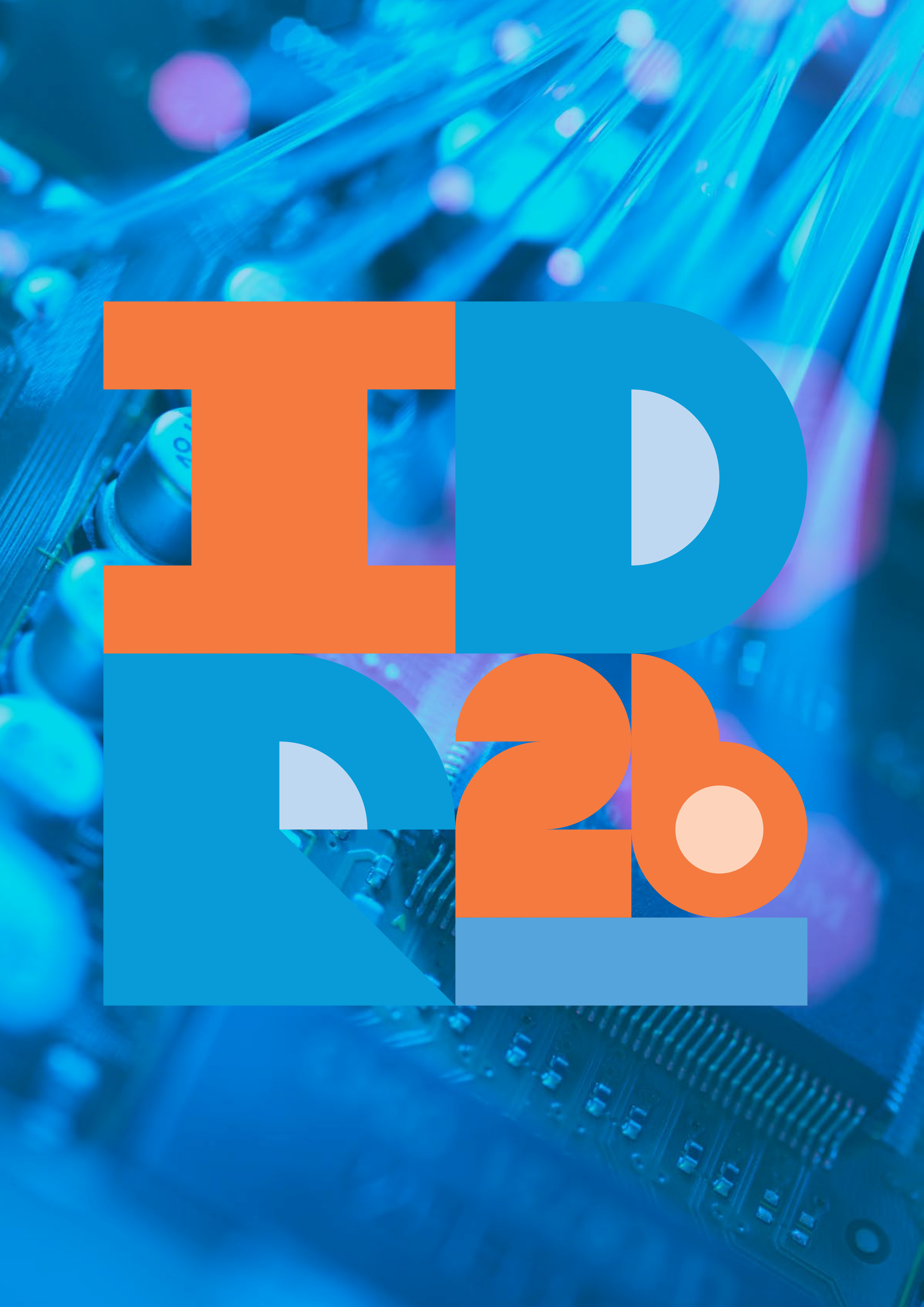
INDUSTRIAL DEVELOPMENT REPORT 2026

THE FUTURE OF INDUSTRIALIZATION

BUILDING FUTURE-READY INDUSTRIES FOR SUSTAINABLE DEVELOPMENT

FULL REPORT

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna, November 2025



Contents

PART B

REGIONAL PERSPECTIVES

PART C

ANNEXES AND REFERENCES

LIST OF BOXES

LIST OF FIGURES

LIST OF TABLES

FOREWORD

Gerd Müller

Director General
United Nations Industrial Development Organization (UNIDO)

The world is changing at an unprecedented pace as several megatrends are reshaping the global economy – changes which present challenges, but also unprecedented opportunities for development. These range from long-term structural transformations such as the demographic shifts, climate change, the energy and green transition, and the transformation of food production systems, to fast-emerging forces like the rise of AI and rapidly evolving geopolitical and trade dynamics.

Unfortunately, recent years and current events have seen setbacks which put decades of hard-won development progress at risk. The *Industrial Development Report 2026* underscores that, warning that if current trends continue our development goals will not be met.

But the current path is not set in stone. Our Industrial Development Report also shows that if we invest in the many opportunities for sustainable industrialization, we can create a better world for current and especially future generations. If decisive measures are taken, developing countries can lift more than half a billion people out of poverty by 2050, including 155 million escaping extreme poverty. And ending hunger is possible - we have the knowledge and the technology, and the financial resources are there; it is merely a question of political will and targeted investments. Crucially, we can achieve all this and at the same time decouple industrial growth from carbon emissions. Clean technology, critical minerals, electric mobility, semiconductors, and the bioeconomy are some sectors where the foundations of tomorrow's industrial development are being laid, allowing for the chance to leapfrog old development models directly into a sustainable future.

As we stand at this crossroads, we must choose our path forward and as a global community ask ourselves: what kind of future do we want, and how do we get there? We live in a world that is more interconnected than ever and creating a brighter future for all with shared prosperity means adopting a broader and more long-term perspective. UNIDO is looking ahead to the next quarter century and reimagining the future of industry in 2050, setting the course for sustainable industrial development in the decades ahead.

Industrial policy is back on the agenda in countries around the world and this reflects the growing recognition that industry is the key driver of job creation, income generation and improved living standards worldwide – a catalyst for progress and development, offering promising perspectives for the future.

The IDR26 also informed UNIDO's new Vision 2050: *The Future of Industries for Development*, which presents UNIDO's strategic offer on how to support Member States and partners in realizing UNIDO's Vision of creating a fair global economy in which poverty and hunger are eradicated and where industries create decent jobs, foster innovation and promote prosperity while protecting people and the planet.

Turning these ambitions into reality demands a new scale of investments and joint action nationally, regionally and globally. It is a question of collective responsibility and international solidarity. The time to act is now. Together, we can shape a future where industry continues to provide the foundations for development for people, the planet and future generations.

EXECUTIVE SUMMARY

The world economy stands at a critical turning point. The current development trajectory is increasingly unsustainable, and global shocks, from the COVID-19 pandemic to the climate crisis and ongoing conflicts, continue to reverse years of development gains, especially in the most vulnerable regions. The prospects for achieving the United Nations 2030 Agenda for Sustainable Development have never been bleaker.

UNIDO projections suggest that if current trends persist, more than 3 billion people will remain in poverty by 2050, including 700 million in extreme poverty. Over 300 million will continue suffering from undernourishment. Environmental degradation is set to worsen: under current policies, global temperatures could rise by 2.3°C above pre-industrial levels, with CO_2 emissions continuing to climb and threatening life on Earth.

These impacts will impact low- and middle-income economies the hardest, deepening global inequality. Nearly 95 per cent of the world's extreme poor are projected to live in these economies—predominantly in Africa—while food insecurity will remain concentrated in Africa and Southern Asia, the regions most exposed to severe climate risks.

It is not too late to change course. Manufacturing must be placed at the heart of this transformation. Industrialization has historically been one of the most powerful drivers of poverty reduction, food security and job creation. Today, manufacturing continues to serve as the backbone of industrial ecosystems that create and diffuse green innovation, generate productive employment and strengthen resilience to shocks.

Today, industrial capabilities remain unevenly distributed. While some developing economies have made notable progress in advancing their industrial sector, others have stagnated or even deindustrialized. Most developing regions are under-represented in their global industrial output relative to their population size. Future industrialization must aim to close three interrelated gaps: (i) an intensity gap, by increasing developing economies' share of global output; (ii) a productivity gap, by boosting technology adoption and upgrading; and (iii) an environmental efficiency gap, by accelerating the greening of industrial ecosystems.

The current wave of industrialization will unfold against the backdrop of five transformative megatrends: (i) the energy and green transition; (ii) the rise of AI and digitalization; (iii) the reconfiguration of global value chains; (iv) demographic shifts, and (v) the transformation of food systems. These megatrends create both risks and opportunities. Developing countries face mounting pressures to create decent jobs, especially for women and youth, and to invest in climate mitigation and adaptation. At the same time, they can seize new windows of opportunity arising from global demand, local resources, capabilities and institutions.

The challenges and opportunities of future industrialization vary widely across regions, and so too must the responses. Reflecting this diversity, the IDR26 provides region-specific analyses that identify key bottlenecks of industrial development and highlight emerging sectoral opportunities, ranging from clean technology manufacturing and critical minerals to the bioeconomy.

Real progress will depend on coordinated action across seven priority areas to strengthen industrial ecosystems: (i) advancing physical and digital infrastructure; (ii) strengthening institutions' and government capacity; (iii) developing skills for the green and digital transition; (iv) empowering the Global South through technological upgrading and innovation; (v) deepening regional integration and resilience amid rapidly shifting global trade patterns; (vi) prioritizing environmental sustainability, industrial decarbonization, resource efficiency and circularity, and (vii) mobilizing finance for industrial transformation.

To explore industry's possible pathways for the future of industry, the IDR26 models two alternative scenarios to the current trajectory. The *industrialization push scenario* evaluates the impact of ambitious, coordinated policies aimed at accelerating industrial growth. The *clean energy and just industrialization scenario* builds on the *industrialization push scenario* by integrating sustainability and equity objectives alongside industrial expansion.

Under the *clean energy and just industrialization scenario*, developing countries could lift more than half a billion people out of poverty by 2050, with 50 million fewer suffering from hunger. Expanding renewable energy and phasing out coal would help decouple industrial growth from CO_2 emissions, enabling developing countries to reduce emissions at a faster pace than advanced economies. Developing countries could regain ground in global manufacturing, narrowing the gap with the global technological frontier.

These megatrends and challenges are global in scope, and so must be the response. No country can achieve a clean and just industrial transition on its own. Global solidarity and coordinated action are essential in three priority areas: (i) building fair and sustainable supply chains through stronger standards, effective monitoring and support for developing-country producers; (ii) limiting climate breakdown by scaling up renewable energy, clean technology, adaptation resource efficiency and circularity, backed by access to finance, skills and technology, and (iii) eradicating poverty and hunger by boosting manufacturing productivity, creating quality jobs, and promoting inclusive and sustainable agro-industrialization.

The window for action remains open. Only through bold national efforts and renewed global solidarity can the international community build a more inclusive, sustainable and resilient world for all.

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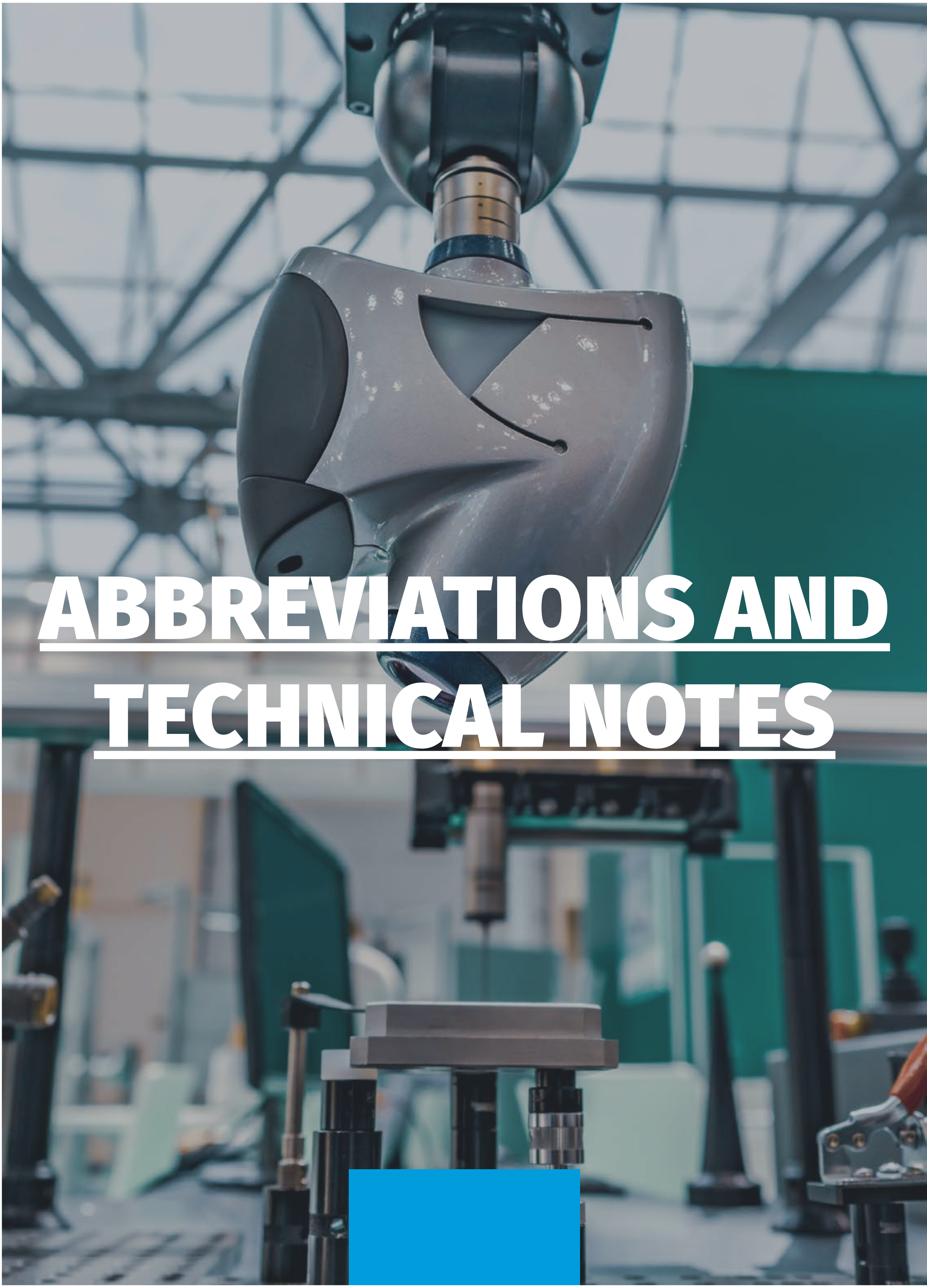


ABBREVIATIONS AND TECHNICAL NOTES

4IR:	Fourth Industrial Revolution
AfCFTA:	African Continental Free Trade Area
AI:	Artificial intelligence
APIs:	Active pharmaceutical ingredients
ATP:	Assembly, testing and packaging
CA:	Central Asia
CO_2:	Carbon dioxide
CP:	Current path
CSA:	Climate-smart agriculture
EU:	European Union
EVs:	Electric vehicles
FDI:	Foreign direct investment
GDP:	Gross domestic product
GVCs:	Global value chains
HIIEs:	High-income industrial economies
HINGEs:	High-income industrializing economies
IAIPs:	Integrated agro-industrial parks
ICT:	Information and communication technology
IDR:	Industrial Development Report
IFs:	Denver University's Pardee Institute for International Futures
IoT:	Internet of Things
IT:	Information technology
KIBS:	Knowledge-intensive business services
LAC:	Latin America and the Caribbean
LDCs:	Least developed countries
LLMIEs:	Low-income and lower middle-income economies
MNEs:	Multinational enterprises
MSMEs:	Micro-, small and medium-sized enterprises
MVA:	Manufacturing value added
OEMs:	Original equipment manufacturers
PPPs:	Public-private partnerships
PV:	Photovoltaic
R&D:	Research and development
RVCs:	Regional value chains
SDGs:	Sustainable Development Goals
SEZs:	Special economic zones
SMEs:	Small and medium-sized enterprises
SOEs:	State-owned enterprises
TVET:	Technical and vocational education training
UMIEs:	Upper middle-income economies
UNIDO:	United Nations Industrial Development Organization

- References to dollars ($) are to United States dollars, unless otherwise indicated.
- In-text values in non-$ currencies are generally followed by a $-approximation, based on the average exchange rate for the relevant year.
- Components in tables may not sum precisely to the totals shown due to rounding.

PART A
The Future of Industrialization

CHAPTER 1 THE FUTURE WORLD AND THE ROLE OF INDUSTRIAL DEVELOPMENT

The global economy is on an unsustainable path. If current trends continue, over 3 billion people—nearly one-third of the world's population—will live below the poverty line by 2050, including 700 million in extreme poverty and 303 million suffering from hunger. Global temperatures are projected to rise by 2.3°C above pre-industrial levels, leading to more frequent and severe climate-related disasters and loss of life. These challenges will disproportionately impact today's low- and lower middle-income economies, where poverty, hunger and climate vulnerability are already most acute. Reversing this trajectory requires placing sustainable industrialization at the centre of development strategies. Manufacturing remains the most powerful engine of growth, innovation, job creation and socio-economic resilience. Yet the countries most in need of industrial transformation remain marginalized within the global industrial landscape: by 2050, under current conditions, low- and lower middle-income economies will account for only 16 per cent of global manufacturing output, despite representing 55 per cent of the world's population. Without decisive action, the divides in manufacturing productivity and environmental performance between the Global South and Global North will continue to widen, entrenching global inequalities.

Carlos Lopes

"Industrialization offers a powerful tool for poverty reduction and for addressing inequalities often exacerbated by rent-seeking practices in many developing countries. Strategically developed backward and forward linkages can help diversify economies and reduce vulnerability to external shocks. Moreover, it provides a pathway for leapfrogging towards a green economy, integrating sustainability and innovation into economic growth from the outset."

Honorary Professor at University of Cape Town and former UN Under-Secretary General and Executive Secretary, Economic Commission for Africa

1.1 OUR WORLD IN 2050

The global economy is evolving at an unprecedented pace. Rapid technological advances, including the rise of artificial intelligence (AI), demographic shifts, rising inequality, growing geopolitical tensions and the accelerating depletion of natural resources and climate change impacts are reshaping economies and societies, and fundamentally transforming the landscape of industrial development for years to come.

Twenty-five years into the new century, the international community stands at a crossroads. Since the adoption of the United Nations' 2030 Agenda for Sustainable Development in 2015, the global landscape has changed profoundly. At that time, the world economy was emerging from the aftermath of the 2008 Great Recession, and extreme poverty rates and hunger were still declining steadily each year.

Today, the outlook is far less optimistic. Global disruptions, such as the COVID-19 pandemic, climate shocks and regional conflicts, have substantially altered the path of progress, reversing years of development gains, particularly in the world's most vulnerable regions. Without decisive and coordinated action, the prospects for achieving the Sustainable Development Goals (SDGs) have deteriorated considerably.

If current trends persist, the world in 2050 faces a daunting outlook. Projections from Denver University's International Futures (IFs) model indicate that, under *current path* scenario[1], close to 3,15 billion people will live below the USD 8.30 poverty line, and 697 million in extreme poverty (below the USD 3.00 poverty line) by 2050. This represents 32 per cent of the global population (7 per cent in the case of extreme poverty). Similarly, 303 million people, or 3.1 per cent of the world's population, will suffer from undernourishment (see Figure 1.1). At the same time, environmental conditions are expected to deteriorate further, with projections showing that under existing policies, global temperatures could rise by approximately 2.3°C, and CO_2 emissions will reach 38 gigatonnes (Gt). This rise in temperature is projected to drive higher mortality rates, resulting in an estimated 13.5 million additional deaths worldwide by 2050.[2]

Figure 1.1 **What can we expect for 2050?**

3.15 billion people under the poverty line and nearly 700 million in extreme poverty	303 million malnourished people	2.3°C global temperature rise and 38 Gt of CO_2 emissions
32% and 7% of global population, respectively	3.1% of global population	13.5 million additional deaths due to global warming

Note: Projections on poverty, hunger and global temperature by 2050 are based on the IFs model *current path* scenario (see Annex A.1). Extreme poverty is measured by the number of people projected to be living under the USD 3.00 poverty line. Middle-income poverty is measured by the number of people projected to be living under the USD 8.30 poverty line. Food insecurity is measured by the population projected to be malnourished. Additional climate-related fatalities are based on the UNDP Human Climate Horizon moderate Representative Concentration Pathway (RCP 4.5) scenario, where global warming reaches around 2°C by mid-century.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model and UNDP Climate Human Climate Horizon.

Under the *current path*, poverty and hunger will continue to remain severe. These outlooks stand in sharp contrast to the SDG targets of eradicating poverty and achieving zero hunger by 2030. This, in turn, threatens to undermine global stability and human dignity. The persistence of these challenges at this scale will not just be a moral failure, but a profound risk to international peace and security, given that large populations without access to basic needs and opportunities can become sources of instability and conflict.

The most acute forms of social deprivations will be heavily concentrated in specific regions, further reinforcing global inequalities. Nearly 95 per cent of the world's extremely poor are projected to reside in low-income and lower middle-income economies (LLMIEs), with 72 per cent of this total residing in Africa. Similarly, food insecurity is expected to predominantly affect LLMIE regions, with Africa accounting for 57 per cent of the world's malnourished population, followed by South Asia at 22 per cent (see Figure 1.2, Panels A and B).

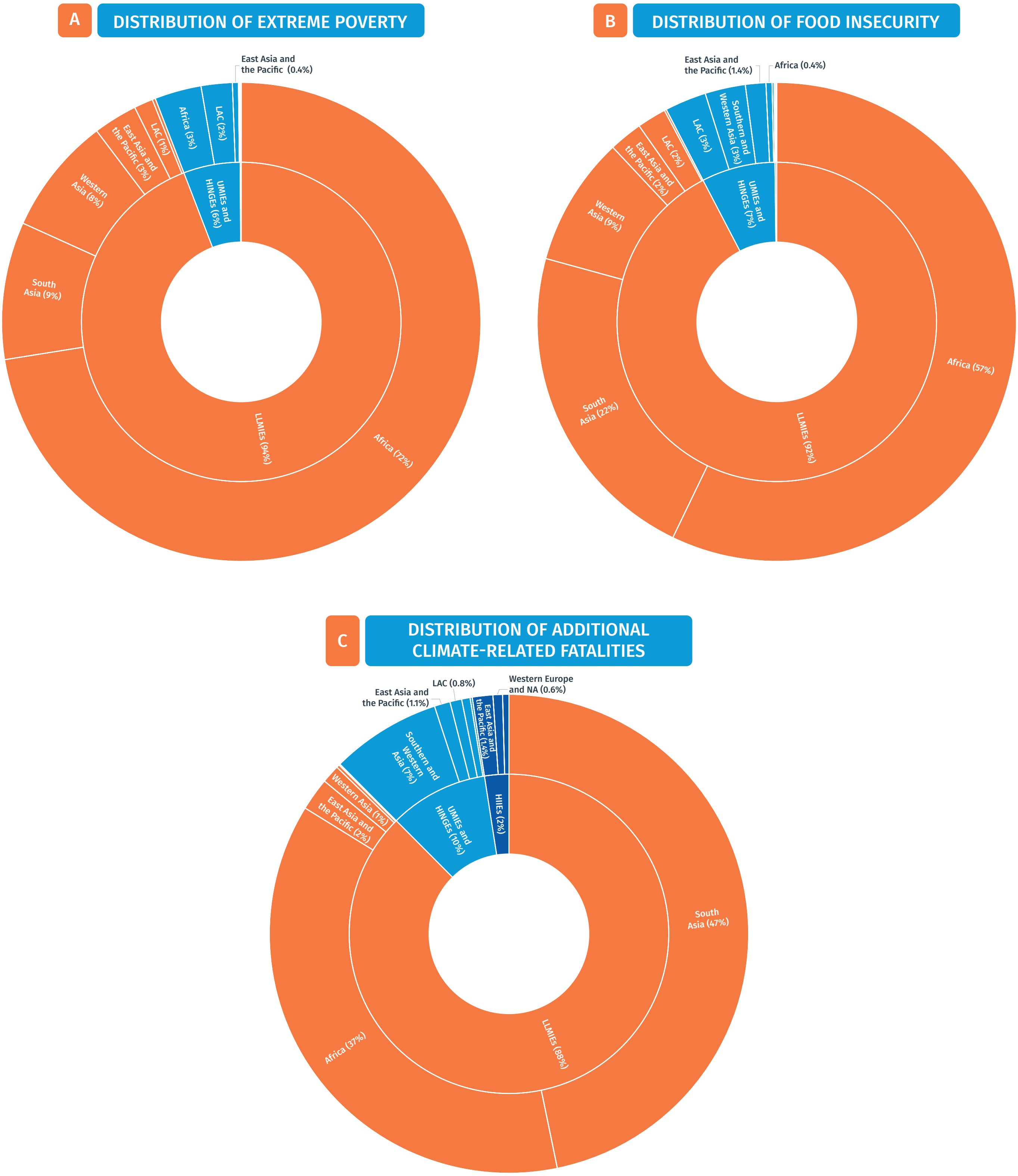
Climate change and resource scarcity exacerbate the already bleak outlook. Regions struggling with high levels of poverty and malnutrition are also projected to face the most severe climate-related impacts. According to the UNDP Human Climate Horizon,[3] by 2050, populations living in countries with the greatest increases in climate-related fatalities will be concentrated in LLMIEs, primarily in South Asia and Africa (see Figure 1.2, Panel C). These regions, already grappling with severe socioeconomic challenges, are expected to experience disproportionate harm from climate-induced health risks, with increases in climate-related deaths far exceeding the global average.

Continuing current practices is no longer an option. The prevailing trajectory is clearly unsustainable and calls for urgent change. Building a more equitable and sustainable global economy requires more than simply pursuing economic growth alone. It requires simultaneously addressing economic inequalities, social injustices and environmental challenges, while fostering a more balanced relationship between the Global North and Global South. Such a comprehensive approach requires a fundamental rethinking of existing development paradigms to ensure inclusive progress for all nations and communities.

Where should efforts begin to redirect the current trajectory? Historically, industrialization has proven an effective strategy for reducing poverty, alleviating malnutrition and creating productive employment opportunities. The experiences of countries such as the Republic of Korea and China illustrate how planned development measures and targeted industrial policies can catalyse significant economic and social transformations. In the Republic of Korea, government-led strategies promoting export-oriented industrialization since the 1960s have resulted in notable reductions in poverty and inequality. The transition from agriculture to manufacturing has fuelled high growth rates, generated structural economic changes, and lowered poverty levels.[4] Likewise, China's remarkable progress in poverty alleviation over the past four decades is closely tied to its rise as a global industrial powerhouse. Nearly 800 million people were lifted out of poverty[5]—accounting for nearly 75 per cent of the global reduction in extreme poverty—while the share of Chinese manufacturing in global production surged from 3 per cent to over 30 per cent between 1990 and 2022.

Recent academic research reinforces these historical lessons. There is a strong link between industrialization and its critical role in poverty alleviation.[6] Studies indicate that structural shifts towards a more diversified, high-output manufacturing sector, coupled with productivity gains, are key drivers of poverty reduction, particularly in the developing regions of Asia and sub-Saharan Africa. Evidence suggests that economic policies prioritizing industrial development are essential for enhancing the poverty-reducing impact of economic growth, highlighting the critical link between industrial policy and improved living standards.

Figure 1.2 **Where will extreme poverty, malnourishment and climate-related fatalities be concentrated in 2050?**



Note: Projections on poverty, hunger and global temperature by 2050 are based on IFs model *current path* scenario (see Annex A.1). Extreme poverty is measured by the number of people projected to be living under the USD3.00 poverty line. Food insecurity is measured by the population projected to be malnourished. Additional climate-related fatalities are based on a moderate Representative Concentration Pathway scenario (RCP 4.5), where global warming reaches around 2°C by mid-century. Only countries with a projected increase in climate-related deaths are included. LLMIEs = Low- and lower middle-income economies; UMIEs = Upper middle-income economies; HINGEs = High-income industrializing economies; HIIEs = High-income industrial economies; CA = Central Asia; LAC = Latin America and the Caribbean.

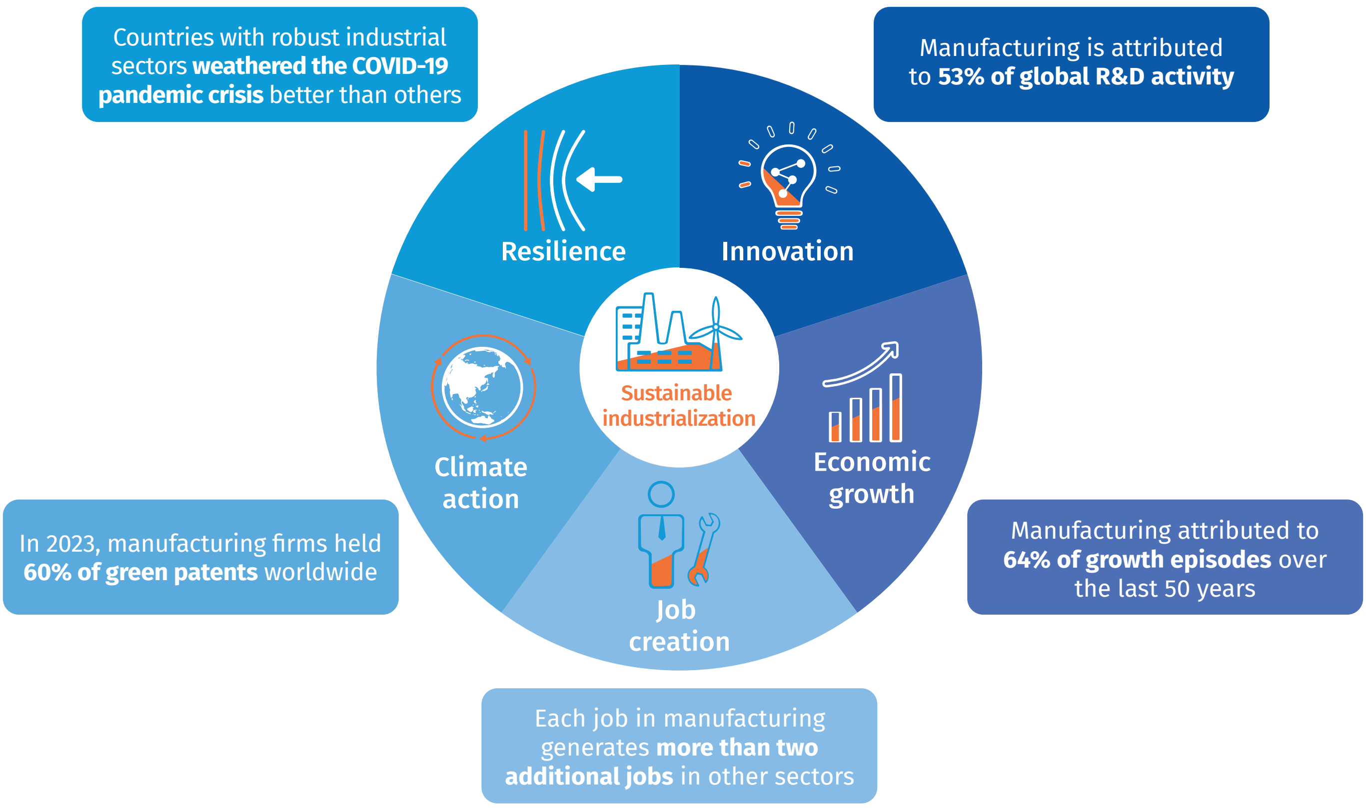
Source*:* UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model and UNDP (2025a).

1.2 INDUSTRY IS ESSENTIAL FOR DEVELOPMENT

There is a host of compelling reasons why industrialization is central to development. Traditionally, it has been recognized as an engine of economic growth, job creation and foreign exchange earnings. These benefits are rooted in the manufacturing sector's ability to exploit economies of scale, create productive linkages and facilitate technological spillovers.[7] By advancing into higher value added, more sophisticated, and diversified economic activities, industrialization becomes a cornerstone of socioeconomic progress. Furthermore, it generates more employment opportunities, thereby raising household incomes, which in turn stimulates domestic consumption and drives further economic expansion. Additionally, the development of export-oriented industries generates foreign exchange inflows, which are essential for economic stability and sustained growth.

New evidence confirms industrialization's crucial role for sustainable development. In recent years, the focus has shifted to other benefits associated with industrialization, such as its role as a driver of innovation, a hub for green technologies, and a source of resilience against economic shocks. The manufacturing sector remains central to research and development (R&D) accounts for the majority of new technological patents, and leads in the advancement of green technologies. Strong industrial capabilities boost resilience during crises, as exemplified during the COVID-19 pandemic, where countries with robust manufacturing sectors were better able to navigate sudden socioeconomic disruptions. Recent UNIDO research provides empirical evidence on the channels through which industry contributes to development across five critical dimensions (see Figure 1.3). Collectively, these channels generate extensive positive linkages between SDG 9 (industry, innovation and infrastructure) and all the other SDGs.[8]

Figure 1.3 **How does industry address global challenges?**



Source: UNIDO elaboration based on (i) UNIDO (2023a); (ii) Lavopa and Riccio (2024) ; (iii) Lavopa and Riccio (2025); (iv) Lavopa and Menéndez (2023); (v) Lavopa and Donnelly (2023).

Expanding the industrial sector does not automatically lead to improvements across all socioeconomic and environmental dimensions. Countries can follow different industrialization pathways. The benefits of industrialization depend on how it is managed and integrated into national development strategies and policies. For instance, prioritizing heavily polluting industries without strong environmental regulations can cause severe ecological harm, while neglecting labour rights may result in poor working conditions and limited progress in poverty alleviation.

Industrialization must follow an environmentally sustainable trajectory to advance sustainable development. This requires weaving sustainability into the design and implementation of industrial policies, ensuring that economic growth does not deplete natural resources or cause severe environmental degradation. Furthermore, sustainable industrial development should prioritize inclusive job creation by generating high-quality employment opportunities that provide fair wages and safe working conditions. This dual approach not only promotes economic prosperity but also safeguards the health and well-being of both people and the environment.

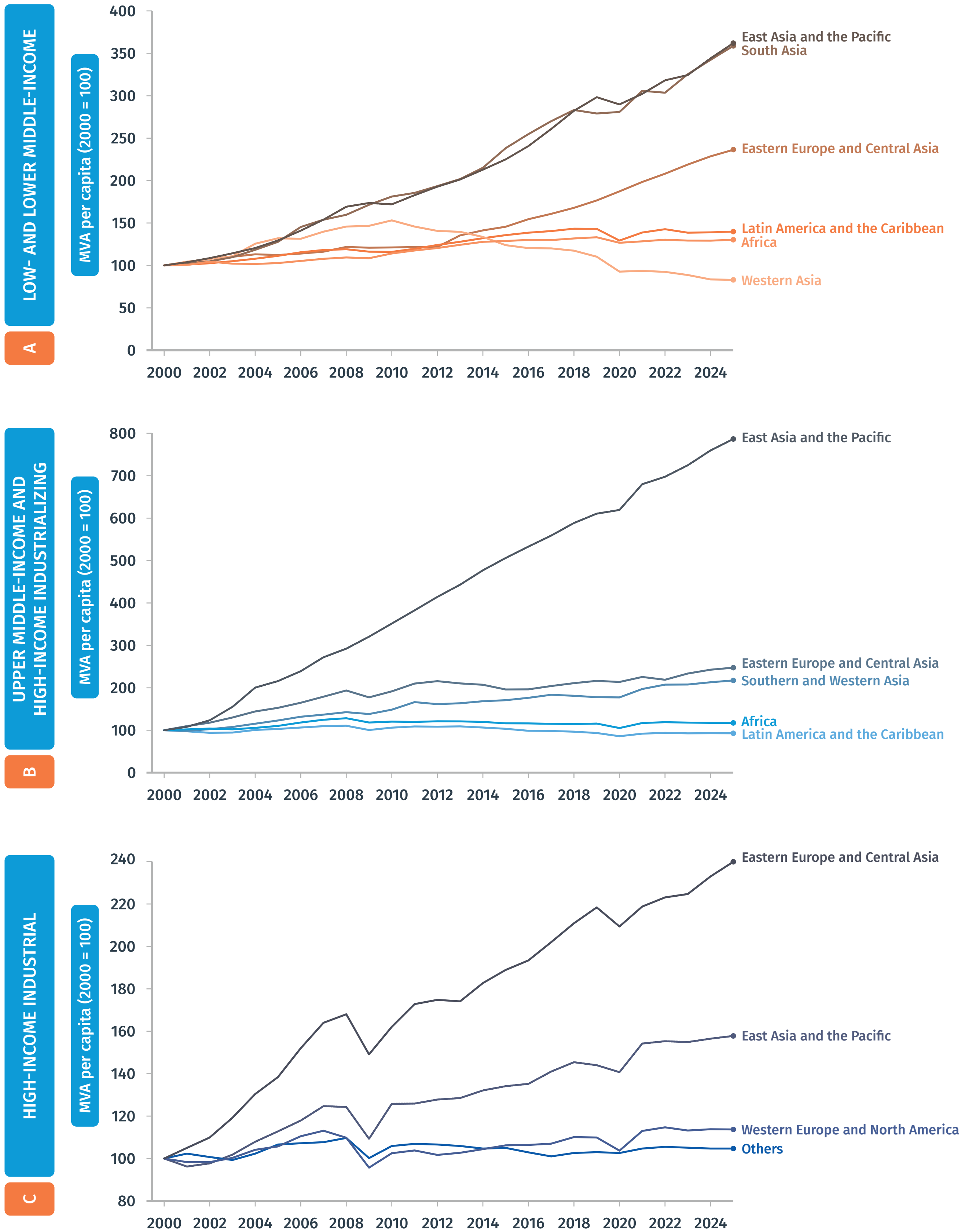
Industrialization in the Global South is essential for addressing socioeconomic challenges. Given the projected high rates of extreme poverty and malnutrition in many LLMIEs, cultivating a vibrant and dynamic manufacturing sector will be indispensable. Industrialization must form the backbone of their domestic strategies, with a focus on sectors that offer high growth potential and the capacity to generate substantial employment. By building robust manufacturing capabilities, these countries can more effectively integrate into diverse global and regional value chains, thereby enhancing their economic resilience and growth prospects.

At the same time, industry worldwide must become greener and actively contribute to global climate objectives. This raises critical questions about current trajectories: is industrial growth in LLMIEs sufficient, and is the industrial sector becoming environmentally sustainable at the global level at the pace needed? Addressing these questions through targeted and strategic industrial policies will be crucial for realizing the broader vision of future sustainable development.

1.3 THE INDUSTRIALIZATION GAP

Industrial dynamics have varied considerably across countries and regions over the last decades. Despite the recognized importance of industry for development, recent trends reveal significant divergences in industrial trajectories across countries and regions. While some parts of the developing world have successfully expanded their industrial sector and accelerated innovation, others have faced stagnation or even deindustrialization (see Figure 1.4). Countries in the Asia-Pacific region, for instance, have witnessed remarkable growth in manufacturing value added (MVA) per capita, particularly upper middle-income economies (UMIEs), with China leading the way. In stark contrast, Africa and Latin America have experienced slower industrial growth across all income levels. These trends highlight the disparities in industrial progress, both across regions and income groups.

Figure 1.4 **Industrial dynamics in the first quarter of the 21st century**



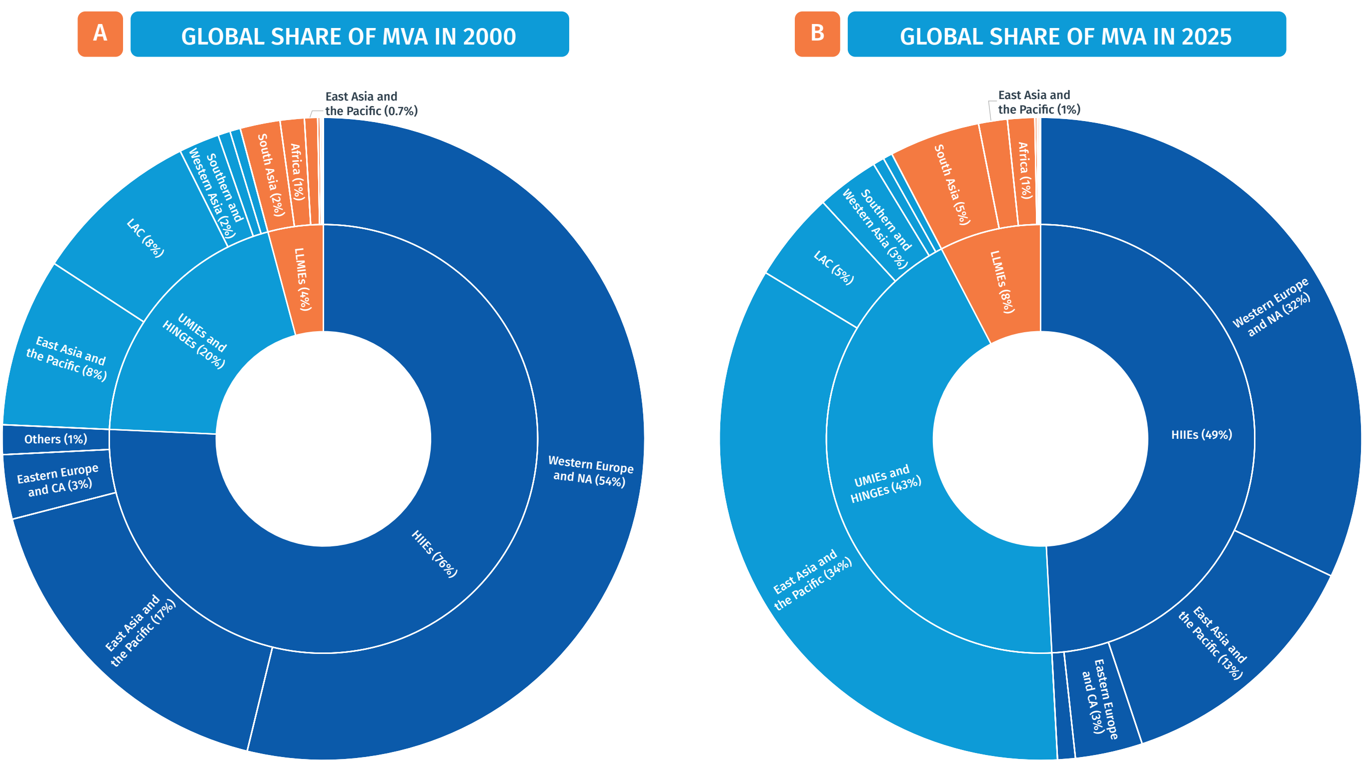
Note: Regional averages are calculated using population weights. Values indexed to 2000 (2000 = 100). See Annex A.3 for the list of economies included in each group. MVA = Manufacturing value added.

Source: UNIDO elaboration based on UNIDO (2025a).

Divergent industrial dynamics have led to stronger concentrations of industrial production in specific regions and countries. In 2000, high-income industrial economies (HIIEs) dominated global MVA, accounting for 76 per cent of global production. Within this group, Western Europe and Northern America alone represented 55 per cent of global MVA (Figure 1.5). By 2025, this concentration had shifted, and UMIEs and HINGEs doubled their share of global MVA, jumping from 20 per cent to 44 per cent. This increase is almost entirely attributable to East Asia and the Pacific, particularly China, whose global MVA share rose from 9 per cent in 2000 to 35 per cent in 2025. This surge came at the expense of consolidated HIIEs and other developing regions, such as LAC and Western Asia, which saw their relative positions decline or stagnate during this period, further deepening the global imbalance.

The growing concentration of industrial production becomes particularly striking when assessed relative to population size. The manufacturing sector's capacity to drive socioeconomic development ultimately depends on the intensity of the industrialization process in relation to each country's population. IDR 2026 proposes a novel indicator to capture this feature in a manner comparable across countries: the industrial intensity index, defined as the percentage ratio between a region's share of global MVA and its share of the global population. A value below 100 per cent indicates low industrialization intensity, meaning the region is under-represented in the global industrial landscape relative to its population size. The results are clear: in ten out of the 12 developing regions assessed, the contribution to global MVA is much lower than expected when looking at their share of the world's population (Figure 1.6). Among LLMIEs, the average industrial intensity index is just 20 per cent, implying a significant under-representation in global industrial production. Africa, Eastern Europe and Central Asia, South Asia, and LAC lie far below the equal proportion line. In contrast, East Asia and the Pacific (and to a lesser extent, Western Asia) are the only two developing regions with values above 100 in the figure, reflecting strong industrial specialization. Among HIIEs, the result is reversed: Western Europe and Northern America account for over three times their population share in global manufacturing output.

Figure 1.5 **The changing structure of global industrial production**



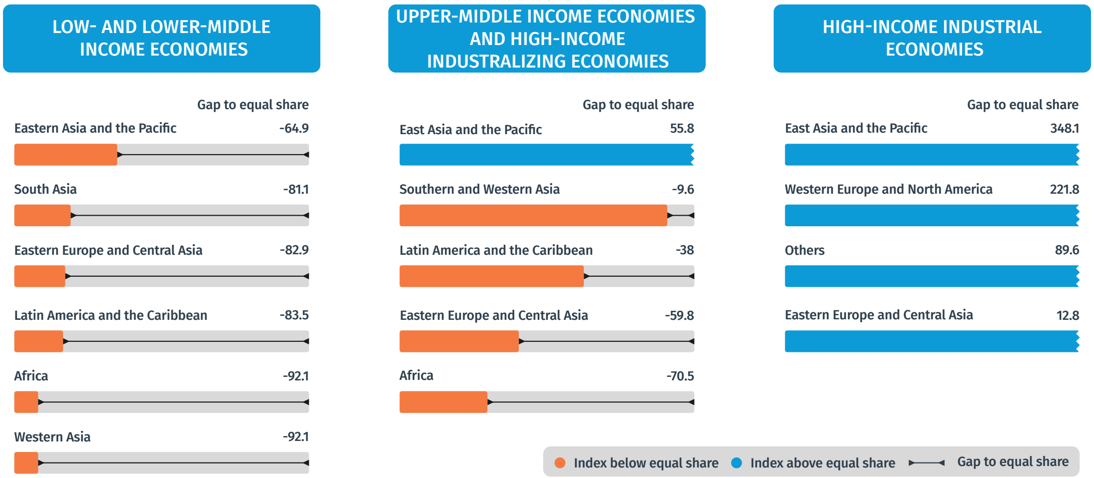
Note: LLMIEs = Low- and lower middle-income economies; UMIEs = Upper middle-income economies; HINGEs = High-income industrializing economies; HIIEs = High-income industrial economies; CA = Central Asia; LAC = Latin America and the Caribbean.

Source*:* UNIDO elaboration based on UNIDO (2025b).

The industrial intensity gap partially reflects technological backwardness. A key structural factor behind developing countries' underrepresentation in the global industrial landscape is the technology gap separating them from advanced economies. One straightforward way to assess the impact of technological differences is to compare every region's industrial labour productivity with the average productivity observed in HIIEs. Higher productivity in HIIEs reflects both greater uptake of new technologies and a pattern of specialization in more productive manufacturing industries.

Most developing regions fail to reach even one-third of the productivity levels observed in HIIEs. In all cases except one, developing countries, on average, do not reach one-third of HIIEs' productivity level (Figure 1.7). Productivity levels in LLMIE's are particularly low, at barely 5 per cent of the frontier level in Africa and LAC, and below 15 per cent in other regions within this group. Among UMIEs and HINGEs, the highest scores are recorded in East Asia and the Pacific (34 per cent) and Western Asia (39 per cent).

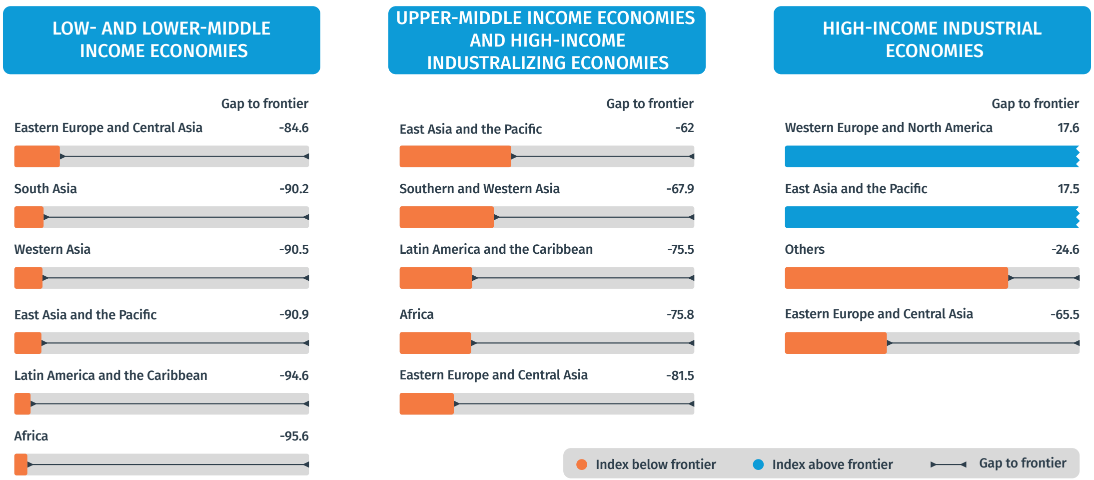
Figure 1.6 **Industrial intensity gap: Developing regions produce less than they should, given their population size**



Note: The industrial intensity index is defined as the percentage ratio of each region's share in global manufacturing value added (MVA) and its share in world population. A value of 100 indicates an equal proportion. Values below 100 indicate industrial sub-representation. The bars refer to 2025.

Source: UNIDO elaboration based on UNIDO (2025b).

Figure 1.7 **Productivity gap: Developing regions lag behind the technological frontier**



Note: The industrial relative productivity index is defined as the percentage ratio of each region's manufacturing value added (MVA) per worker measured in 2017 USD, to the average of high-income industrial economies (HIIEs). A value of 100 indicates that the region is at the frontier in terms of industrial labour productivity. The data refer to 2025. The regional averages are weighted by countries' shares of manufacturing employment.

Source: UNIDO elaboration based on UNIDO (2025b) and ILO (2025).

Developing countries lag significantly in terms of environmental efficiency. A simple proxy for environmental efficiency in industrial processes is MVA produced per unit of emissions, measured against the frontier level. Using the average value of HIIEs as a benchmark suggests that most developing regions remain well below the frontier levels (Figure 1.8). For example, environmental efficiency in Eastern Europe, Central Asia and South Asia is less than one-third of the frontier level across LLMIEs, UMIEs and HINGEs. In some UMIEs, such as in Africa and Western Asia, environmental efficiency remains below 25 per cent. One notable exception is LAC, where environmental efficiency is relatively high, although still below the frontier.

Low environmental efficiency does not imply greater climate responsibility. In terms of absolute CO_2 emission volumes, advanced economies still account for a substantial share of global industrial emissions. The environmental efficiency gap should not obscure the fact that high-income industrial economies remain the largest contributors to cumulative global emissions and continue to emit far higher per capita levels. However, as developing countries' industrialize, this gap highlights the urgency of integrating deep decarbonization strategies into their industrialization efforts, particularly by anchoring them in renewable energy sources from the outset to limit emissions and reduce dependence on fossil fuels.

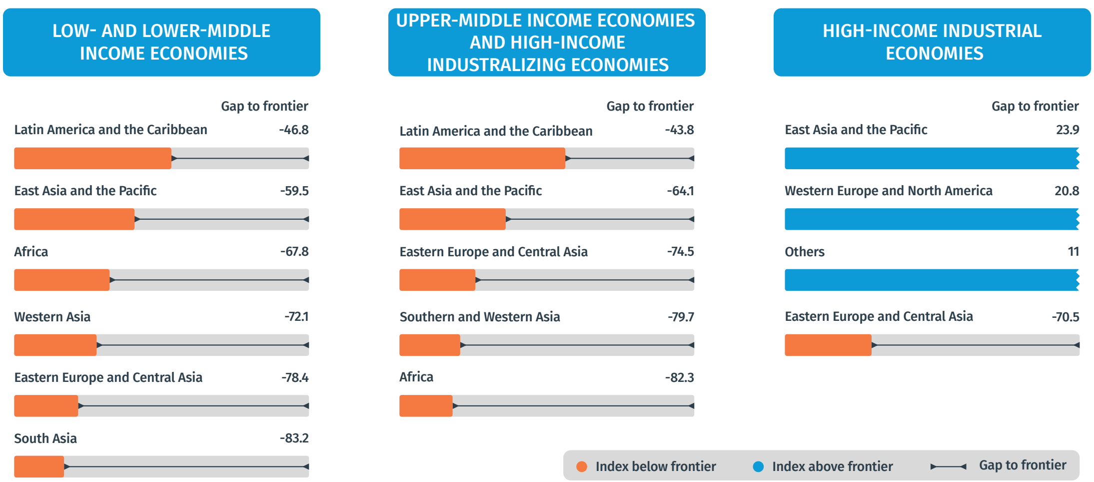
Future industrialization in developing countries must address three critical gaps. The current industrial landscape reveals three interrelated gaps that disproportionately affect developing countries:

- **Industrial intensity gap**: Most developing countries account for a small share of global industrial production despite their large populations.
- **Productivity gap**: Reflects low levels of technological absorption and industrial upgrading.
- **Environmental efficiency gap**: Industrial production tends to be more carbon-intensive.

These gaps represent fundamental structural challenges that constrain developing countries' ability to leverage industrialization as a driver of poverty reduction, job creation, and sustainable development. The gaps also reveal that, despite some progress in certain regions, most developing countries remain excluded from the benefits of modern industrial development.

The critical question that arises is whether these gaps will narrow if business continues as usual. Understanding the trajectory of these gaps under current trends is essential for determining the urgency and scale of action needed to ensure that industrialization becomes an engine of inclusive and sustainable development in regions where it is most needed. Addressing these gaps can generate positive spillovers. Strengthening industrial intensity can lead to learning dynamics that will accelerate local innovation and help close the productivity gap with advanced economies. Enhanced local innovation can lead to more effective solutions to address environmental gaps through green technologies better suited to the context in which developing countries' industrial firms operate.

Figure 1.8 **Environmental efficiency gap: Developing regions produce less output per unit of manufacturing emissions than advanced economies**



Note: The industrial environmental efficiency index is defined as the percentage ratio of each region's manufacturing value added (MVA) per unit of CO_2 emissions measured in 2017 USD, and the average value of high-income industrial economies (HIIEs). A value of 100 indicates that the region is at the frontier in terms of industrial environmental efficiency. The data refer to 2025. The regional averages are weighted by countries' share in regional MVA.

Source*:* UNIDO elaboration based on UNIDO (2025b) and IEA (2025a).

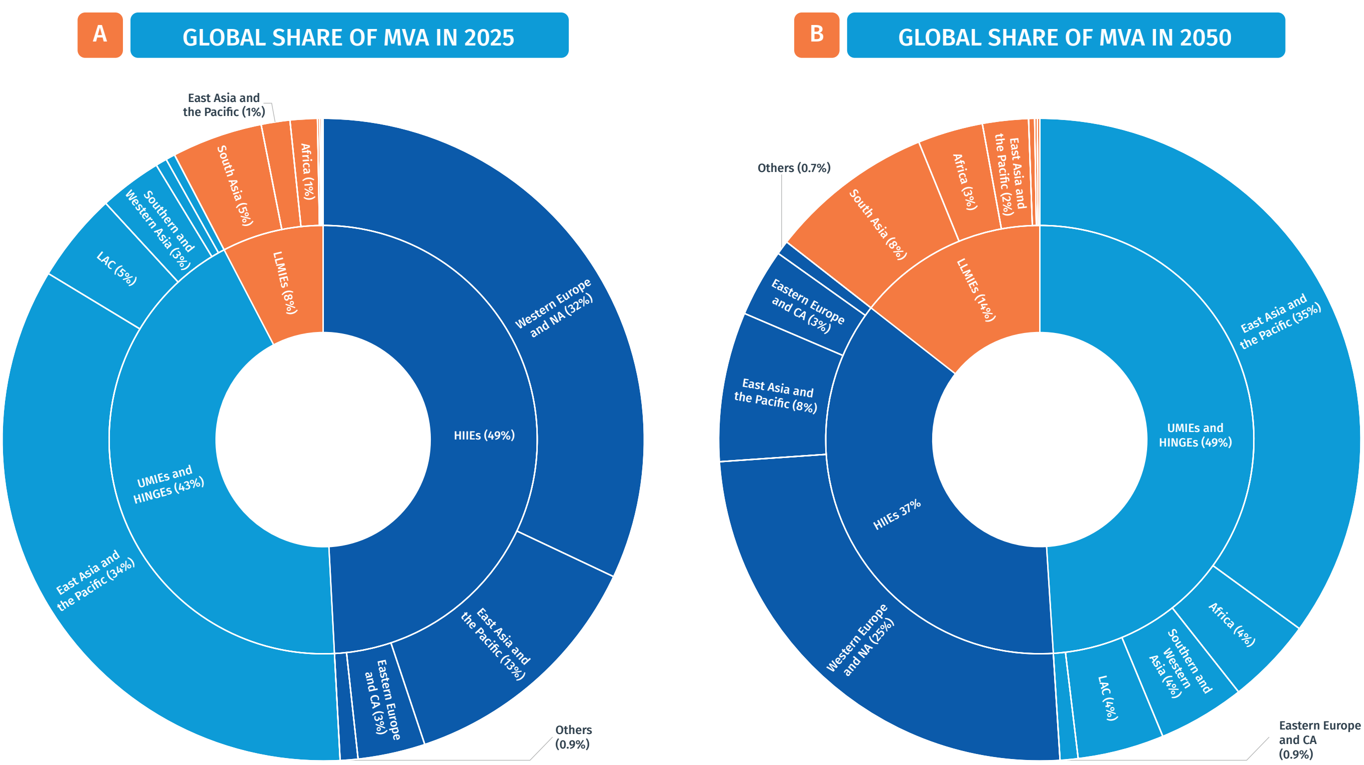
1.4 THE FUTURE OF INDUSTRY UNDER THE *CURRENT PATH*

If no action is taken, the future industrial landscape will remain highly unequal. Projections based on Denver University's IFs model suggest that, under the *current path* scenario, the industrialization gaps observed today will persist, or even widen, by 2050. While some regions are expected to maintain or moderately improve their industrial performance, many countries most in need of industrial development will remain marginalized.

Industrial dynamism will continue to remain highly uneven across regions. Projections of MVA per capita over the next 25 years indicate varying speeds of industrialization (Figure 1.10). Eastern Europe and Central Asia are expected to lead across all income groups, followed by South Asia among the developing country group. East Asia is projected to continue its upward trend, although at a slower pace than in previous decades. By contrast, regions such as Africa, LAC and Western Asia—especially among UMIEs and HINGEs—are expected to see slow or stagnant growth in MVA per capita and are unlikely to close the industrialization gap.

The global structure of industrial production is not projected to change markedly. The share of global manufacturing output produced by all UMIEs and HINGEs is expected to increase from 41 per cent to 44 per cent, surpassing that of HIIEs and reinforcing the pattern established in recent decades (Figure 1.9). Developing East Asia and the Pacific is expected to stabilize at around 34 per cent, similar to today's levels, while LLMIEs in South Asia are projected to double their share of global industrial output from 5 per cent to 9 per cent by 2050. However, these gains will not offset stagnation or decline in other developing regions. LAC's share is expected to stall at 5 per cent, and Africa's will remain low as well. As a result, by 2050, LLMIEs as a group will account for only 16 per cent of global industrial production, despite representing the majority of the world's population and hosting the vast majority of people living in extreme poverty and facing food insecurity.

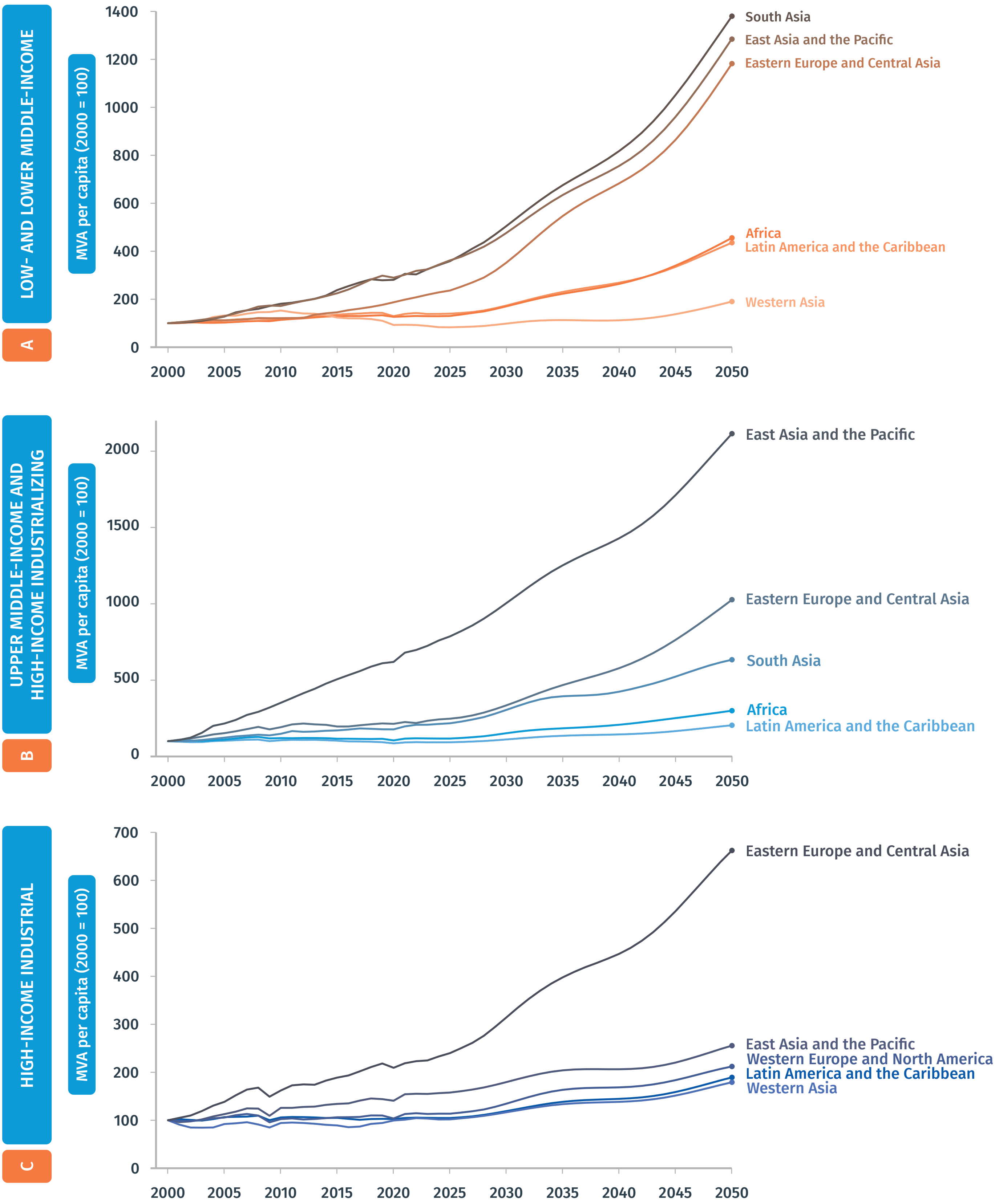
Figure 1.9 **Projected structure of global industrial production by 2050**



Note: Projections to 2050 are based on IFs model *current path* scenario (see Annex A.1). LLMIEs = Low- and lower middle-income economies; UMIEs = Upper middle-income economies; HINGEs = High-income industrializing economies; HIIEs = High-income industrial economies; CA = Central Asia; LAC = Latin America and the Caribbean; NA = Northern America.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

Figure 1.10 **Projected industrial dynamism in the second quarter of the 21st century**



Note: Projections to 2050 are based on IFs model *current path* scenario (see Annex A.1). Regional averages are calculated using population weights. MVA = Manufacturing value added.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

Despite some progress, the industrial intensity gap will persist across most regions of the developing world. Under the current trajectory, the participation of developing regions in global MVA relative to their population shares (the industrial intensity index) will remain very low by 2050 (Figure 1.11, Panel A). In some cases, notable improvements are projected. LLMIEs in East Asia and the Pacific and in Central Asia, as well as UMIEs and HINGEs in Eastern Europe, for example, are expected to double their levels of industrial intensity. Countries in South Asia will also achieve significant gains in the index over the next 25 years, largely driven by stronger productive linkages with global manufacturing hubs, deeper integration into regional value chains, and sustained investments in infrastructure and skills. South Asia may also benefit from a large and young labour force, alongside gradual improvements in industrial capacity and connectivity. By contrast, progress in Africa and LAC will be minimal across all income levels. In these regions, structural bottlenecks, limited diversification weak integration into global value chains (GVCs), and lower technological absorption continue to constrain industrial spillovers and the expansion of manufacturing activity. HIIEs, on the other hand, will remain highly overrepresented in global industrial production relative to their global population share, but to a lesser extent than today. The average industrial intensity index for this group of economies is projected to decline from 269 to 250 over the period.

The productivity gap is also unlikely to narrow significantly. Under the current trajectory, many developing regions are expected to show some improvement in relative productivity by 2050, but the gap will remain large (Figure 1.11, Panel B). The geographical performance replicates a similar pattern as that of the industrial intensity index: Central Asia, Eastern Europe and Eastern Asia and the Pacific are projected to achieve the largest gains in relative productivity, while countries in Africa and LAC are expected to fall further behind compared to their current levels. Overall, the productivity gap in developing countries will remain substantial, with only UMIEs and HINGEs in East Asia reaching half the productivity level of HIIEs. This underscores the urgent need to accelerate technological and industrial upgrading in other regions.

Environmental efficiency will remain a major challenge. The sustainability of industrial production is projected to improve only marginally in the developing world (Figure 1.11, Panel C). From the 12 regions analysed, only three are expected to achieve significant progress in this indicator: African LLMIEs, and UMIEs and HINGEs of Eastern Europe, Central Asia and South Asia. This suggests that industrialization in developing regions could entail high environmental costs if no corrective measures are implemented. Although LAC is currently more efficient than other regions, its environmental efficiency is projected to decline, falling to levels more typical of other developing regions.

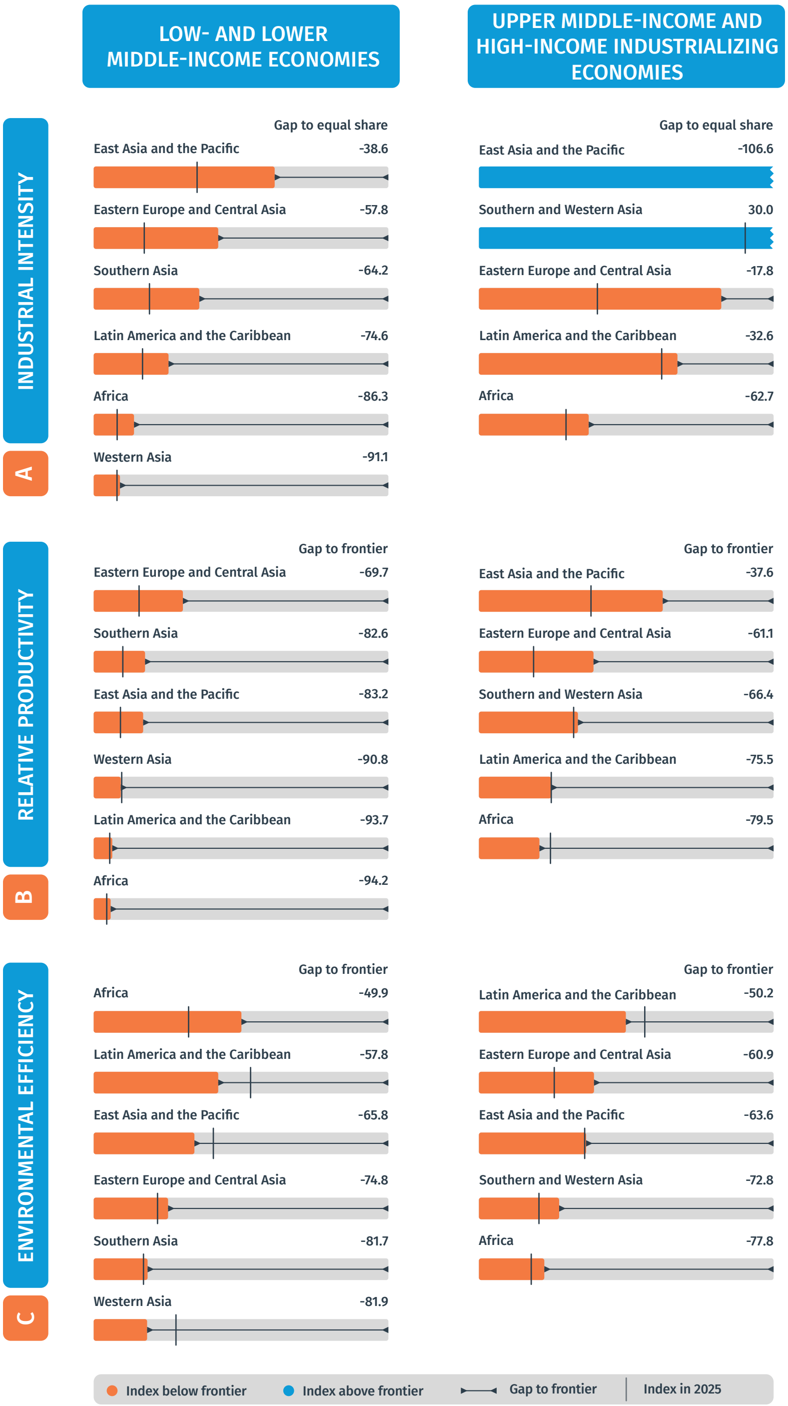
The outlook for 2050 looks bleak. Projections highlight that, under current trajectories, today's industrial development gaps will persist and may even widen relative to the evolving global economy. Industrial production is expected to remain concentrated in a handful of countries, particularly in East Asia and advanced economies, while the majority of developing countries will continue to be marginalized in the global industrial landscape.

Slow industrialization or even deindustrialization will persist across much of the developing world. This is particularly concerning because it affects countries where poverty, food insecurity, and unemployment are projected to remain highest, as noted in Section 1.1. The result is a vicious cycle: the regions facing the most severe development challenges are also those least equipped to address them through job creation, productivity growth, and technological advancement.

To change course, developing countries will need to accelerate industrialization. This can only be achieved by acknowledging that the nature of industry is evolving rapidly. The traditional industrialization model based on labour-intensive manufacturing may no longer be viable in a world increasingly shaped by automation, digitalization, and environmental constraints. Future industrialization strategies must account for technological disruptions, climate change imperatives, and shifting patterns of global trade and investment.

The next chapters will explore how developing countries can chart a different course, one that harnesses industry's transformative potential while navigating the megatrends that are reshaping the global economy.

Figure 1.11 **Industrialization gaps by developing regions, current values and projections for 2050**



Note: Bars show projections for 2050 and vertical lines denote 2025 values. Regional averages are weighted by countries' share of manufacturing value added (MVA) in each subregion. The indicators reported in each panel are defined as follows: A) Industrial intensity index = percentage ratio of each subregion's share of global MVA to its share of the world population. A value of 100 indicates equal share. Values below 100 reflect industrial under-representation. B) Industrial relative productivity index = manufacturing labour productivity (MVA per worker in constant 2017 USD) of each subregion relative to high-income industrial economies' average manufacturing labour productivity. A value of 100 indicates that the region stands at the frontier in terms of industrial labour productivity. C) Industrial environmental efficiency index = MVA per unit of CO_2 emissions in constant 2017 USD relative to the average value of high-income industrial economies. A value of 100 indicates that the region stands at the frontier in terms of industrial environmental efficiency.

Source*:* UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

ENDNOTES

[1] The projections presented in this chapter are based on the *current path* scenario of the IFs model, which represents a "development as usual" trajectory in which countries continue to follow historical patterns without major policy shifts or unexpected disruptions. This scenario is not a simple extrapolation of past trends but rather reflects a dynamic unfolding of projections within the model, with variables interacting across development systems, including demographics, the economy, health, education, environment and technology. It incorporates some of the megatrends that will be discussed in Chapter 2, such as demographic transitions, climate change and gradual technological diffusion, but assumes no dramatic breakthroughs or coordinated global efforts to alter current trajectories. As such, the *current path* provides a benchmark against which to assess what the future might look like if no significant course corrections are undertaken. For a detailed overview of the IFs model structure and assumptions, see Annex A.1.

[2] The projected number of climate-related deaths by 2050 is in line with WEF (2024) which estimates that climate change will place immense strain on global healthcare systems, resulting in 14.5 million deaths and USD 12.5 trillion in economic losses.

[3] Human Climate Horizons is a data and insights platform that provides localized information on the future impacts of climate change across several dimensions of human development and human security. It is the result of joint work by the Climate Impact Lab and UNDP's Human Development Report Office.

[4] Kniivilä (2007).

[5] World Bank (2022).

[6] Erumban and De Vries (2024); Karahasan (2023); Lavopa and Donnelly (2025a).

[7] Kaldor (1996); Szirmai (2012).

[8] Haraguchi and Cheng (2025).

CHAPTER 2 MEGATRENDS AND THE INDUSTRY OF THE FUTURE

Five major megatrends are reshaping the global industrial landscape, with profound implications for the future. The energy and green transition is redefining production through decarbonization, circularity and greater energy efficiency. At the same time, the rise of artificial intelligence is accelerating digitalization, while geoeconomic shifts are reconfiguring global value chains. Labour markets are evolving under the combined pressures of automation and demographic change, and food systems are being reshaped by urbanization, globalization and the convergence of agriculture and manufacturing. These megatrends pose significant challenges to future industrialization. Developing economies face the dual imperative of industrializing while decarbonizing; risks of premature deindustrialization linked to reshoring of production; and the need to create nearly one billion new jobs by 2050 in rapidly changing labour markets. Yet as global demand patterns evolve, the megatrends also open new windows of opportunity. Clean technology manufacturing, critical minerals, AI-enabled innovation, and the bioeconomy are emerging drivers of the next industrial era. Regional value chains and growing workforces can drive inclusive growth, technological upgrading and greater resilience, provided they are supported by strategic industrial policies and investments in industrial capabilities.

Daron Acemoglu

"We are in the midst of transformative social and economic currents, with new technologies, organizations and communication tools reshaping every aspect of our lives. The changes of the past decades, including globalization, automation, deindustrialization, weaker unions and aspects of deregulation, have reduced wages and job quality and boosted inequality. None of this is inevitable. The direction of technology and the institutions that shape how new innovations are produced and used are our choices, and can be changed in order to steer technology and our society in a more socially beneficial direction."

© Bryce Vickmark

Professor at the Massachusetts Institute of Technology (MIT), Nobel Laureate

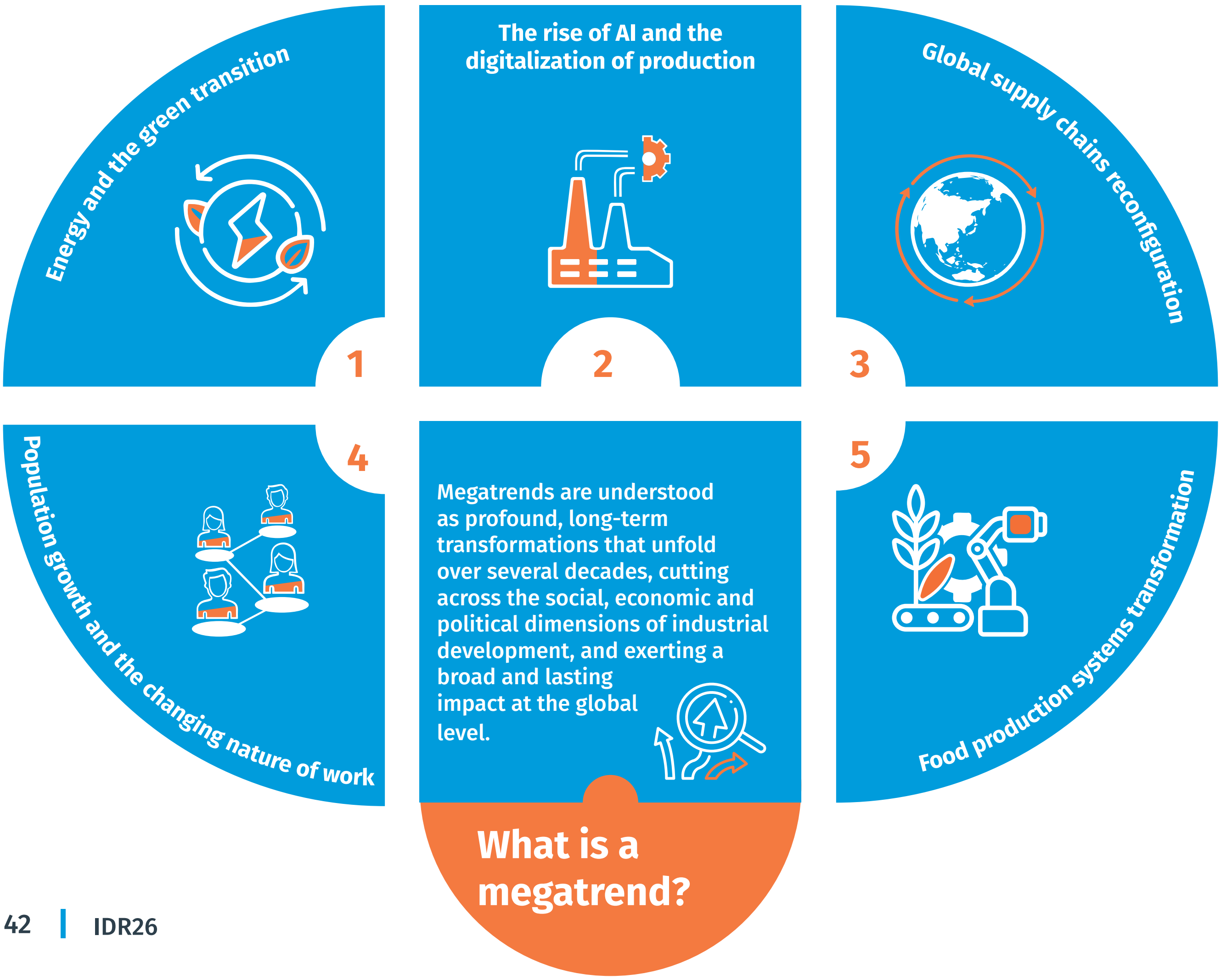
2.1 THE KEY MEGATRENDS RESHAPING INDUSTRY

Looking into the future of industrialization means navigating deep uncertainty. While all long-term development projection must contend with the unknown, today's global context, marked by climate change, rapid technological transformation and geopolitical instability, makes foresight particularly complex. Future pathways are increasingly difficult to predict, yet the need to anticipate them has never been greater.

Despite this uncertainty, several megatrends will continue to shape the global industrial landscape. These trends are not isolated; rather, they intersect and reinforce one another, generating new challenges and opportunities that will redefine how industrial ecosystems evolve. This report focuses on five megatrends that are especially relevant for understanding the future of industrial development:

1. **The green transition** is driven by the imperative to decarbonize and enhance circularity in industrial ecosystems. This shift is no longer viewed merely as an environmental necessity, but as a prerequisite for competitiveness in the global economy.
2. **The rise of artificial intelligence (AI) and the digitalization of production** are transforming production processes and redefining the drivers of global competitiveness.
3. **The reconfiguration of global supply chains** is prompting countries to respond to shifts in economic power and geopolitical tensions by pursuing greater self-reliance and relocating production.
4. **Population growth and the changing nature of work** are shaped by divergent demographic trends, including the rapid expansion in the Global South and ageing populations in the Global North. These dynamics, combined with technological change, are exerting pressure on labour markets, social protection systems and healthcare.
5. **The transformation of food production systems** is being driven by the need to meet the growing demand for processed food while adapting to the impacts of climate change.

Together, these megatrends are reshaping the global industrial development landscape. They are creating opportunities for new forms of industrial growth, while at the same time intensifying challenges related to value addition, inclusion and sustainability. For developing countries in particular, the stakes are high, as their ability to adapt to these shifts will largely determine whether industrialization can continue to serve as an engine of sustainable development in the decades ahead.



2.2 ENERGY AND THE GREEN TRANSITION

The energy and green transition represents a policy- and institution-driven technological transformation.[1] Governments worldwide are responding to the impacts of climate change by reshaping policy frameworks, investment priorities and market signals. In this context, developing economies, whose emissions are historically lower, face the challenge of pursuing industrialization goals while narrowing the environmental efficiency gap. At the same time, industries must adapt to the growing risks of climate change, such as extreme weather events. As a result, industries are increasingly required to innovate more rapidly and in new directions.

2.2.1 Manufacturing the green transition

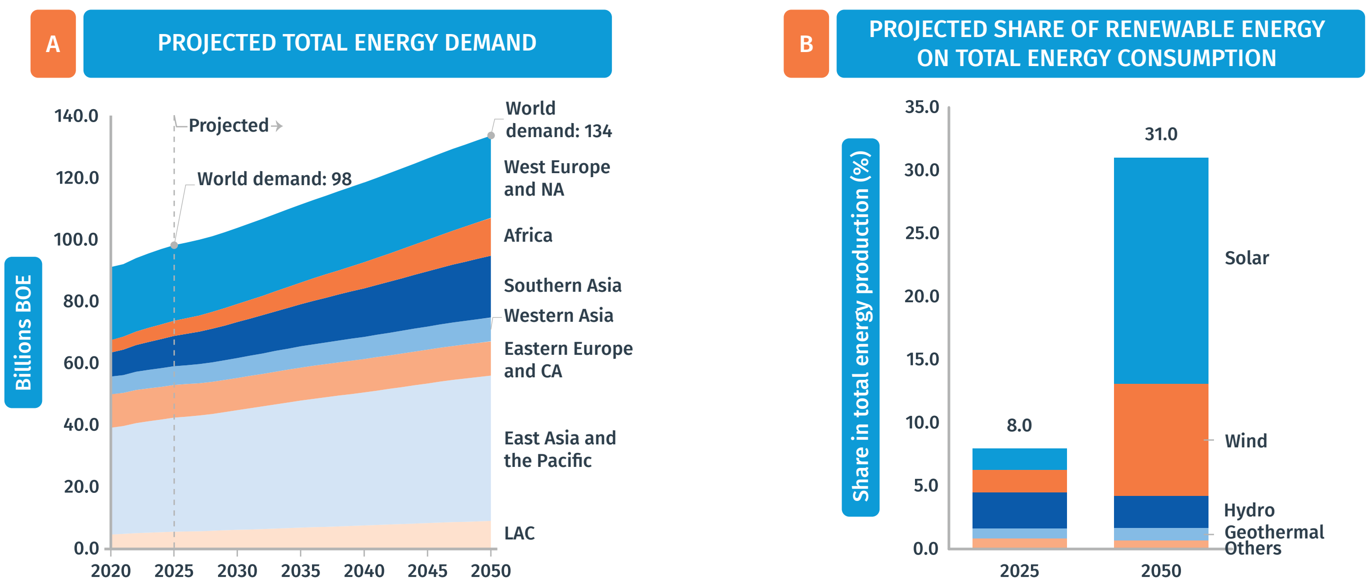
Limiting global warming to 1.5°C requires a rapid transition from fossil fuels to renewables. This entails cutting emissions by at least 43 per cent by 2030 relative to 2019 levels, necessitating rapid changes across energy, industry, resource use, land use and infrastructure systems across all regions and income groups.[2] Current policies fall short of the Paris Agreement targets, leaving the world on a trajectory towards a 2.3°C increase by 2050. At the same time, global energy demand is expected to continue growing, with total demand for energy in 2050 expected to be 36 per cent higher than in 2020, with the largest increases anticipated in Africa and Southern Asia, driven by population growth and rising incomes (Figure 2.1, Panel A).

The development and deployment of renewable energy technologies are essential for advancing the green transition. At present, renewable energy accounts for only 14 per cent of global industrial energy demand, dropping below 5 per cent in many developing countries.[3] Under the *current path* scenario, renewables could provide up to 30 per cent of total energy consumption by 2050 (Figure 2.1, Panel B). While this is an important step, a large share of energy is still being supplied by fossil fuels.

Renewable energy generation is only part of the solution. Electrification of industrial processes using renewables can replace fossil fuels in low- to medium-heat processes, such as textiles, food processing and paper production. Hard-to-abate industries such as steel, cement and chemicals will increasingly rely on low-emission hydrogen, which is projected to supply up to 14 per cent of global final energy consumption by 2050.[4]

Achieving the green transition also depends on product and process innovation. Electric vehicles (EVs) and their associated infrastructure exemplify this, as they play a crucial role for decarbonizing transport and reducing the carbon footprint of supply chains and logistics. Other transformative solutions include carbon capture, utilization and storage (CCUS), sustainable cooling technologies, circular business models and smart mobility systems.[5]

Figure 2.1 **Demand for energy is expected to grow significantly, but only a few are sourced from renewables**



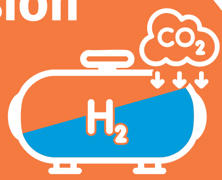
Note: BOE = Barrel of oil equivalent; CA = Central Asia; LAC = Latin America and the Caribbean, NA = Northern America.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

The extent of the global impact of such innovations depends on where and how they are developed. Capabilities for green innovation in consumer and capital goods industries remain largely concentrated in the Global North (Figure 2.2, Panel B). Developing and industrializing economies account for only 8 per cent of global green patenting, with 94 per cent originating from China. Strengthening green industrial innovation in developing countries requires building robust domestic knowledge bases, including skills, expertise and institutions. Without targeted investment, the technology landscape is unlikely to change.

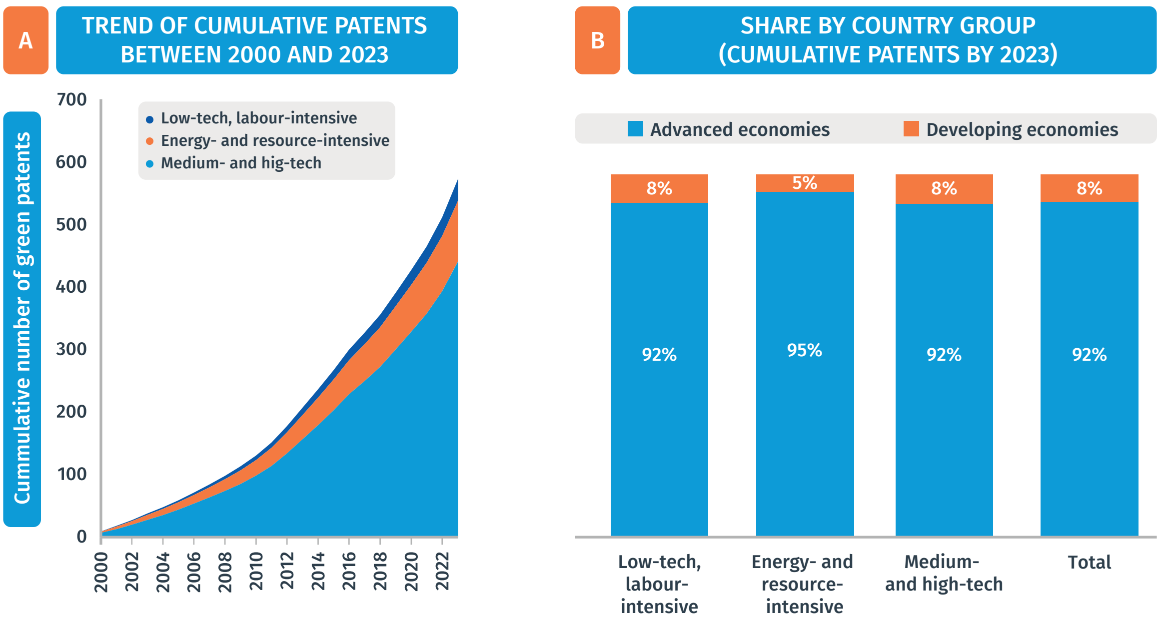
The transition also relies on critical minerals such as copper, lithium and nickel, which are largely concentrated in a few countries in the Global South.[6] While these resources create opportunities for resource-based industrialization, they also pose risks including price volatility, supply shortages and environmental and social impacts from poorly managed mining. Addressing these challenges requires both responsible resource extraction and more efficient material use. Many materials used in clean energy technologies, notably aluminium, copper and components for batteries, wind turbines and solar panels, can be recycled indefinitely. [7] Urban mining, which recovers materials from end-of-life products, buildings and infrastructure, can decouple material demand from primary extraction and support a more sustainable energy transition.

Low-emission hydrogen



Low-emission hydrogen is emerging as a critical solution for the decarbonization of hard-to-abate industries such as steel, chemicals, and heavy transport. As an efficient energy carrier with long-term storage potential, hydrogen is also particularly valuable for integrating renewables, by balancing seasonal fluctuations in solar and wind supply. In 2023, global hydrogen demand reached 97 million tonnes, yet the production of low-emission hydrogen remained below 1 million tonnes, highlighting the technology's early stage of deployment.[8] Most hydrogen is still produced from fossil fuels (mainly natural gas) via steam methane reforming without carbon capture, resulting in significant CO_2 emissions. In contrast, low-emission hydrogen encompasses both renewable hydrogen, produced via water electrolysis powered by renewable electricity, and hydrogen from natural gas combined with carbon capture, utilization and storage (CCUS) to significantly reduce emissions. Replacing high-emission production methods with low-emission alternatives can substantially cut emissions and enable the transition toward net-zero energy systems.

Figure 2.2 **Industrial firms in developing countries are lagging behind in the green technology race**



Note: This figure presents the distribution of patent families in green technologies within the manufacturing sector. Green patents are identified using CPC codes Y02 and Y04. The data refer to IP5 patent families, as defined by the OECD: patents protected in at least two intellectual property offices worldwide, including one of the five IP offices (IP5): EPO, JPO, USPTO, the Korean Intellectual Property Office (KIPO), and the China National Intellectual Property Administration (CNIPA). The country of origin is assigned based on the applicant's country. Fractional counting is applied when a patent has multiple applicants.

Source: UNIDO elaboration based on Delera et al. (2025), using data from BvD (2025).

Finally, scaling up investments in climate adaptation is essential. As extreme weather events grow more frequent and severe, manufacturers face rising risks to infrastructure, assets, supply chains and energy access.[9] In this context, governments and business leaders should treat investments not as sunk costs, but as strategic measures that protect value and reduce the risk premium on long-lived industrial investments. Well-targeted and timely investments in adaptation can deliver triple dividends, including avoided damages, economic gains and socioenvironmental benefits.[10]

2.2.2 New challenges associated with the green transition

Efforts to decarbonize industry may exacerbate existing structural inequalities.[11] While improving energy efficiency often requires relatively modest investments, greening the energy mix and climate-proofing industrial infrastructure can be far more capital- and knowledge-intensive. The energy transition also risks reinforcing the unequal global division of labour. High-income countries lead in green technology development, while resource-rich, lower-income nations risk being locked into "green extractivism", exporting raw materials with minimal domestic processing, capturing limited economic benefits, and bearing disproportionate environmental and social costs.[12] This dynamic further deepens developing countries' dependence on advanced economies for green technologies.

The transition also introduces a new set of challenges, some of which are driven by policies adopted in advanced economies. Carbon border taxes, environmental, social and governance (ESG) disclosure requirements, and green procurement standards can unlock capital for producers by helping them meet rising investor and buyer expectations while reducing investment risk. However, these measures also impose additional burdens on exporters in the Global South, as compliance is increasingly becoming a prerequisite for market access and competitiveness.[13] Sustainability regulations are inherently costly, raising questions about how compliance burdens are distributed to ensure an inclusive and sustainable transition.

Emerging challenges are not uniform: they vary across industries, reflecting differences in environmental, economic and regulatory pressures. The key requirements for "environmental upgrading", the improvement of environmental performance, also differ by industry (Table 2.1).[14]

What are green technologies?

Green technologies encompass products, services and processes that minimize negative environmental impacts and promote sustainability. Green technologies can be classified into two categories depending on their role in the manufacturing sector. On the one hand, there are manufactured green technologies: these are physical products or systems created through industrial processes, such as renewable energy equipment or technological hardware used for recycling, which are often embedded in green value chains and may be exported. On the other hand, there are green technologies used in manufacturing, which improve environmental performance within factories by making processes cleaner and more resource efficient. Examples include energy management systems, process optimization tools, and cleaner production methods that reduce emissions, water use, waste and resource use on production sites. There is substantial overlap between these two categories: for example, an energy-efficient motor is a manufactured product used in factories. Green technologies are increasingly service-intensive and digitalized, with AI and the internet of things (IoT) playing central roles in unlocking cleaner and smarter production. This convergence gives rise to the "twin" digital and green transition. Distinguishing between manufactured green technologies and those applied within manufacturing is essential to understanding industrial opportunities and sustainability benefits.[15]

Table 2.1 **New challenges and opportunities for future industrialization in a greener world**

	Energy- and resource-intensive industries		Low-tech, labour-intensive industries	Medium- and hig-tech industries
	Energy-intensive industries	Resource-intensive industries		
Examples of industries	• Mineral processing, chemicals, cement and concrete, pulp and paper.	• Agro-industry.	• Textiles, garments, furniture, leather	• Automotive, consumer electronics, appliances, and clean-tech manufacturing
Main environmental challenges	• Reliance on fossil fuels for high-temperature requirements, process emissions and long-lived assets.	• Land degradation, water scarcity, biodiversity loss and deforestation. • Rising global demand for traceability and certification.	• Water pollution, chemical use and carbon-intensive inputs. Mounting pressure from buyer standards and ecolabels.	• Carbon emissions in production and logistics. Stringent end-market regulations (e.g. EV mandates, product standards).
Environmental upgrading requirements	• Improve technology performance requirements. • Increase energy and material efficiency. • Fuel switching and the electrification of low- and medium-heat equipment and processes.	• Strengthen traceability and environmental compliance. • Invest in clean energy, infrastructure and sustainable sourcing.	• Upgrade processes through cleaner production methods and sustainable inputs. • Adapt to lead firm requirements. • Adopt environmental standards and certification.	• Transition to cleaner technologies. • Adopt energy-efficient equipment. • Engage in local green innovation. • Establish public–private alliances to build capabilities.
Green windows of opportunities	• Value addition in critical raw materials (e.g. lithium) and developing low-carbon hydrogen. • Tapping into the growing market for low-carbon materials and environmental attribute certificates.	• Agro-industrial greening (climate-smart processing, sustainable inputs). • Green sourcing advantages. • Energy from bio-waste.	• Environmental upgrading through eco-design, circularity and standards compliance. • Buyer-driven demand for low-carbon textiles and sustainable sourcing.	• Green manufacturing of appliances (e.g. energy-efficient cooling). • Recycling e-waste. • New mobility solutions (e.g. e-bikes). • Expansion of manufacturing activities in clean-tech value chains (wind turbines, EVs, solar panels).
Supporting policies	• Carbon pricing. Performance standards and green technology incentives.	• Support sustainable agro-industrial practices. • Develop mineral value chains through export rules. • Infrastructure and green processing incentives.	• Fund cleaner production and certification. • Green public procurement. • Supplier support for eco-innovation.	• Use of standards and demand-side instruments (e.g. appliance energy labels).

Note: EV = Electric vehicle

Source: Lema (2025), policy brief produced for the IDR 2026.

In energy- and resource-intensive industries, the priority is to reduce reliance on fossil fuels and mitigate environmental externalities. Energy-intensive activities, such as iron and steel, chemicals and cement, require high-temperature heat for many processes, such as blast furnaces reaching 1500°C to produce iron, a demand almost exclusively met today by burning fossil fuels. In contrast, agroprocessing is associated with pressures ranging from land degradation to biodiversity loss. With rising global expectations for traceability and certification, firms must adopt sustainable sourcing practices, implement robust water and waste management systems and address risks such as deforestation.

In lower-tech, labour-intensive industries, such as textiles, garments, furniture and leather, environmental scrutiny is increasing, focusing on water and chemical use, pollution and supply chain transparency. For developing countries to remain competitive and continue supplying lead buyers, producers must adopt circular and resource-efficient production methods, upgrade technologies to reduce resource consumption, and align with international ecolabels.

Medium- and medium-high-technology industries, such as automotive, consumer electronics, appliances and clean-tech manufacturing, face similar pressures from tightening environmental and regulatory expectations. These industries contend with carbon emissions, rare material sourcing and product design regulations in end-markets. Being globally integrated, they must adopt resource-efficient production processes, comply with extended producer responsibility schemes, enhance traceability across complex supply networks, and meet rising standards for carbon disclosure and eco-design.

Challenges vary not only by industry, but also by countries' level of industrialization. In middle-income industrializing economies, a key challenge is meeting global demand without locking in high-carbon capacity. Public procurement can support this shift, while carbon border taxes may realign incentives, provided that industrialized economies support producers in developing economies in adapting to the new standards. In economies with high renewable energy potential, powershoring or relocating energy-intensive industries to these regions, can provide clean, affordable and abundant energy, while attracting investment and promoting green industrialization.

2.2.3 Green windows of opportunity for future industrialization

The transition also creates opportunities for structural change, allowing latecomers to enter or upgrade in new value chains.[16] Windows of opportunity can emerge externally, triggered by shifts in global demand, regulations, trade norms, or energy security concerns. They can also arise internally, arising from domestic responses to local environmental or developmental pressures. The absence of legacy infrastructure can allow latecomers to leapfrog into cleaner technologies.[17] In addition, the convergence of green and digital transitions can open new pathways for environmental upgrading in manufacturing.[18]

Clean-tech manufacturing has significant potential for expansion in developing economies. Economies in Latin America, Africa and Southeast Asia currently account for less than 5 per cent of clean technology value generation. However, these regions could become important producers across these supply chains.[19] This includes, for example, increased production of polysilicon and wafers for solar photovoltaic (PV) modules in Southeast Asia, wind turbine blades in Brazil and other Latin American countries, and EVs in North Africa.[20] Countries such as Thailand and India are leveraging industrial policy to secure positions in EV and battery value chains.[21,22] Capturing these opportunities will require building ecosystems for green innovation and manufacturing (see Chapter 3, section 3.6).

In energy- and resource-intensive industries, the rising demand for low-carbon materials is creating opportunities to align climate action with industrial and economic development (Table 2.1). Growing demand for "transition minerals",[23] such as lithium and nickel, opens pathways to move beyond raw material exports towards local refining and component manufacturing,[24] as illustrated by Indonesia's nickel export ban[25] and Chile's lithium value added strategy.[26] Agro-industries, on the other hand, face increasing pressure for sustainability-related traceability, low-carbon logistics and climate resilience, presenting opportunities to link environmental upgrading with food security and rural livelihoods.[27]

Elsewhere in manufacturing, the rising demand for greener products is creating opportunities for value addition and industrial upgrading. In low-tech industries, such as textiles, garments and furniture, expanding markets for eco-certified and recycled products favour firms that adopt circular, cleaner processes and obtain sustainability certifications.[28] Finally, the clean energy transition is transforming medium- and medium-high-tech industries, such as automotive, electronics and appliances, as changing demand patterns and production models are restructuring global supply chains and opening new opportunities for market entry.

2.3 THE RISE OF AI AND THE DIGITALIZATION OF PRODUCTION

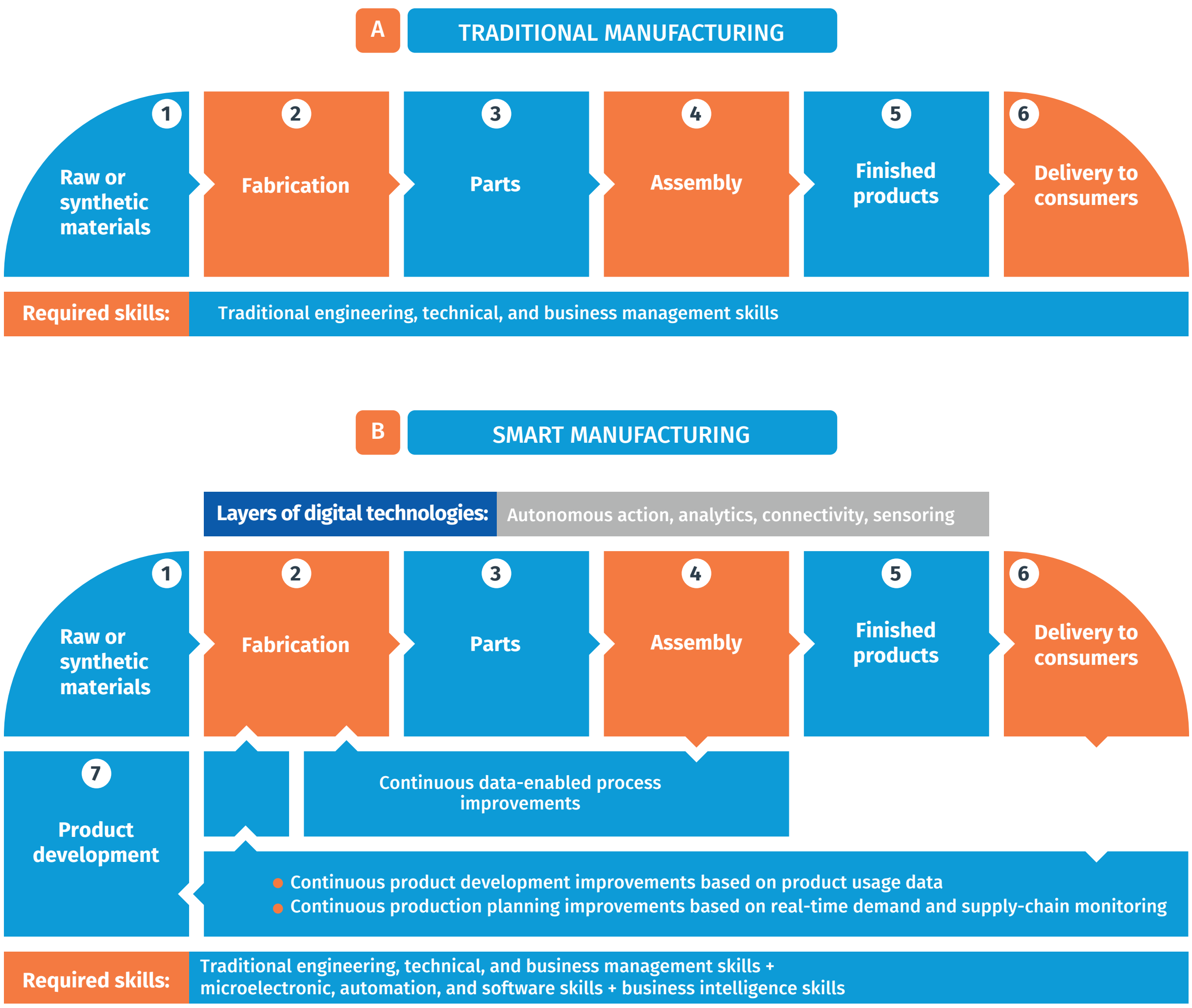
2.3.1 The digital transition and the manufacturing sector

The digital transition is a technological shift driven by a series of interconnected, incremental innovations.[29] Central to this transition is the integration of digital technologies into production processes to enhance efficiency, adaptability and decision-making in real time. While this transformation has been unfolding over decades,[30] recent advances in computing capacity, machine learning, and connectivity have accelerated its pace and broadened its scope.

The key technologies driving this transition include software, hardware and connectivity tools. While rooted in manufacturing, they have far-reaching implications across the economy and society, from agriculture and construction to a range of service activities. Digital transition technologies include three-dimensional printing, AI, cloud computing, IoT, augmented and virtual reality, big data and advanced data analytics, advanced robotics and cyber-physical systems.

Digital technologies are transforming the nature of manufacturing processes. On the factory floor, the integration of advanced robotics with sensors and other digital devices for real-time monitoring and big data analytics, supported by increasingly powerful computing capabilities, has given rise to "smart manufacturing". Unlike traditional production processes, smart manufacturing enables continuous feedback loops throughout the production cycle. The upshot is performance optimization and improved predictive capabilities, and includes new forms of oversight and control (Figure 2.3).

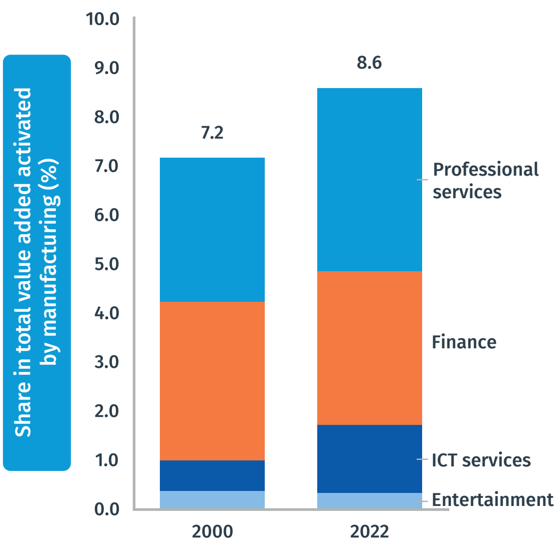
Figure 2.3 **From traditional to digital manufacturing**



Source: Labrunie et al. (2025), policy brief produced for the IDR 2026.

Digitalization is increasingly blurring the boundaries between manufacturing and services, as the two are becoming deeply integrated. The increasing adoption of digital technologies has enhanced manufacturing productivity through automation and transformed the role and nature of supporting services across the entire value chain.[31] For instance, communication technologies have enabled the decentralization of management and administrative functions, such as legal and accounting, which firms can increasingly outsource externally. This trend is driving a growing contribution of knowledge-intensive business services (KIBS) to the total value added of industrial ecosystems. The share of KIBS in manufacturing value added generated by final demand in manufacturing is steadily rising across economies at all stages of industrial development (Figure 2.4).

Figure 2.4 **Digital technologies and the servification of industry**



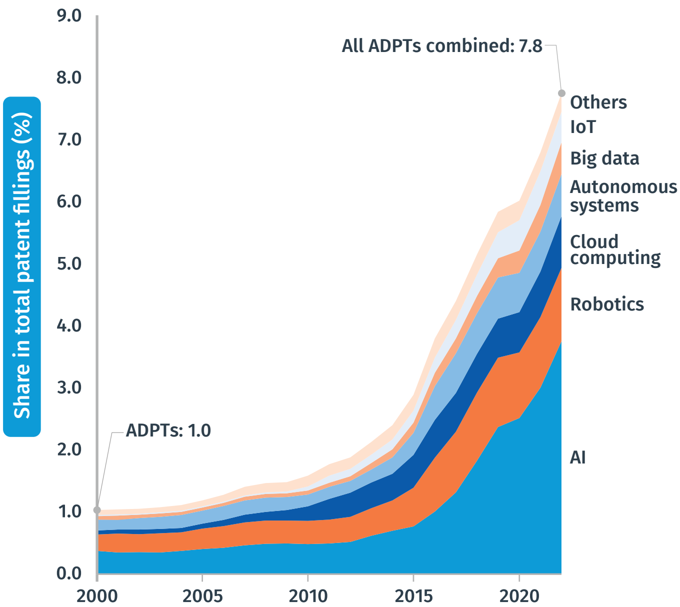
Note: The shares are obtained by dividing the value added generated in KIBS by the total value added linked to manufacturing final demand. The data are presented as unweighted three-year moving averages. The analysis includes 80 economies (42 high-income industrial economies, 19 upper middle-income economies and high-income industrializing economies and 19 low- and lower middle-income economies). KIBS are knowledge-intensive business services.

Source: UNIDO elaboration based on Inter-Country Input-Output (ICIO) Tables (OECD (2025a)).

Among all digital technologies, AI is emerging as one of the key drivers of the digital transformation. Recent trends in AI patenting highlight the rapid pace of change. Over the past five years, the share of AI-related patents has tripled, and this trend shows no signs of slowing (Figure 2.5). Provided that AI is deployed within industrial ecosystems alongside the necessary skills, infrastructure and institutional support, its transformative potential can reshape entire industries and drive structural change across economies.

With the development of AI advancing at an unprecedented pace, it is recognized as a new general-purpose technology (GPT). AI has three defining characteristic of GPTs. First, AI is broadly embedded across a wide range of products and services, spanning multiple industries: generative AI has been applied in at least 21 different areas, from software and life sciences to publishing and manufacturing.[32] AI innovation itself is also diversifying: AI patents are increasingly filed by innovators outside the information, communication and technology (ICT) industry.[33] Second, AI is continuously improving.[34] Finally, innovation in AI serves as an enabler of innovation elsewhere in the economy, as AI-related patents are widely cited across different fields, demonstrating that AI not only drives progress but also stimulates follow-on innovations.[35]

Figure 2.5 **The rise of AI**



Note: ADPT = Advanced digital production technologies; AI = Artificial intelligence; IoT = Internet of Things. ADPTs include all other technologies listed in the Figure.

Source: UNIDO elaboration based on WIPO (2022).

In smart manufacturing, AI has emerged as a key enabler, particularly in processing and analysing vast amounts of unstructured data generated by interconnected machines and systems. Recent breakthroughs, such as the large language models, have further expanded AI's capabilities. Data-driven decisions can be made faster and more accurately, opening new possibilities for improving efficiency, optimizing processes, and supporting decision-making across multiple levels of production. The potential for widespread AI adoption and its strong complementarity with other digital technologies suggests AI could have far-reaching effects, with the capacity to positively influence 79 per cent of the targets outlined in the Sustainable Development Goals (SDGs).[36]

2.3.2 New challenges and structural deficiencies

Developing economies are falling behind in the global race to advance AI and digital technologies. Innovation in AI remains heavily concentrated in a few leading economies, most notably the United States, China, Japan, the Republic of Korea and the United Kingdom, which dominate the production of advanced AI-tailored computer chips. Among developing economies, Malaysia is one of the few countries that plays a leading role in the semiconductor value chain, with strengths in back-end manufacturing and ongoing investment in developing circuit design capabilities (see Section 6.3).[37] Other developing countries, such as India and Viet Nam, are also investing in developing capabilities to participate in the semiconductor value chain.[38]

The uneven global diffusion of digital technologies reflects persistent structural gaps in industrial capabilities, infrastructure and education systems. Compared to more advanced countries, those with a manufacturing sector that is less developed are also significantly less prepared to adopt and integrate AI technologies. These disparities suggest that the rise of AI risks reinforcing existing techno-economic dependencies and inequalities in the global economy.

The rise of AI is driving a growing concentration of digital capabilities, not just in a few countries, but also among a few dominant firms. This is particularly evident in AI innovation and development. Generative AI is becoming more capital- and data-intensive, raising entry barriers for smaller firms and developing countries. The training of large, state-of-the-art language models now requires investments exceeding USD 100 million, with the United States and China are taking the lead. Evidence from developed economies shows that 29 per cent of AI patents are held by just 0.2 per cent of firms engaged in AI patenting.[39] These high barriers to entry, coupled with a growing concentration of talent, capital and capabilities, severely limit the possibility of firms from the Global South from developing their own AI capabilities.

The adoption of AI remains largely confined to a small group of firms. AI adoption remains limited, although there are clear signs of acceleration, particularly in advanced economies. In 2023, just 8 per cent of European Union firms reported using AI, but by 2024, this share had increased to over 13 per cent, with similar adoption levels observed across OECD members.[40] The adoption of AI remains largely concentrated in the largest and most productive firms.[41] Available data for developing countries indicate that the adoption of the most advanced digital production technologies, which include AI, remains very limited and concentrated in larger, internationally connected firms.[42] To accelerate the adoption of AI and advanced digital production technologies, gaps in access to high-speed internet and human capital remain among the key barriers that must be overcome by domestic small- and medium-sized enterprises (SMEs).[43]

The digital transition also carries socioeconomic risks. If the digital transition renders existing jobs redundant and automation becomes economically viable, it could reduce the employment-generation potential of industrial development.[44] Empirical studies in both developed and developing countries remain mixed. Some studies report job losses, while others find job gains or no impact.[45] Outcomes depend heavily on how technologies are defined, the research methods used and the specific context under study (see Section 2.5).

Accelerated automation and digitalization in industry risks reshaping the global distribution of competitive advantage and constraining employment creation in developing economies. The digital transition may reduce the importance of labour costs in production—a historical driver of competitiveness for developing economies—or trigger important changes to the configuration of GVCs and accelerate premature deindustrialization in the Global South (see Section 2.4).

2.3.3 AI-driven opportunities for future industrialization

Despite the challenges, AI presents significant opportunities and can increase productivity for developing countries, particularly in industries where production processes are highly standardized. AI can be integrated across various stages of the value chain, from research and design (R&D) to manufacturing production, logistics, maintenance and even recycling, making it relevant across multiple industries. Not all AI applications require advanced technical and organizational capabilities. In production processes, for example, AI can enable the use of sensors to monitor the performance of machinery. With more advanced applications, AI can also enhance process optimization, design, predictive capacity and decision-making (Table 2.2).

In manufacturing, AI can enhance efficiency and product innovation across all production processes and beyond. For instance, large language models can be trained to simulate feedback on new product ideas, accelerating the design, testing and creation of prototypes. AI contributes to greater efficiency in supply chain management, as AI-equipped warehouse drones can automate tasks such as barcode reading and inventory updates. In addition, image-recognition systems in fulfilment centres can identify damaged items and redirect them for further inspection.[46]

Table 2.2 **Potential applications of AI in manufacturing**

<table>
<tr><th>Area</th><th>Capabilities required</th><th>Applications and benefits</th></tr>
<tr><td rowspan="2">Business processes</td><td>Basic</td><td>• Market analysis –automated surveys and trend prediction for faster insights.
• Chatbots –instant customer support and recommendations.
• Finance automation –payroll, invoicing and forecasting with fewer errors.
• Cybersecurity –fraud detection and blocking malicious bots.</td></tr>
<tr><td>Advanced</td><td>• IT/HR integration – centralized platforms can streamline operations.
• AI search assistants –quick access to internal documents and knowledge.</td></tr>
<tr><td rowspan="2">Manufacturing</td><td>Basic</td><td>• Sensors on machines –downtime and performance monitoring.</td></tr>
<tr><td>Advanced</td><td>• Predictive maintenance – detection of anomalies (heat, vibration) and prevention of breakdowns.
• Quality control (computer vision) – identification of defects beyond human capability.
• Autonomous robots – selection and placing of items in complex scenarios.
• Energy optimization – smart heating and cooling to cut costs.
• Digital twins – simulation of processes to test improvements.</td></tr>
<tr><td rowspan="2">Product development</td><td>Basic</td><td>• Generative AI – brainstorming product ideas and creating visuals.
• User feedback analysis –sentiment analyses from text, video and audio.</td></tr>
<tr><td>Advanced</td><td>• Generative design – optimization of parts for weight, performance and sustainability.
• Natural language interfaces – facilitating the use of design software.</td></tr>
<tr><td>Products</td><td>Advanced</td><td>• IoT connectivity – enabling smart devices and appliances.
• Embedded AI – wearables that predict health issues, autonomous vehicles, smart homes and industrial robots.</td></tr>
<tr><td rowspan="2">Supply chain</td><td>Basic</td><td>• Inventory optimization – real-time stock management.
• AI drones – scanning barcodes and tracking warehouse items.
• Damage detection – identification of issues during fulfilment.</td></tr>
<tr><td>Advanced</td><td>• Analytics – providing visibility across ports, carriers and weather.
• Predictive forecasting – anticipating demand and disruptions.
• Sustainability tools – measuring emissions (including Scope 3 emissions).</td></tr>
</table>

Source: Labrunie et al. (2025), policy brief produced for the IDR 2026.

Across industries and ecosystems, the adoption of AI can directly support industrial upgrading and job creation. For instance, in industries such as automotive, chemicals and aerospace, AI enables predictive maintenance, process optimization, quality control, and supply chain efficiency.[47] While concerns about automation-driven job losses dominate public debate, evidence suggests that AI and digital technologies can both displace and create employment, depending on each country's context, industrial structure and policy responses. In manufacturing, AI tools can enhance quality, safety and productivity, complementing rather than simply replacing workers.[48]

AI adoption in manufacturing presents opportunities for developing countries to design local solutions tailored to their specific industrial contexts. Given that many AI models are available through open access, they can be adapted using locally generated data that better reflect domestic production processes and market needs. These context-specific solutions could boost productivity, reduce costs and provide firms, particularly SMEs, with tools that are better aligned with their environments. For AI to scale effectively, developing countries must continue strengthening their industrial ecosystems. This requires investment in data infrastructure and standards, while also improving access to finance for SMEs.

Additionally, collaborative approaches to data sharing offer a promising pathway forward. The development of industrial data-sharing consortia and communities of practice can help lower barriers to entry for AI deployment. These collaborative structures can support the development of locally relevant AI applications and create opportunities for domestic actors to become both users and developers of AI solutions. Some of these applications require only modest technical and organizational capabilities, making them accessible to a wide range of firms. With appropriate institutional support, developing countries can leverage AI to improve efficiency, competitiveness and resilience within their manufacturing sectors.

Promoting responsible and inclusive AI adoption is essential. This involves embedding the principles of safety, fairness, transparency and accountability into national AI strategies and industrial policy frameworks. Ensuring that AI applications in manufacturing align with international standards and ethical guidelines can strengthen trust, while inclusive innovation policies should engage a broad range of stakeholders and prioritize solutions that benefit diverse firms and workers across the economy.

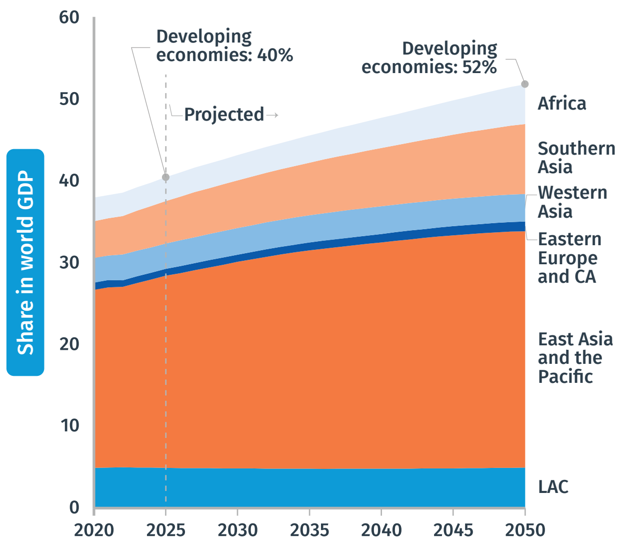
2.4 THE RECONFIGURATION OF GLOBAL SUPPLY CHAINS

Since 2000, the global economy has undergone a significant rebalancing in economic power.[49] The Global South[50] has nearly doubled its share of world gross domestic product (GDP), rising from 22 per cent to 40 per cent between 2000 and 2025 (Figure 2.6). This growth has been driven primarily by developing economies in East Asia and the Pacific, most notably China. A key factor behind this shift has been the integration of these economies into GVCs, which over the past 25 years, have played a key role in industrial development, accounting for up to 70 per cent of global trade[51] and generating 450 million jobs.[52]

Looking ahead, the rise of the Global South is expected to continue, with its share of global GDP projected to reach 50 per cent by 2050 under the *current path* scenario. While developing economies differ greatly in terms of their productive structures and exposure to macroeconomic headwinds, several common drivers underpin this trajectory. These include a favourable demographic development and rapid urbanization, growing demand for processed critical raw materials and related products, the transition towards low-carbon production, deeper regional integration, and the expanding role of strategic industrial policies designed to increase local value addition.

Industrial development models and the distribution of industrial activity across the Global South may shift in the future due to the rise of geoeconomics. Recent shocks, including the COVID-19 pandemic and geopolitical tensions, are driving large industrialized and industrializing economies towards greater self-reliance – a trend that accelerated sharply between April and July 2025, due to the United States administration's tariff escalation. A recent simulation on the short-term and long-term effects of tariff increases in major global economies indicates that this shift in trade policy will have a negative impact on global GDP, manufacturing value added (MVA) and poverty. The impacts are especially pronounced in least developed countries (LDCs) and developing countries whose exports are concentrated in a few industries and end-markets. [53]

Figure 2.6 **In the *current path* scenario, global rebalancing is expected to continue**



Note: Projections to 2050 are based on the *current path* scenario. Developing economies are defined as all economies not classified as high-income industrial economies in UNIDO's 2025 statistical classification. CA = Central Asia; LAC = Latin America and the Caribbean.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

As countries seek to reduce their dependence on global markets and trade, investment flows are shifting, altering the international geography of industrial production. The growing decoupling in trade and investment between the United States and China is a major driver of GVC reconfiguration, reshaping the global industrial landscape. Manufacturing import shares are changing rapidly in the two countries, which together account for over a quarter of global manufacturing imports. Even before the latest tariff escalation in 2025, the United States had been reducing its share of imports from China. At the same time, China has redirected its imports away from the United States and other high-income East Asian countries. Investment flows are increasingly following a similar pattern.[54]

Amid this reshuffling, a few emerging regions, most notably East and Southeast Asia, have positioned themselves as suppliers to both blocs (Figure 2.7).

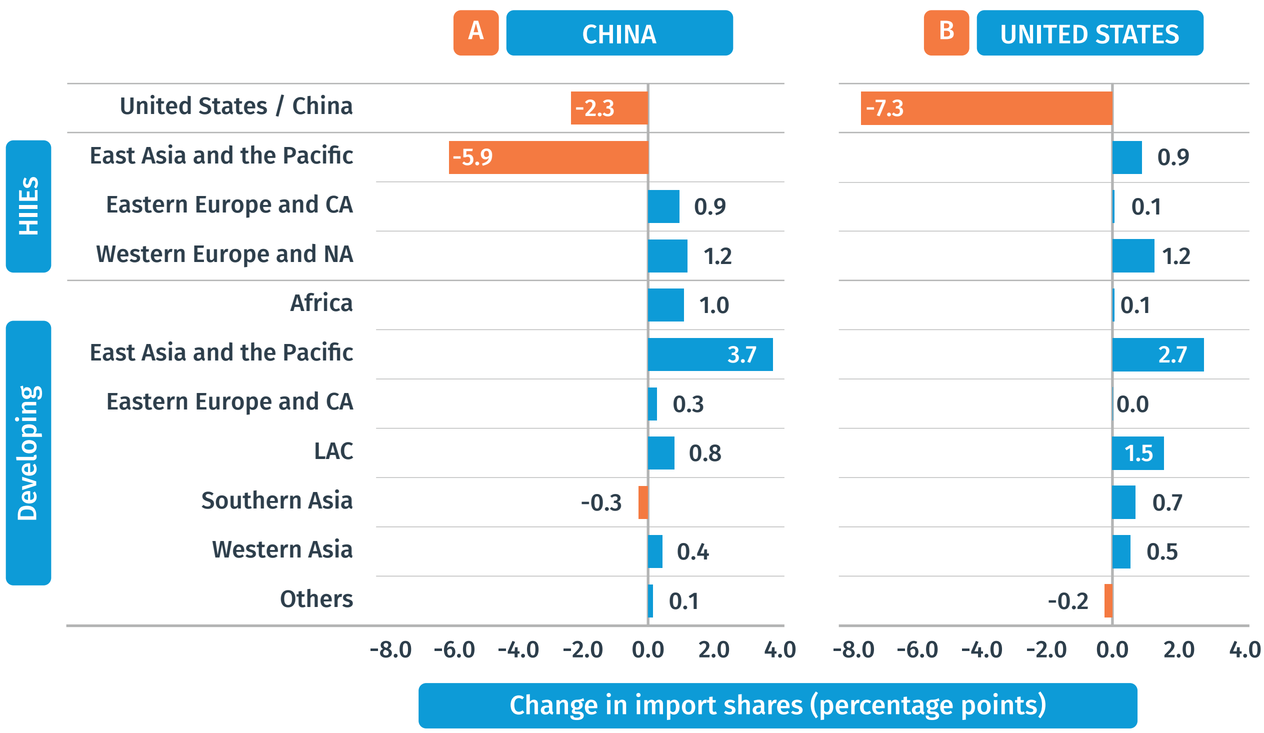
Geoeconomic pressures are prompting multinational firms to relocate production, with technology facilitating these shifts. Reshoring involves bringing previously offshored activities back home, with technology—particularly automation—serving as a key enabler. Automation can offset the competitive advantage of low labour costs and allow production in advanced countries to remain competitive.[55] At the same time, geopolitical concerns are encouraging firms to relocate production to politically allied or neutral countries, a strategy known as friendshoring, to lower disruption risks and enhance supply chain resilience.[56]

As global value chains are reshaped by geoeconomic pressures and technology, developing countries face the pressing challenge of sustaining industrial development in a rapidly changing environment. Amid uncertainties over tariffs, replicating the East Asian model of export-led growth driven by high-income markets may prove less feasible. Instead, countries in the Global South may need to explore alternative strategies that leverage opportunities offered by friendshoring, while diversifying their markets, including through strengthened regional trade (see Section 3.5).

2.4.1 Geoeconomics and technology: The two forces rocking supply chains and creating risks

Reshoring may trigger premature deindustrialization. If advanced economies start repatriating substantial segments of production, developing countries will face a dual challenge. First, foreign firms operating locally may scale back or withdraw investments, redirecting capital and production to their home markets. Second, the shift towards domestic manufacturing in advanced economies could reduce demand for imports from developing countries, particularly in labour-intensive sectors where they have traditionally held a competitive advantage. This threat is further amplified by technological change because the digital transition and increasing automation are eroding developing countries' labour cost advantage, making reshoring more feasible.[57] The risk is that deindustrialization may occur before industrialization has fully taken hold.

Figure 2.7 **China and the United States are gradually decoupling and reshaping GVCs**



Note: Changes refer to the period 2017–2023 (the latest year with available data). CA = Central Asia; LAC = Latin America and the Caribbean; NA = Northern America; and HIIEs = High-income industrial economies.

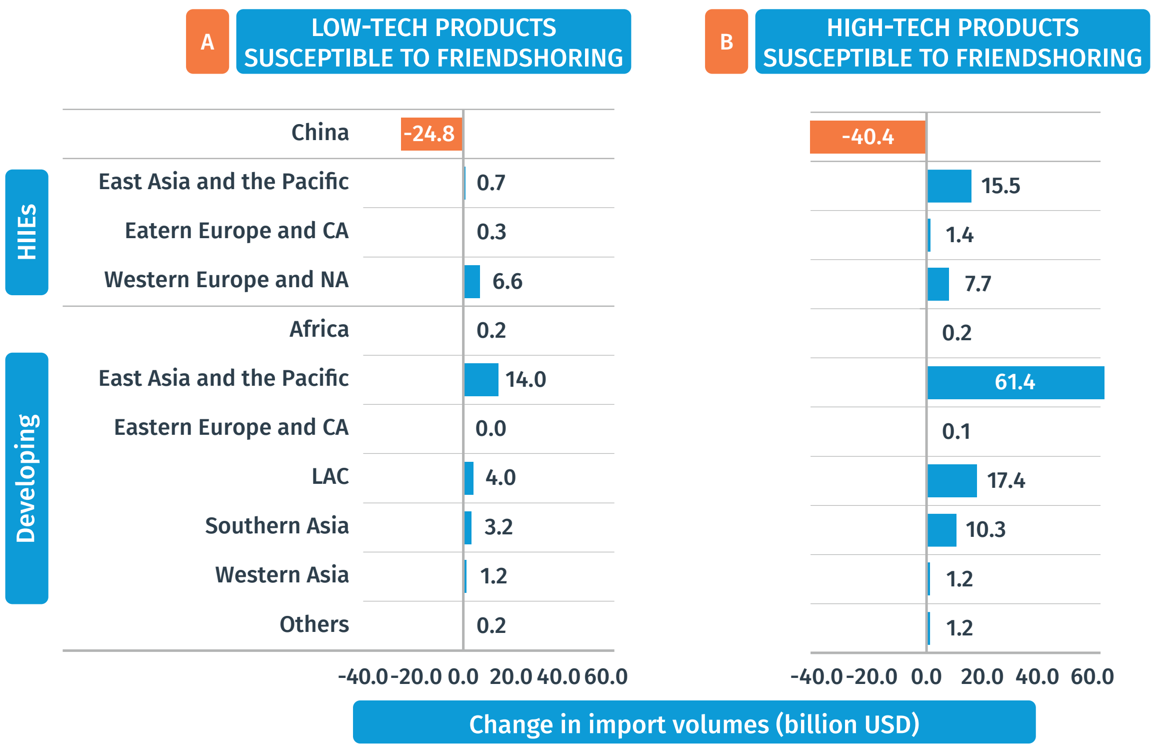
Source: Pietrobelli et al. (2025), policy brief produced for the IDR 2026.

The risk of reshoring is real but remains limited in scale. Take, for instance, the decoupling between the United States and China. While production for the United States market is gradually moving out of China and vice versa, the two countries have continued to increase their imports over time, suggesting that they are shifting to alternative suppliers rather than reshoring production.[58] Where reshoring is taking place, it remains concentrated in specific industries that are particularly conducive to automation, such as the automotive industry.[59] Nevertheless, the new wave of technological innovation, especially in AI, combined with rising tariffs, may intensify reshoring pressures in the near future.

Friendshoring risks locking developing countries into low value-added segments with limited prospects for industrial upgrading. GVCs are often characterized by asymmetric power dynamics, where lead firms from advanced economies retain control over higher-value activities, such as R&D, product design and branding, while outsourcing standardized, lower-value tasks to partners.[60] Early evidence suggests that many products currently subject to friendshoring are relatively simple.[61] This reinforces concerns that, in the absence of industrial policies that can support local firms move into higher-value activities, developing countries risk remaining confined to these low value-added segments with limited prospects for upgrading. The challenge for developing countries is to attract investment, ensure that it occurs in strategic industries, and leverage these investments for knowledge and technology transfer.

Additional risks arise from the combined effect of trade reshuffling and other megatrends. For example, rising tariffs driven by sovereignty concerns, together with sustainability requirements and carbon taxes on imports, could increase costs for firms in developing countries to unsustainable levels, undermining their competitiveness and threatening their broader industrialization trajectory.[62]

Figure 2.8 **Regions are taking advantage of decoupling**



Notes: The graph shows changes in import volumes between 2017 and 2023, measured in billion USD. Products susceptible to friendshoring include products for which imports to the United States from China are declining and domestic production capacity is limited, proxied by a revealed comparative advantage index below 1. These products are further divided between low-tech products (Harvard University's PCI, lower than zero) and high-tech products (PCI higher than zero). CA = Central Asia; LAC = Latin America and the Caribbean; NA = Northern America; and HIIEs = High-income industrial economies. PCI = Product Complexity Index.

Source: Pietrobelli et al. (2025), policy brief produced for the IDR 2026.

2.4.2 Opportunities for future industrialization

The global relocation of production can open new windows of opportunity for developing economies. By attracting foreign investment currently relocating to new domestic facilities, developing countries can enter emerging value chains or expand their participation in existing ones. Friendshoring can also facilitate technology transfer from multinational firms.[63] To capture these benefits, countries need to strengthen supporting frameworks—including infrastructure and education—and assist domestic firms in building production and innovation capabilities. Reinforcing regulation at both the national and international levels is also essential to ensure the sustainability and fairness of GVCs.[64]

As the United States and China decouple, both countries are increasingly sourcing inputs from other countries, creating opportunities for value chain integration and industrialization in developing economies. These opportunities are emerging in product segments where import shares are declining, yet the importing country lacks a competitive advantage in domestic production. For these products, friendshoring (i.e. trade diversion towards geographically or politically closer economies) is more likely to occur. The scope of this opportunity can be illustrated by the decline in imports from China to the United States (Figure 2.8). Products susceptible to friendshoring account for over 6 per cent of manufactured imports to the United States, which is a relatively small share but represents a sizable USD 181 billion in merchandise.[65]

Friendshoring creates opportunities for both low- and middle-income developing economies, depending on their industrial capabilities and patterns of specialization. Products susceptible to friendshoring can be grouped according to their relative technological complexity, highlighting where developing economies might capture new export opportunities. Most decoupling occurs in relatively complex production, providing regions with an existing industrial base the chance to upgrade, such as Asia and Latin America. At the same time, shifts in less complex industries offer entry points for less industrialized countries. While it is too early to assess the full impact, these changes have the potential to increase industrial output and accelerate structural transformation, particularly when they involve higher-value added activities.

Not all activities can be easily relocated, which preserves opportunities for developing countries to participate in GVCs. Many production stages are difficult to reshore due to technical complexity, regulatory requirements, and embedded production networks.[66] This creates space for developing countries to remain integrated in or to enter global manufacturing value chains, provided they can offer reliability, scale and cost-effectiveness.

Beyond friendshoring, the ongoing reconfiguration of GVCs presents additional opportunities for industrial development. For many developing countries, natural resources constitute a strategic advantage, particularly given the rising demand for these resources to support the green and digital transitions. When these resources are leveraged through coherent industrial strategies and trade agreements, they can be used to negotiate entry into GVCs and secure participation in higher value-added segments of the value chain.[67]

2.5 POPULATION GROWTH AND THE CHANGING NATURE OF WORK

2.5.1 The future of work: Demographic and technological shifts

Demographic changes are reshaping labour markets worldwide. Variations in fertility rates, life expectancy, and migration flows have direct impacts on labour force participation among the working-age population.[68] Low-income countries that start developing often see a rapid decline in mortality rates, especially among children, leading to a surge in population growth. Fertility rates typically tend to decline later, influenced by urbanization, rising education levels and evolving social norms. The lag between these two shifts creates a 'bulge cohort' in the age pyramid. When this cohort reaches working age, the country undergoes a period with a low ratio of non-working-age to working-age population, also known as the dependency ratio.[69]

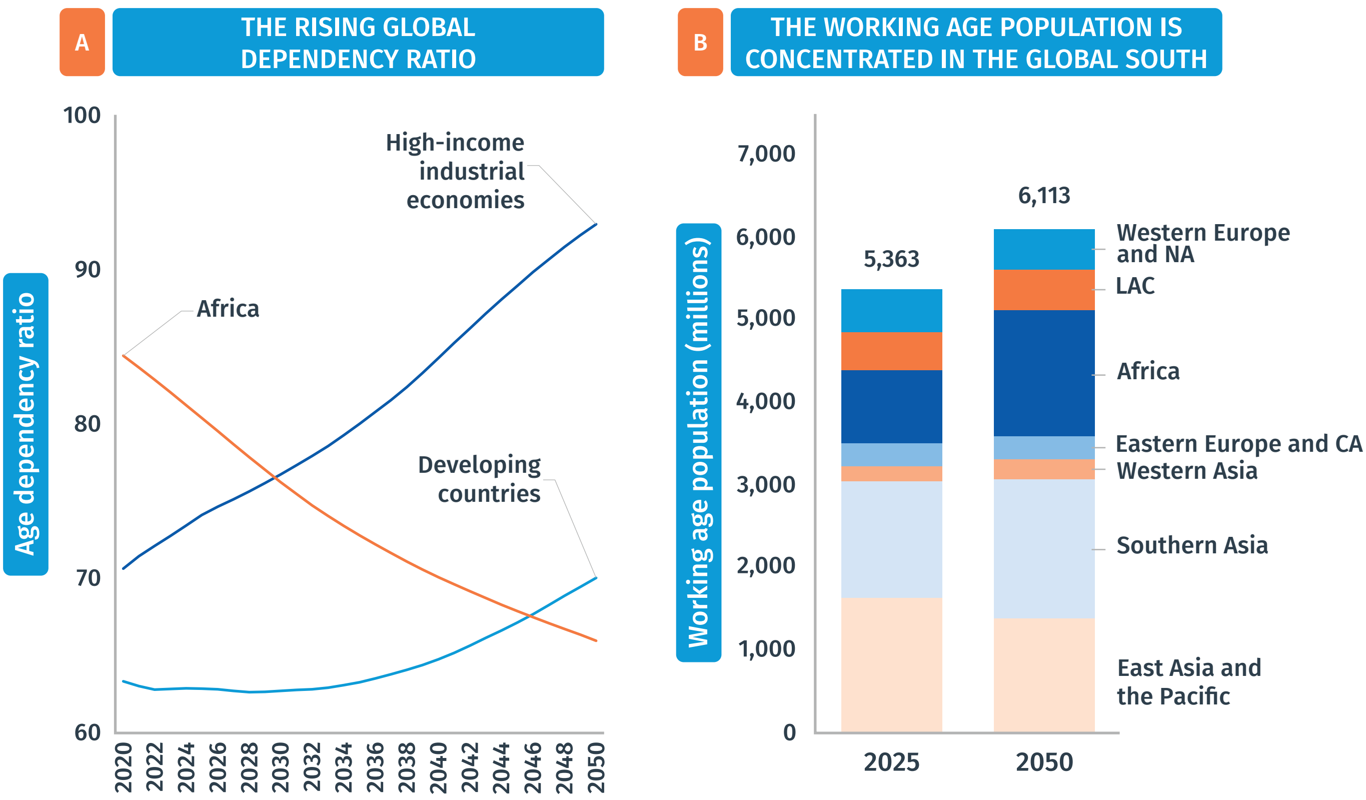
Countries currently stand at different stages of this demographic transition, which generally correlates with their income levels. Leading up to 2050, high-income countries and many industrialized upper middle-income countries will face an ageing population and workforce, resulting in both a shrinking labour supply and a higher dependency ratio (Figure 2.9, Panel A). At the aggregate level, both high-income industrial economies as well as developing countries are projected to witness a significant increase in their age dependency ratios. By 2025, the dependency ratio of high-income countries is expected to exceed 90 per cent, while developing countries' will remain below 70 per cent. African countries exhibit the opposite trend. Their currently high dependency ratio—driven by a large population under 15—is expected to decline by 2050, as this cohort enters the workforce.

Different demographic dynamics indicate that by 2050, the working-age population will be concentrated in the Global South, particularly in Africa. Most LLMIEs are entering a phase where their demographic profile is dominated by a bulge of working-age people. This is especially pronounced in Africa, where the share of the global working-age population is projected to jump from 16.6 per cent to 24.5 per cent between 2025 and 2050 (Figure 2.9, Panel B). A growing working-age population creates the potential for economic growth, referred to as a demographic dividend. Effectively leveraging the opportunities and benefits of this demographic dividend is not automatic and requires the creation of quality jobs for youth, access to education and technical and vocational training. Meanwhile, most high- and middle-income countries in the Americas, Europe and Asia will experience stagnating and ageing populations, leading to a rise in their dependency ratio.

At the same time, new technologies are also reshaping labour markets around the globe. Technological change continues to expand the scope of what can be automated, with impacts on specific occupations depending on the extent to which their tasks are exposed to automation. While the introduction of new technologies and automation may initially pose risks to employment, these effects can be offset by compensation mechanisms, such as productivity gains from increased final demand and the creation of new tasks, which can ultimately support job growth and help balance potentially negative impacts.[70] Evidence shows that AI adoption can generate employment in certain areas, such as in ICT security, while reducing it in others, such as administrative processes and functions.[71] These structural shifts in labour markets may cause significant distributional changes, even in the absence of mass technological unemployment.[72]

Creating stable, high-quality jobs in developing countries will be a key priority for future policy. This is particularly critical for women, who face persistent barriers to accessing high-quality employment in developing countries. One clear example of such gender gaps is in accessing formal work in manufacturing

Figure 2.9 **The changing global demographic structure**



Note: The dependency ratio is defined as the number of people aged 14 or younger and 65 or older per 100 people aged 15–64. CA = Central Asia; LAC = Latin America and the Caribbean; and NA = Northern America.

Source: UNIDO elaboration based on data from the UN World Population Prospects 2024, UN (2025) (medium scenario projections).

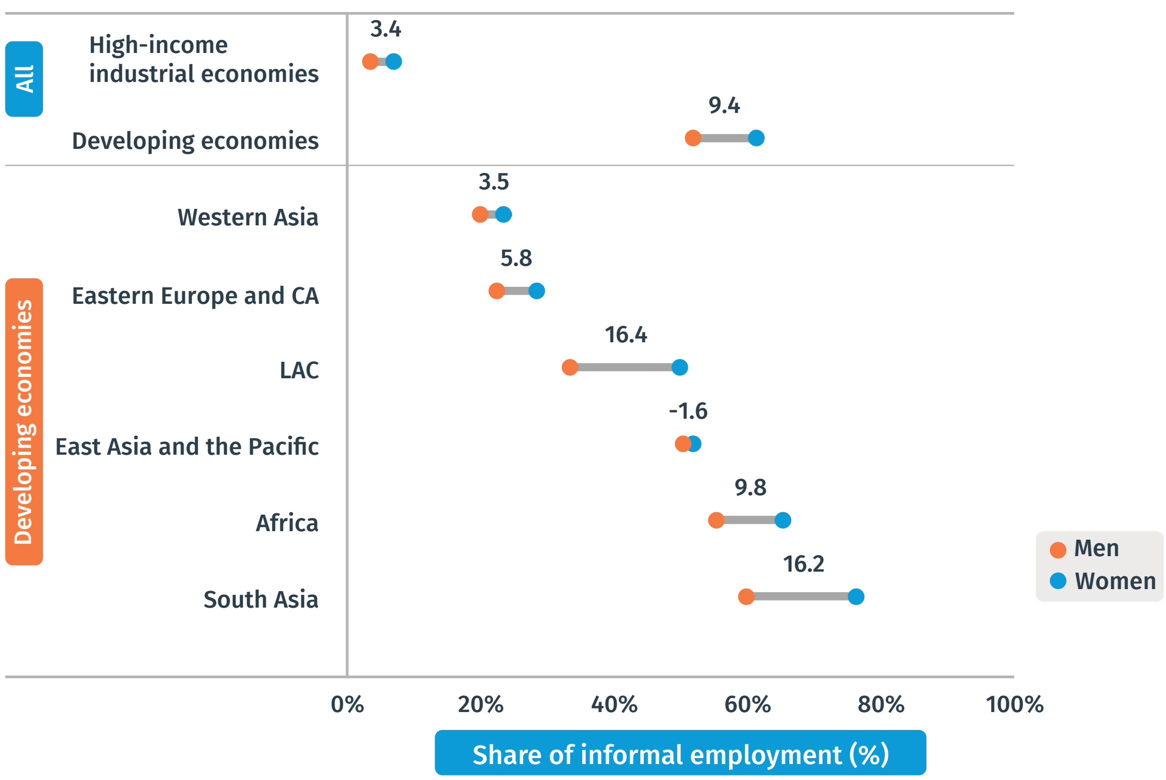
(Figure 2.10). The share of women informally employed in manufacturing is 10.3 percentage points higher than that of men across the world. This gender gap is evident across developing regions, with Latin America and the Caribbean (LAC) and South Asia exceeding 16 percentage points, and Africa showing nearly a 10-point difference. Women are typically also underrepresented in leadership roles and in high-tech industries, while being overrepresented in low-tech ones, as well as in second- and especially third-tier segments of GVCs, where gender data collection and monitoring are often more limited.[73]

2.5.2 Preparing for future jobs: Employment needs in developing countries

Demographic and technological changes will create the need for 1 billion new jobs worldwide by 2050.[74] The world's adult population share is expected to grow by 1.5 billion between 2025 and 2050, with about 800 million expected to be actively participating in the labour market by 2050. This growth in the labour force will take place exclusively in developing economies, with technology adding additional pressure. To offset the labour-substituting effects of automation, 160 million new jobs will be needed by 2050, under a medium-automation scenario.[75] Since these are conservative estimates, they constitute a low-automation baseline. Under a higher-automation scenario, the number of additional jobs needed due to automation-driven displacement could exceed 300 million. These projections should be interpreted with caution: they reflect the likelihood that a task can be automated based on AI's current capabilities, but do not account for its actual adoption, and may therefore overestimate or underestimate the scale of job losses.

The majority of new jobs will need to be created in the Global South, which is projected to host nearly 80 per cent of the new jobs required globally by 2050 (Figure 2.11). In these regions, demographic factors are the primary driver for job creation, accounting for over 85 per cent of new jobs needed. In advanced countries, demographic trends are expected to reduce labour demand, resulting in significantly fewer new jobs being required than in developing countries.

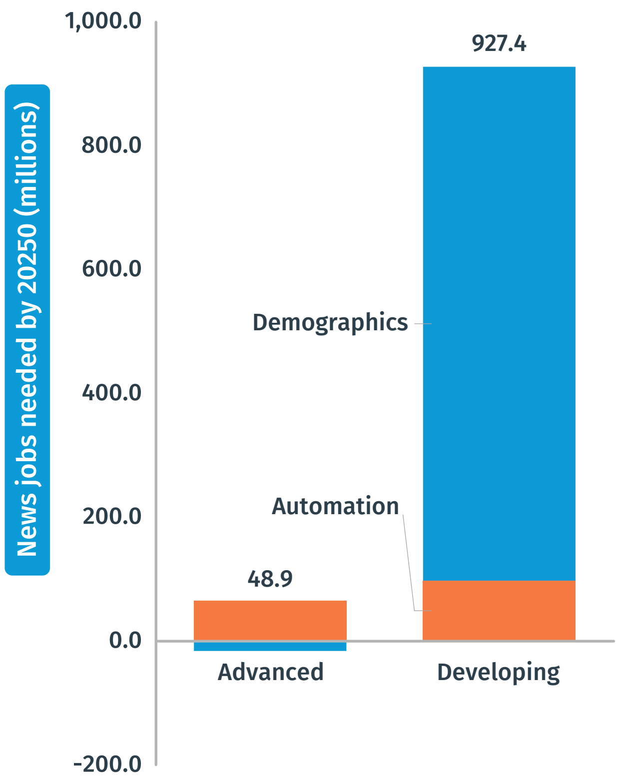
Figure 2.10 **Jobs are increasingly informal across developing regions, disproportionately affecting women**



Note: The labels above the lines indicate the difference in percentage points between the higher share (women) and the lower share (men). CA = Central Asia; and LAC = Latin America and the Caribbean.

Source*:* UNIDO elaboration based on ILO data.

Figure 2.11 **Developing countries projected to need more than 900 million new jobs by 2050 due to demographic and technological changes**



Notes: Bars illustrate the combined projected demand for new jobs resulting from demographic changes and AI-driven automation. New jobs needed due to demographic changes are calculated by projecting the labour force to 2050, assuming an unemployment rate of 4 per cent (or the 2025 rate if lower than 4 per cent). New jobs needed due to AI-driven automation are based on the share of jobs susceptible to automation, using estimates from Gmyrek et al. (2023) and an additional annual automation rate of 2.5 percentage points.

Source: Prettner et al. (2025), policy brief produced for the IDR 2026.

2.5.3 The future role of industrialization for employment generation

Job creation will be a central priority for future policy action. The projections highlight the urgent need for mission-oriented industrial policies in developing economies to generate sufficient employment opportunities to absorb both the influx of new labour market entrants and workers displaced by automation. Industrialization remains the key driver of employment in developing economies due to its capacity to produce higher-quality jobs and its strong multiplier effects.[76] While automation may pose risks to manufacturing employment, job growth in related industries through productive linkages is expected to remain robust. Industries such as renewable energy and the circular economy can support job creation at scale.

Developing countries should take concrete steps to strengthen the role of manufacturing in creating high-quality jobs. Together with industrial policies that ensure such jobs even exist, initiatives that increase labour protection and workers' bargaining power are essential to maintain jobs of high quality. Larger investments will also be needed to improve domestic education systems, vocational training, reskilling programmes for displaced workers, and lifelong learning and training programmes to equip workers with skills needed in a highly automated environment.[77] Gender-focused policies are particularly important to address horizontal inequalities in the labour market, such as fostering women's participation in technical or science, technology, engineering and mathematics training and ensuring access to safe health care and care systems to reduce the domestic burden on women. Expanding women's participation in medium- and high-tech industries has the potential to drive both productivity and inclusion.

2.6 THE TRANSFORMATION OF FOOD PRODUCTION SYSTEMS

2.6.1 Increased demand and the integration of agriculture and manufacturing

Rising populations, incomes and urbanization are fuelling a surge in global food demand.[78] Worldwide, food demand is projected to increase by 35 per cent by 2050, with some regions showing increases in demand of over 60 per cent (South Asia and Western Asia) or even doubling in Africa (Figure 2.12, Panel A). Meeting this demand will require agro-industries to feed more people with higher-quality food while reducing environmental impacts. Without adaptation, many regions risk increasing their dependence on food imports, missing opportunities for rural-based industrial development.[79] At the same time, climate change is transforming agricultural production, reshaping which crops can be grown, where production takes place and how food is processed, which can drive the adoption of resilient varieties and innovations, such as water-efficient irrigation, vertical farming and climate-proof logistics.

It is precisely in the regions where food demand is projected to grow faster that dependence on food imports is likely to intensify. Countries with low agricultural productivity and limited output tend to become reliant on food imports, exposing them to global market volatility and potential supply disruptions.[80] This pattern extends to processed food as well. Between 2000 and 2020, the share of processed foods in Africa's total food imports increased from 28 per cent to 33 per cent, a trend that is likely to continue, unless agricultural growth and food processing output can outpace rising demand.[81]

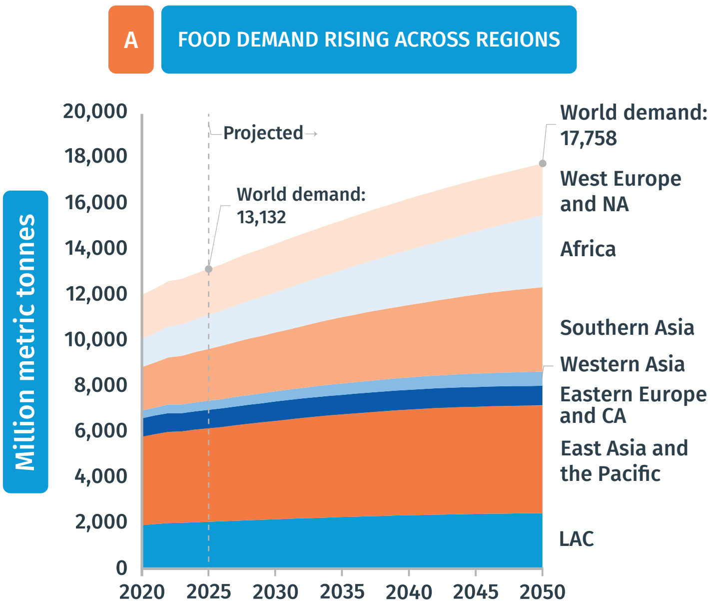
Rising demand is driving the rapid transformation of food systems across developing economies. As diets diversify to include more processed, nutritious and convenient foods, food systems are shifting from traditional to modern ones (Figure 2.12, Panel B). They are characterized by longer and more formalized value chains and by technological change both on- and off-farm (Table 2.3). Initially observed in East Asia and LAC, these dynamics are now increasingly evident in South Asia and sub-Saharan Africa as well. As transformation progresses, food processing gains importance and countries become more integrated into regional and global trade. More recently, the digital transition and AI have begun reshaping food systems. Looking ahead, a new wave of potentially disruptive innovations, such as gene editing, synthetic food production and frontier agriculture, including insect farming, may play an increasingly significant role.[82]

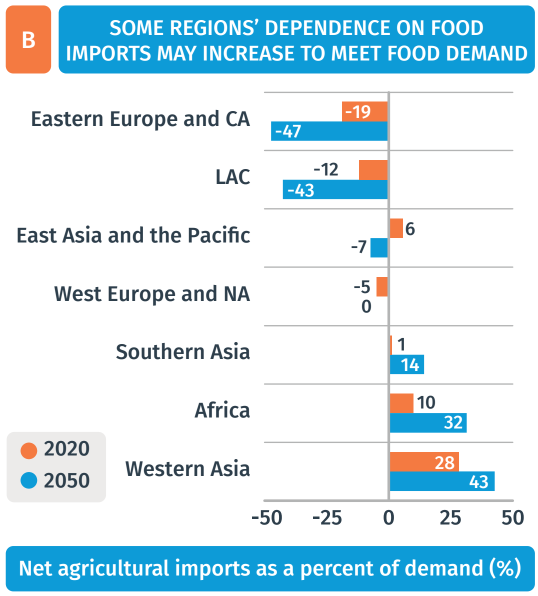
At the heart of this transformation lies the blurring of boundaries between manufacturing and agriculture. Strong linkages have always existed between the two sectors, with labour moving from agriculture to manufacturing and the two sectors exchanging inputs and commodities, such as affordable food, on the one hand, and tractors and fertilizers, on the other.[83] These linkages are now deepening.

On the farm, mechanization serves as a major bridge linking agriculture and manufacturing. The replacement of human labour with mechanical power now takes place through technologies such as tractors, harvesters, shellers, threshers and irrigation systems. By reducing farm labour and improving production efficiency, mechanization boosts agricultural productivity, strengthens the competitiveness of local food systems, and contributes to structural transformation. Where mechanization leads to higher yields and incomes, it can also increase overall agricultural employment.[84]

Digitalization is another major driver of transformation of farms and is expanding rapidly across developing economies. It offers opportunities to improve farm productivity and lower transaction costs among value chain participants. The widespread diffusion of mobile phones and computers has enabled the use of software tools even in less mechanized farming systems.[85] Digital platforms, such as those for mobile finance or tractor hire, can further reduce transaction costs and mitigate risks. By contrast, the diffusion of digital hardware integrated into farm equipment, which combines data sensing, analytics and automation for applications ranging from irrigation to harvesting, is progressing more slowly.[86] Ownership over digital platforms and inputs plays an important role, as reliance on foreign providers risks widening the technological divide between the Global South and the Global North.[87]

Figure 2.12 **Future food demand will outpace local supply in many developing regions**





Notes: CA = Central Asia; LAC = Latin America and the Caribbean; and NA = Northern America.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

Off the farm, the transformation of food production systems is closely linked to the rise of food processing industries. Food processing is among the fastest-growing industries in many developing countries, and plays a key role in industrial development and reshaping food systems.[88] As countries industrialize, agrifood processing gains increasing importance within their economy.[89] This rise is fuelled by urbanization, growing demand for food safety and quality, and shifting dietary patterns, including greater consumption of meat, dairy, fruits, vegetables and convenience foods.[90]

Bridging agriculture, manufacturing and food processing can serve as a powerful driver of rural industrialization. Compared to other industries, agrifood processing has relatively low barriers to entry, making it a common starting point for the industrialization of agrarian economies. In its early stages, the industry is typically more labour-intensive and less technology-intensive than other industries. Consequently, in many developing countries, food processing is one of the largest sources of non-farm employment.[91] In Africa, it contributes substantially to both employment and value added, with food

Table 2.3 **Transition of food systems in developing economies**

	"Traditional"	"Transitional"	"Modern"
Food consumption	• High share of staple crops. • Local and seasonal diets.	• Declining share of staple crops. • Growing share of animal-based food, fruits and vegetables.	• Low share of staple crops. • High share of animal-based food, fruits and vegetables. Processed and ready-to-eat foods.
Food production	• Small-scale. • Labour-intensive.	• Small-to-medium scale. • Growing importance of capital (mechanization, external inputs).	• Large-scale. • Capital-intensive (mechanization, external inputs).
Food processing, retail, trade	• Short, local value chains. • Non-vertical and horizontal integration. • Limited processing and value addition. • No food safety and quality standards. • Lack of contracts.	• Long, rural-urban value chains. Emerging SMEs (e.g. small mills). • Mixed retail environment (e.g. wet markets). • Growing importance of standards and (relational) contracts.	• Long, rural-urban and globally integrated value chains. • Large wholesalers, processors and supermarkets, including foreign investors. • High public and private standards and formal contracts.
Implications for manufacturing	• Economy is dominated by labour-intensive agriculture. • Low demand for production and processing technologies. • Manufacturing is dominated by artisanal and informal producers (e.g. blacksmiths, craftspeople).	• Declining economic importance of agriculture in relative terms. • Growing importance of off-farm agrifood manufacturing. • Rising demand for (small-scale) production and processing technologies and biotechnology. • Development of agri-businesses related to machinery, inputs, trade, processing, retail - by a mix of artisanal and informal producers and formal SMEs. • Gradual shift of labour to new subsectors (dairy, meat, dairy, fruits, vegetables) and off-farm food manufacturing.	• High economic importance of off-farm agrifood manufacturing. • High demand for (high-tech) processing technologies and biotechnology. • Increasingly integrated agro-industrial systems. • Agrifood processing, trade, and transport dominate GDP of agrifood system. • Agrifood jobs are concentrated in midstream and downstream agrifood systems, offering better pay.

Source: Daum (2025), policy brief produced for the IDR 2026.

import substitution providing further opportunities for job creation.[92] Employment in agrifood processing also tends to be more inclusive, providing opportunities for women and low-skilled workers, and is known to be less spatially concentrated than employment in other industries.[93]

The development of domestic food processing industries creates economic spillovers for farms. Technologies for processing, preservation and transport, such as mills, dryers, cold storage and refrigerated trucks, can substantially reduce food losses, particularly for highly perishable non-staple products such as dairy, meat, fruits and vegetables. By mitigating losses, estimated to exceed 30 per cent for perishable goods, these technologies strengthen farmers' incentives to produce for markets and enhance the competitiveness of domestic food production.[94] Food processing also adds value along the supply chain and generates positive spillovers to related industries such as logistics and retail. Similar to mechanization, it stimulates demand for industrial products such as grain mills and oil presses, thereby creating additional opportunities for local manufacturing.[95]

2.6.2 The state of play in the transformation of food systems across regions

The transformation of food production systems is progressing unevenly across the globe, with negative implications for poverty and hunger. Over 700 million people face hunger globally, with substantial regional differences. In Africa, hunger affects 20 per cent of the population, compared to 8 per cent in Asia and 6 per cent in Latin America.[96]

The pace of mechanization in African economies lags behind other regions of the globe. While mechanization is already relatively widespread in LAC and much of Asia, it remains limited across Africa.[97] Expanding mechanization among the world's 500 million smallholder farms (80 per cent of which are less than two hectares) represents a significant opportunity for the manufacturing sector in developing countries. Recent evidence indicates that in Africa, local manufacturers of farm machinery, equipment and spare parts have a competitive edge over foreign producers, as they can produce equipment tailored to local agro-ecological conditions.[98] Expanding local machinery and equipment production can also stimulate demand for domestic inputs, ranging from steel and rubber to electronics.

The adoption of digital agriculture continues to be constrained by low levels of mechanization. Technologies such as automated systems for barns, greenhouses, and irrigation, as well as drones, are becoming increasingly common in some developing countries. Some countries, including India and China, are witnessing the rise of vibrant agri-tech industries centred around the development of automated greenhouse systems, livestock production, irrigation solutions and agricultural drones. A notable example is Kenya's "Silicon Savannah", which focuses on providing digital services to farmers. However, in countries where the pace of mechanization remains slow, the local production of digital tools and their adoption remain limited.[99]

Access to finance and skill shortages pose significant barriers to scaling up mechanization, digitalization and processing. On farms, the high cost of technology limits adoption, a challenge that manufacturers also face. Across the sector, limited access to finance restricts domestic equipment manufacturers from scaling up operations or investing in quality improvements. In addition, both processing firms and equipment manufacturers face shortages of skilled workers.[100]

Turning megatrends such as the transformation of food systems into industrial development opportunities for developing economies requires targeted policies and strategic investment. The following chapter outline seven areas of action that these countries can pursue to prepare for megatrends, strengthen domestic industrial ecosystems and build future-ready industries.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ENDNOTES

[1] This section builds on Lema (2025), policy brief produced for the IDR 2026, and Somavilla et al. (2025).
[2] Dhakal et al. (2022).
[3] Somavilla et al. (2025).
[4] IEA (2024a).
[5] The extraction and processing of raw materials into products, their use and eventual disposal in a linear economic model are together estimated to be responsible for more than half of global greenhouse gas emissions. For further information see: Ellen MacArthur Foundation (2019); Circle Economy (2023); EEA (2016); Deloitte (2016).
[6] EVs require about six times more mineral inputs than internal combustion engine vehicles, while onshore wind plants require up to nine times more mineral resources per unit of capacity compared to gas-fired power plants. See Somavilla et al. (2025).
[7] UNIDO (2021a).
[8] IEA (2024b).
[9] Carlin et al. (2023).
[10] Mongelli et al. (2024).
[11] UNCTAD (2022).
[12] Tunn et al. (2024).
[13] Haddad et al. (2024).
[14] Lema and Rabelotti (2023).
[15] Lema (2025).
[16] Lema et al. (2021).
[17] Pegels and Altenburg (2020).
[18] Lema and Perez (2025).
[19] See, for example IEA (2024c).
[20] IEA (2024c).
[21] Lema et al. (2024b).
[22] Intarakumnerd and Charoenporn (2024).
[23] UNEP (2024).
[24] Lebdioui et al. (2021).
[25] See Box 6.1 in Chapter 6.
[26] See Section 8.3.1 in Chapter 8.
[27] Asiama et al. (2025).
[28] Lema et al. (2024a).
[29] This section builds on Labrunie et al. (2025), policy brief produced for the IDR 2026.
[30] Research on AI, for example, dates back to the 1950s. In 1951, the first artificial neural network, known as the Stochastic Neural Analog Reinforcement Calculator was designed to model human behavior through reinforcement learning, known as a type of machine learning process. See Mucci (2025).
[31] See Miroudot and Cadestin (2017).
[32] For example, in the manufacturing sector, generative AI is used to optimize design processes, develop new products, and enhance production efficiency. In finance, it supports personalized financial advisory services and the creation of tailored investment strategies. In healthcare, it complements medical diagnostics and assists in drug discovery by facilitating molecule screening and design. For additional examples of AI applications, see Calvino et al. (2025).
[33] See Damioli et al. (2025).
[34] Calvino et al. (2025).
[35] Ibid.
[36] Vinuesa et al. (2020).
[37] Wang et al. (2024).
[38] Bhandari (2025).
[39] See Damioli et al. (2025).
[40] See Kergroach and Héritier (2025).
[41] See Aghion et al. (2025). Calvino and Fontanelli (2023), McElheran et al. (2024).
[42] UNIDO (2019). See also Delera et al. (2022).
[43] See Cirera et al. (2022) and Liu and Wang (2024).
[44] Labrunie and Chang (2025).
[45] For a systematic literature review on the topic, see Filippi et al. (2023).
[46] Labrunie et al. (2025).
[47] See McKinsey (2023), NAM (2024).
[48] Labrunie and Chang (2025).
[49] This section builds on Pietrobelli et al. (2025), policy brief produced for the IDR 2026.
[50] The Global South in this report is associated with all economies not classified as high-income industrial economies in UNIDO's 2025 statistical classification by level of development.
[51] OECD (2025b).
[52] UNIDO (2023b).
[53] UNIDO and WIFO (2025).
[54] See, for instance Boeckelmann et al. (2024).
[55] See, for instance Lamperti et al. (2025).
[56] Alfaro and Chor (2023).
[57] See, for instance Krenz et al. (2021).
[58] Freund et al. (2024).
[59] Faber et al. (2025).
[60] See, for instance UNIDO (2023c) and Gereffi et al. (2005).
[61] Blanga-Gubbay and Rubínová (2024).
[62] See, for instance Section 2.2 and Xiaobei et al. (2022).
[63] Lee (2021).
[64] UNIDO (2023c).
[65] Pietrobelli et al. (2025).
[66] See, for instance Panon et al. (2024). See also Thun et al. (2023).
[67] Karkare and Medinilla (2023).
[68] Bloom et al. (2019), Abeliansky et al. (2020).
[69] Canning et al. (2015).
[70] See Autor and Salomons (2018), Autor et al. (2024).
[71] Aghion et al. (2025).
[72] Freire (2025).
[73] Hartwich et al. (2025b).
[74] The analysis in this section is based on Prettner et al. (2025), policy brief produced for the IDR 2026.
[75] These projections draw on estimates of the share of jobs at risk of automation from AI, differentiated by country income group reported in Gmyrek et al. (2023).
[76] Lavopa and Riccio (2025).
[77] Prettner and Bloom (2020).
[78] This section builds on Daum (2025), policy brief produced for the IDR 2026.
[79] Hartwich et al. (2025a).
[80] Gollin (2023).
[81] UNCTAD (2023).
[82] Klerkx and Rose (2020).
[83] See, for example Lewis (1954).
[84] Adu-Baffour et al. (2019). In addition, when it replaces unpaid family labour—including that of women and children—or compensates for workers shifting to better-paying industrial jobs, its labour-saving effects can be positive. See Daum (2023).
[85] These include services providing market price updates, weather forecasts, extension advice, as well as more advanced tools for farm-specific decision support using farmer-entered data, hand-held sensors, or satellite imagery.
[86] See Birner et al. (2021) and Daum et al. (2021).
[87] See, for example Mann and Iazzolino (2021).
[88] Ellis et al. (2022).
[89] Hartwich et al. (2025a).
[90] Barrett et al. (2022).
[91] Christiaensen and Kanbur (2017).
[92] Ellis et al. (2022).
[93] Christiaensen and Kanbur (2017).
[94] Ellis et al. (2022).
[95] Daum (2025).
[96] UNIDO and FAO (2024) .
[97] Ibid.
[98] Daum et al. (2024).
[99] Birner et al. (2021).
[100] Daum et al. (2024).

CHAPTER 3 BUILDING FUTURE-READY INDUSTRIES

Preparing for the future requires building stronger industrial ecosystems through coordinated action across seven key areas: (i) infrastructure, (ii) institutions, (iii) skills, (iv) technology, (v) regional integration, (vi) environmental sustainability, and (vii) financing. While progress has been made, many countries continue to face persistent structural bottlenecks. Expanding infrastructure is essential, alongside strengthening government capacities to design and implement goal-oriented industrial policies. Scaling up research institutions to foster university-industry linkages, facilitate cluster development and promote international technology transfer can accelerate industrial upgrading. Deeper regional integration and the mobilization of long-term, risk-tolerant capital remain critical. At the same time, emerging challenges demand new approaches. Developing countries must decarbonize, enhance circularity and improve resource and energy efficiency. A dual focus on green and digital skills—particularly among women and youth—is essential to equip the workforce of the future. Ambitious regional trade agreements can deepen integration and attract investment. Finally, innovative financing instruments can unlock the scale of investment required for sustainable industrialization.

Xiaolan Fu

"The Fourth Industrial Revolution and the green transition present significant challenges for developing countries, but they also open new windows of opportunity to catch up with—and even leapfrog—the Global North. Making the most of these opportunities requires the global community to incentivize technological advancements towards inclusive and sustainable industrial development, and create and transfer more appropriate, future-oriented technologies to developing countries."

Founding Director of the Technology and Management Centre for Development and Professor at the University of Oxford

3.1 PREPARING DOMESTIC ECOSYSTEMS FOR TOMORROW'S INDUSTRIAL LANDSCAPE

Megatrends are reshaping the global industrial landscape, presenting both new challenges and deepening existing structural bottlenecks for developing countries. Long-standing constraints such as inadequate infrastructure and financing, limited capabilities to absorb and create new technologies, demographic pressures and persistent skills mismatches continue to hamper industrial development. These obstacles are well known and unlikely to disappear without targeted intervention. Unless they are decisively addressed, future industrialization will fall short of achieving the speed and scale needed to meet the global challenges outlined in Chapter 1.

On the other hand, new and more complex challenges are emerging. Developing countries must reposition themselves in rapidly evolving global supply chains, seize the opportunities that are opening and manage the risks of artificial intelligence (AI) and other advanced digital production technologies, pursue environmental sustainability while maintaining competitiveness, and prepare the labour force for profound transformations in employment. Mobilizing the necessary resources to meet this broader agenda will require reforms of the international financial architecture to lower debt costs and risks, while expanding access to affordable, long-term financing for industrial development.

Traditional boundaries are blurring between production and services, domestic and global knowledge flows, and manufacturing and science. Some of these shifts have been unfolding for a long time, such as the fragmentation of production across regions. Others are new or accelerating rapidly. Digital technologies now permeate all sectors, eroding sectoral definitions.[1] Consumer products, such as electric vehicles (EVs) or smartphones, are evolving into multifunctional platforms that integrate multiple applications and tools and require complex collaborations among suppliers with complementary capabilities.[2] At the same time, science and industrial production are becoming increasingly intertwined, fostering environments where firms, public institutions, intermediaries and consumers interact across distances and domains.[3]

Adapting to these transformations requires coordinated action across multiple, interconnected fronts. Industrial policy can no longer be narrowly confined to just manufacturing; it must embrace an ecosystem perspective. Future industrialization will be embedded in networks of actors, technologies and relationships that cut across sectors and regions. These ecosystems are dynamic; they co-evolve in response to technological progress, shifts in consumer preferences, regulatory changes and broader societal transformations.[4] Understanding and supporting this dynamic interplay will be central to developing countries' ability to industrialize successfully in the era shaped by megatrends.

Against this backdrop, this chapter examines the key areas of action required to build industrial ecosystems that are resilient, sustainable and future-ready. The discussion is organized around seven interlinked pillars: (i) infrastructure, which ranges from transport networks to digital connectivity; (ii) institutions which, together with infrastructure, create the enabling environment for ecosystems to take root and grow; (iii) the workforce's productive capabilities and skills, which encompass the industrial know-how and human capital that underpin every dimension of industrial performance; (iv) technology adoption, emphasizing the policies and investments needed to equip firms with the tools to compete in rapidly evolving markets; (v) cross-border integration and coordination, aimed at strengthening connections

An industrial ecosystem refers to the complex network of interconnected actors, from startups to large corporations, academia, research institutions and service providers, that operate within a specific value chain to produce a given manufactured good.

Source: ECCP (2025); European Commision (2024a).

What are industrial ecosystems?

within and across ecosystems to enhance resilience; (vi) greening of production to ensure that industrial ecosystems balance sustainability with competitiveness, and (vii) the importance of financing which ensures that the actions envisaged under the six preceding pillars can be adequately resourced.

Together, these seven pillars provide a comprehensive framework for guiding countries in navigating transformative forces and establishing the foundations for inclusive and sustainable industrial development in the age of megatrends.

3.2 IMPROVING INFRASTRUCTURE

Infrastructure forms the bedrock of a modern society and economy.[5] It considerably reduces production and transaction costs, thereby expanding market access and enabling specialization and economies of scale, yielding long-term productivity gains. Strategic investment in infrastructure also offers a direct pathway to sustainable industrialization and job creation by stimulating demand across interconnected manufacturing sectors. Furthermore, infrastructure, especially ports and special economic zones, provides a significant opportunity to directly boost economic growth and intra-regional trade (see Section 3.5).

Traditionally, infrastructure consisted of robust transport networks, reliable energy systems, functional telecommunications and efficient logistical hubs. However, since the turn of the 21st century, the global industrial landscape has experienced a profound paradigm shift driven by the megatrends described in Chapter 2. A new generation of industries has emerged, requiring infrastructure that far exceeds the traditional scope, necessitating smarter, greener, more integrated and innovative systems.

Megatrends are driving the emergence of three distinct types of infrastructure: (i) information, (ii) integration, and (iii) innovation infrastructure. Information infrastructure serves as the digital economy's "nervous system", encompassing communication networks such as 5G, the Internet of Things (IoT) and satellite internet, which provide high-speed, low-latency connectivity. It also includes advanced technology infrastructure such as AI, cloud computing and blockchain, essential for data processing, intelligent decision-making, and value circulation. Additionally, data centres and intelligent computing hubs will play a crucial role in retaining and processing data locally, facilitating greater technology adoption and industrial advancement.

Integration infrastructure combines digital technologies with traditional systems to enhance operational efficiency, service capacity and sustainability. Green industrial infrastructure is a key example, which can include smart grids, pollution monitoring systems, virtual power plants, eco-industrial parks and digitalized waste management systems that integrate low-carbon performance with circular resource use.[6]

Innovation infrastructure primarily refers to public facilities that support scientific research, technological development, product research and development (R&D) and commercialization, fostering an open, collaborative and efficient innovation ecosystem. National innovation institutions and laboratories play a critical role in linking universities with industry, providing foundational innovation and high-calibre talent to drive industrial advancement. Innovation infrastructure can be reinforced by social infrastructure, such as medical centres, parental support systems and welfare facilities, that enhance workers' well-being and promote gender equality, thereby fostering productivity and innovation.

In addition, quality infrastructure, comprising institutions responsible for metrology, standardization and accreditation, is undergoing a profound transformation. The integration of advanced technologies is reshaping and enhancing measurement and standardization systems, giving rise to Smart Quality Infrastructure.[7] This evolution will be critical for harnessing the opportunities presented by the digital and green transitions. From a digital perspective, the standardization of Industry 4.0 technologies can facilitate technology transfer, the adoption of smart manufacturing systems and enhance productivity. From the green perspective, a stronger focus on sustainability standards and the application of advanced computational tools for conformity assessment can support the development of green supply chains and strengthen developing countries' participation in international trade.

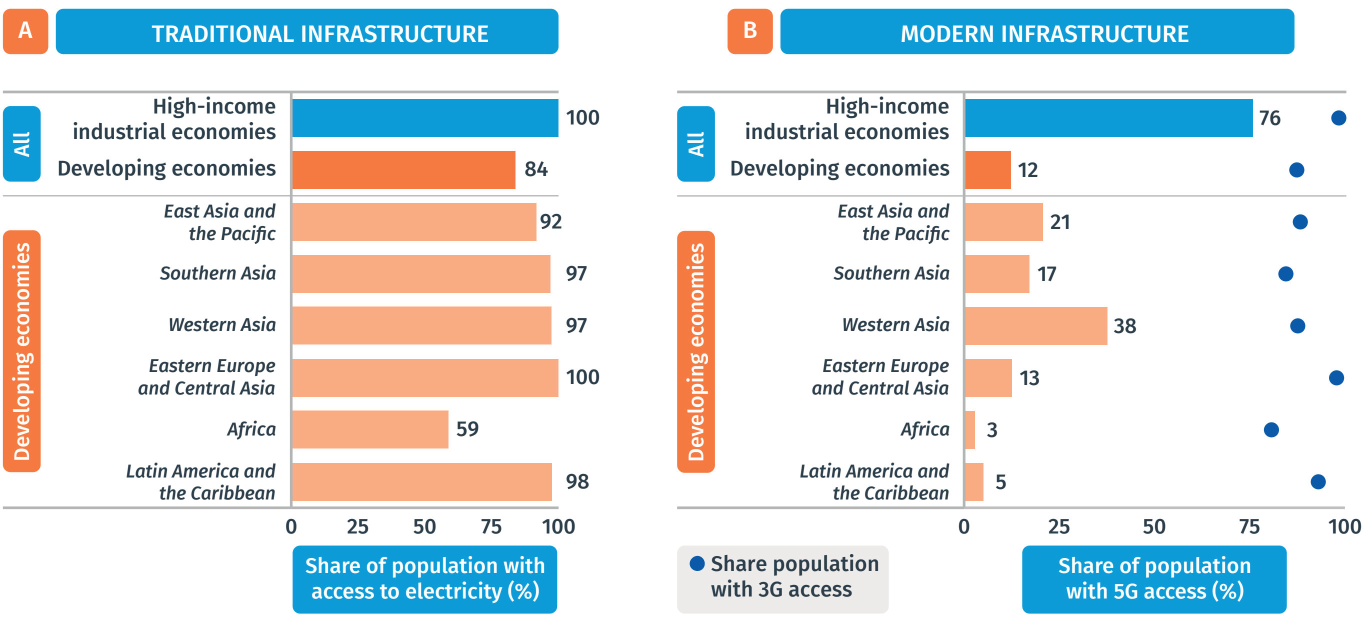
Yet many developing countries face significant deficits, beginning with traditional infrastructure. As Figure 3.1 (Panel A) illustrates, access to electricity remains limited in some developing regions. While high-income industrial economies and parts of the developing world enjoy near-universal coverage (95 per cent to 100 per cent of the population has access to electricity), only around 60 per cent of the population in Africa has access to the electrical grid.

Emerging infrastructural needs are even more pressing. Modern infrastructure remains underdeveloped (Figure 3.1, Panel B). Most of the world's population has access to 3G networks, yet in developing regions, access to 5G remains very limited. This is concerning, as 5G offers significantly greater capacity to process large data volumes than earlier generations of wireless technologies. It is a key enabler, for example, for technologies such as IoT applications.[8] Even in East Asia and the Pacific, where deployment is higher, the share of the population with 5G access does not reach 25 per cent. Insufficient information infrastructure increases reliance on foreign providers, constrains technology choices, and slows domestic innovation and adaptation.[9] A similarly worrying picture emerges for integrated infrastructure, such as EV charging networks, which remain concentrated in a small number of emerging and high-income economies.[10]

Addressing these deficits requires a strategic approach that anticipates future industrial demand. Developing countries should focus on four cross-cutting levers. First, traditional energy and transport networks should be integrated with digital and green technologies, linking energy, transport, and data flows to build sustainable supply chains. Second, infrastructure planning should adopt a regional diffusion approach, and foster cross-border collaboration with local governments and stakeholders to enhance economic spillovers and connectivity. Third, shared-ownership and open-access models can distribute investment costs among multiple users, lower fixed costs, expand participation, and facilitate access to advanced technologies. Finally, infrastructure development should be aligned with the country's factor endowments to ensure that investments address specific production needs while supporting long-term industrial upgrading. Eco-industrial parks, which complement comprehensive industrial plans by providing roads, transport and public utilities, offer a practical instrument for implementing these priorities.[11]

Infrastructure investment is also critical for strengthening food systems, as it yields large payoffs by simultaneously supporting production, processing and trade. In addition, infrastructure can be designed to be environmentally sustainable. Green mechanization, where equipment such as irrigation and cooling systems, mills and small tractors are powered by renewable energy sources, reduces dependence on unreliable energy networks, lowers energy costs and strengthens sustainability. New renewable energy generation technologies also provide alternative energy sources while creating business opportunities for farmers through, for example, solar-powered mini-grids and agrophotovoltaic systems.[12]

Figure 3.1 **Developing countries show strong deficiencies in both traditional and modern infrastructure**



Note: Numbers refers to simple averages for countries in each group. See Annex A.2 for detailed descriptions of indicators and data procedures.

Source: UNIDO elaboration based on World Bank (2025a) and UNSD (2025a).

Box 3.1 China: Infrastructure policies for future-ready industries

Over the past decade, China has developed a distinctive and effective model for advancing new infrastructure, combining strong government leadership, active market participation and coordinated deployment of advanced technology. Strategic long-term planning through frameworks such as the Five-Year Plans are central to this approach, providing strategic guidance while accommodating regional and local planning and coordination across government levels. Another key feature is its hybrid investment system which combines public guidance with private capital. Fiscal Construction Funds and National Guidance Funds supply long-term, purpose-driven financing, complemented by public-private partnership models and capital market financing. Integrated infrastructure development is prioritized, linking physical assets, digital platforms and applications to enable systemic industrial upgrading. State-owned enterprises play a critical role in leveraging their capital and operational capacity to drive large-scale projects and foster innovation networks. Lastly, China emphasizes robust institutional frameworks, including legal, regulatory and technical standards to ensure sustainable infrastructure development for the future.

Source: UNIDO elaboration based on Wang et al. (2025)

3.3 STRENGTHENING INSTITUTIONS

Governments play an important role in supporting economies to adapt and respond to megatrends. Just as in larger, industrialized economies, governments in lower- and middle-income countries can influence the pace and direction of change. Their role can be protective, by creating safety nets and targeted transfers to mitigate negative impacts, or proactive, by building industrial capabilities that allow firms to enter new markets and foster the emergence of new industries and products. For lower- and middle-income countries, a proactive approach also means making strategic decisions about which domestic capabilities to strengthen, ensuring that firms can leverage participation in global value chains (GVCs) and knowledge to upgrade, while also laying the foundations for resilient industrial ecosystems.[13] Against this backdrop, governments around the globe are supporting firms in adopting advanced digital production technologies,[14] taking advantage of the green transition,[15] harnessing natural endowments,[16] and adapting to a rapidly changing international trade landscape.[17]

The directionality of transformation means that governments in developing countries have three essential roles to play.[18] The first is leadership. Governments must formulate a clear strategic vision and establish an enabling environment for both producers and consumers. The second is the management of externalities and global development challenges, including effective responses to climate change or public health emergencies and the equitable diffusion of technology, which by their very nature cannot be contained within national borders and therefore demand international collaboration. Third, governments must ensure the equitable distribution of the gains from the digital and green transitions. Addressing inequality is not only indispensable for social stability but also for sustaining effective domestic demand.

A clear strategic vision, goal orientation and focus on coalition-building are critical building blocks for future-proof industrial policies. Policy goals are unlikely to be achieved by a single ministry or one technical field. In an evolving global landscape, progress is more likely to be achieved when different stakeholders from the public and private sectors align around a set of shared objectives. This includes collaboration across different government departments, policy coordination and the exchange of information, as well as partnerships with knowledge institutions including universities and research centres. Broad-based coalitions can also strengthen societal consensus in countries, which often proves valuable for the success of industrial policies.[19] In addition, industrial policy interventions should be time-bound and subject to close monitoring and evaluation.

Effective implementation capabilities are critical. As megatrends accelerate and industrial policies become increasingly goal-oriented, decision-making and policy design grow more intricate.[20] In an increasingly complex global landscape, government capacities, notably management skills and bureaucratic autonomy, are gaining in significance. Management capacity combines operational and analytical skills, enabling governments to design, execute and monitor policies effectively and to conduct foresight exercises. It requires profound knowledge of the markets and firms targeted by industrial policy, access to high-quality data and both technical and managerial expertise. Bureaucratic autonomy refers to the degree of independent authority and discretion that public institutions have to implement policies.[21]

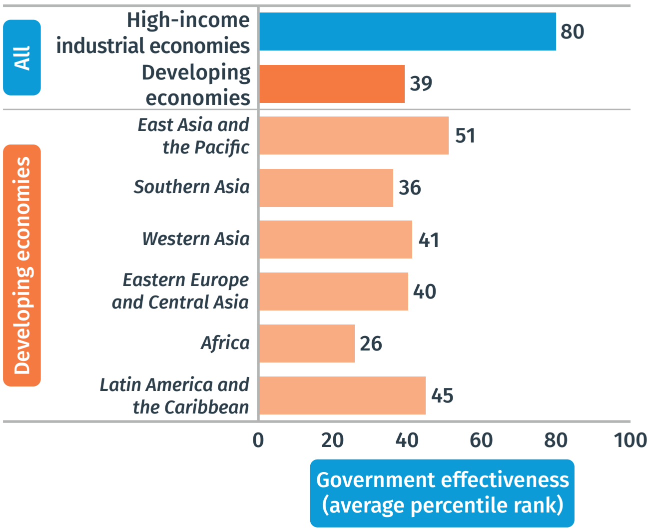
Government capacities are unevenly distributed across the globe. High-income industrial economies (HIIEs) typically possess the strongest government capacities, as they have the necessary fiscal resources to sustain higher levels of analytical and operational capacity. These economies have also had the opportunity to gradually build capabilities over the course of their development trajectory, reflecting the historical co-evolution of government capacity and industrial development. In contrast, developing economies lag behind, with the largest gaps observed in African countries, followed by South and Western Asian economies (Figure 3.2).

Variation in government capacity across developing economies is driven by a combination of income, policy choices and historical legacies. Part of this variation can be attributed to income and resources. The tax base tends to be smaller in African economies than in other developing regions, a challenge that is compounded by informality and capital flight.[22] Policy choices also play a role. The rapid industrialization of East Asian economies between the 1960s and 1980s, for instance, was driven by the developmental state, a bureaucracy with sufficient autonomy yet deeply embedded in the economy.[23] Although the developmental state emerged from unique historical circumstances that may not be easily replicated, many developing countries today are actively working to strengthen state capacities to address market and coordination failures, and to channel resources towards structural transformation.[24]

Closing the gap in government capabilities requires both targeted investment and learning. Investment should ensure that governments, ministries, development banks, intermediary organizations and other relevant agencies have access to the necessary skills, resources and technologies. At the same time, learning must be prioritized and promoted across the entire policy cycle, from agenda-setting to implementation and monitoring.[25] For instance, the Republic of Korea developed increasingly sophisticated implementation and monitoring systems during its industrialization in areas ranging from development finance to trade policy.[26] In Thailand, Brazil and China, learning took place through public-private consultation mechanisms.[27] More generally, learning can occur organically and incrementally in some contexts, while in others it may require more structured, formal approaches. Recognizing and adapting to cultural and institutional differences is essential for effective capacity development.

International solidarity is essential to support government capacity development in developing countries. With lower fiscal resources than high-income economies, these governments face the daunting task of mobilizing and coordinating resources to address several competing priorities. In this context, supporting capacity development for policymakers and industrial leaders should be a priority for the international community. Capacity development can take the form of knowledge sharing and dissemination platforms, with particular emphasis on emerging areas of policymaking, such as the development of foresight capabilities.

Figure 3.2 **Developing economies lag behind in the development of government capacity**



Note: The government effectiveness index captures perceptions of public service quality, civil service quality and independence, quality of policy formulation and implementation, and the credibility of government commitments to such policies. Numbers refers to simple averages for countries in each group. See Annex A.2 for detailed descriptions of indicators and data procedures.

Source: UNIDO elaboration based on World Bank (2025b).

3.4 EQUIPPING THE WORKFORCE

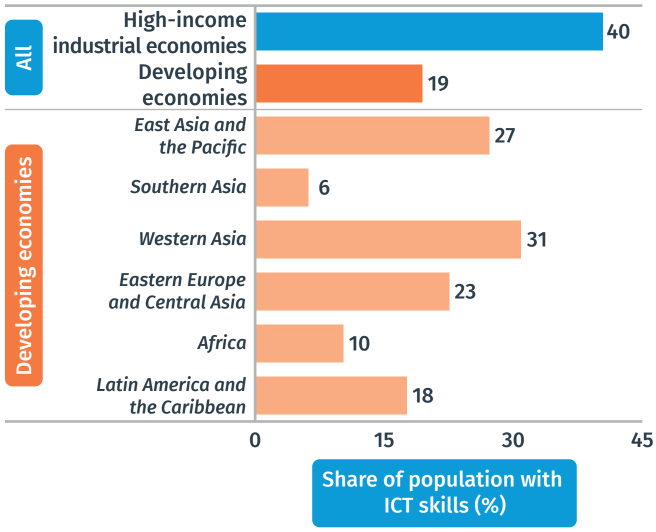
The future of industrialization will be shaped by advanced digital production technologies and efforts to decarbonize and build climate-resilient economies.[28] As discussed in Chapter 2, megatrends are accelerating automation, reshaping supply chains and redefining the industrial workforce, raising demand for certain skills while rendering others less relevant. As a result, countries risk widening skills gaps, making it essential to rethink and adapt training systems to align with these rapidly evolving industrial transformations.

Two categories of skills are emerging as central to future-ready industrialization: digital and green skills.[29] New technologies are transforming both the scope of production by introducing new products and services, and the ways in which work is performed, namely through new processes and novel organizational settings. Advances in digital technologies and AI are reshaping production systems by reconfiguring job roles and fostering automation.[30] At the same time, the green transition is driving the adoption of circular production methods, renewable materials and environmental standards. The result is a transformed workplace characterized by high-performance practices, continuous learning and the growing importance of soft skills such as communication and teamwork.

Digital skills are essential for leveraging technologies that enhance productivity, flexibility and connectivity in production systems. These range from basic digital literacy (such as using software and managing information systems) to more advanced capabilities, including programming, machine learning, systems engineering and data analysis. In manufacturing, digital skills also include knowledge of automation systems, sensor technologies and cybersecurity protocols required for Industry 4.0 applications. While digital skills are currently concentrated among professionals and technicians, demand is increasing across the workforce. For instance, in 2022, 16 per cent of job postings for workers performing routine tasks included some basic knowledge of information and communication technologies (ICTs).[31]

Green skills encompass the knowledge, abilities and values required to implement environmentally sustainable practices and drive innovation. From the process perspective, they include competencies that reduce the pollution content of production, whether it is energy efficiency, waste reduction or conducting environmental impact assessments. They also comprise a broad set of soft competencies, such as systems thinking.[32] From the output perspective, green skills support the design and delivery of goods and services that reduce environmental harm, such as eco-design, renewable materials and clean technologies. Green skills are essential across all occupational levels – from engineers designing clean energy systems to technicians implementing pollution control measures and production workers managing resource-efficient processes.[33]

Figure 3.3 **Developing countries show strong deficiencies in digital skills**



Note: The figure presents the share of the population with skill "using basic arithmetic formulas in a spreadsheet". Figures represent simple averages across countries within each group. See Annex A.2 for detailed descriptions of the indicators and data procedures.

Source: UNIDO elaboration based on UNSD (2025a).

Although developing countries show relative strength in soft skills, gaps in technical, digital and green skills continue to constrain technology adoption and threaten future industrialization. In developing countries, on average, only one-fifth of the population possesses basic ICT skills (Figure 3.3), which is half of the level in advanced economies. Regional disparities are more pronounced. While West Asia and South-East Asia are gradually narrowing the gap, Africa and South Asia lag behind, with less than 10 per cent of the population possessing basic digital competencies. The shortage of digital skills is also acknowledged by the productive sector. Firms in these regions consistently identify skills shortages as a major barrier to adopting innovative technologies such as big data, AI, IoT and industrial robots. A recent survey in Africa[34] found that approximately 20 per cent of firms identified gaps in basic digital skills as a major cause of slow innovation, while more than 60 per cent cited shortages in advanced digital skills.[35] By contrast, around 85 per cent of firms in developing countries report possessing sufficient soft, human-centric capabilities, which are essential enablers of technology adoption.[36] Gaps are also evident in green skills. In recent years, demand for workers with green competencies has grown nearly twice as fast as the available workforce, with particularly rapid acceleration in South America.[37]

While the industries of the future will require a blend of digital and green skills, the two differ. Green skills are often acquired through experiential, on-the-job learning. For example, retrofitting a production line to improve energy efficiency is likely to require hands-on training in the workplace. By contrast, digital skills (particularly at advanced levels) depend on formal education, structured learning environments and access to hardware and connectivity. Moreover, not all skills are required equally across production stages. Developing countries should prioritize building the skills needed for upgrading into higher-value downstream processing activities, such as recycling and repurposing.[38]

Equipping the workforce of the future requires a dual approach of strengthening education and technical and vocational training systems, while promoting workplace-based learning. Education systems should integrate both sustainability and digital literacy across curricula. Technical and vocational education and training (TVET) systems should prioritize practical, modular learning pathways that align with industry needs. Flexible and accessible training strategies, such as micro-credentials, adult learning programmes, and bootcamps, can help address workers' diverse needs. At the same time, policy support is crucial to promote continuous, on-the-job learning through incentives for employer- and union-led training and through stronger stakeholder collaboration in curriculum design. Skills assessment and anticipation exercises can help governments identify emerging skill needs and adjust education and training systems accordingly.[39] Lastly, anchoring skills development within industrial hubs and clusters can help extend outreach to small and medium enterprises and deliver practical, shop-floor training at scale.

Skilling, upskilling and reskilling initiatives must place a strong focus on women, youth and workers in the informal sector. In the digital and green transitions, targeted interventions to close skills gaps among groups most at risk of exclusion must be prioritized to avoid wasting human talent and build more inclusive societies.[40] Women, young people and workers in the informal economy together represent large segments of the labour force, whose participation will be essential for achieving future industrialization.

Persistent gender disparities in the labour market can be addressed through upskilling. Women remain underrepresented in manufacturing and are often concentrated in low-tech segments. Despite comparable education levels to men, they are more likely to occupy lower skilled manufacturing jobs.[41] Compounding this issue are structural gaps in technical skills. For instance, the gender parity index in programming skills stands at 0.5, indicating that women are only half as likely as men to possess such skills, although this figure increases to 0.75 among younger cohorts.[42] These skill gaps, alongside structural power imbalances and entrenched stereotypes further restrict women's participation in high-growth industries.[43] While active labour market policies alone cannot fully eliminate these inequalities, integrating gender considerations into education and training systems is crucial to prevent these disparities from widening.

In contexts where much of the labour force operates in the informal sector, traditional training models often fail to recognize existing skills and knowledge. Yet the informal economy can serve as a site for experiential learning, adaptive problem-solving and innovation-through-use,[44] making it particularly valuable for the development of green skills. Education and innovation systems should therefore be designed to validate and build upon informal learning, for instance, through the recognition of prior learning schemes. This helps workers gain recognition for skills acquired informally and allows them to more effectively transition into formal employment. Additionally, it can support them in upgrading their skills within existing roles and unlocking existing human capital.

Supporting youth upskilling is essential to harness the demographic dividend in developing regions. The demographic transition (see Section 2.5) is expanding the young workforce in developing regions such as in Sub-Saharan Africa, creating a potential pool of talent that, if effectively aligned with national industrial strategies, can drive future industrialization. However, without adequate access to education, a growing young and active population risks becoming a socioeconomic burden. Instead of an opportunity, the youth bulge could turn into higher unemployment, compressed wages, and sluggish domestic demand and industrial production. Expanding access to free public education through schools and universities and aligning curricula with the urgent demands of the twin transition are an urgent policy imperative.

Coordinated investments, cross-sectoral partnerships and innovative delivery models are required to reach young people at scale, particularly those in the informal economy. Such coordination is essential to ensure that education, training and skills development policies effectively translate into tangible outcomes for the workforce. India's skills development mission illustrates an example of an initiative that integrates these dimensions to better prepare the workforce for the future (Box 3.2).

Box 3.2 **India: Skill development in the renewable energy sector**

Under the Government of India's Skill India Mission (SIM), the Ministry of Skill Development and Entrepreneurship has led a nationwide effort to skill, reskill and upskill workers by establishing an extensive network of training centres.

To align skill development with the country's ambitious energy and climate targets, the government created the Skill Council for Green Jobs (SCGJ) – a sector-specific body under SIM collaborating closely with industry to develop national occupational standards, certification frameworks and training curricula. These initiatives cover a wide range of roles, including solar photovoltaic installers, wind turbine technicians, energy auditors and biomass system operators.

Key features of the programme include:

- Customized green skills training delivered through industrial training institutes, polytechnics and private training providers.
- Industry partnerships to ensure employability and job placement in solar, wind and energy efficiency projects.
- Recognition of prior learning to upskill workers already active in informal green jobs.

As of 2023, over 100,000 individuals had been trained in green job roles through the SCGJ-accredited programmes, contributing directly to India's energy transition and employment generation objectives.

Source: UNIDO elaboration based on Kraemer-Mbula (2025).

3.5 MASTERING THE NEW TECHNOLOGIES

To compete in a rapidly changing industrial landscape, developing countries must build the capacity to absorb and master the digital and green technologies that will drive future economic growth.[45] Leveraging new technologies requires the strengthening of domestic industrial ecosystems. The successful adoption and diffusion of advanced digital production technologies hinges on coordinated efforts across a wide range of actors, including firms, universities and government agencies. Ecosystems provide the infrastructure, skills, networks and capabilities needed to turn technological potential into industrial growth.

The performance of industrial ecosystems can be assessed by the level of innovative efforts and their resulting outcomes. R&D expenditure serves as a key indicator of innovative effort, capturing the resources that various actors an ecosystem, including firms and public research institutions, allocate to innovation. However, investment in R&D alone is not sufficient, as a significant share of this investment may not result in successful outcomes. What ultimately matters is the effectiveness with which R&D is translated into tangible outputs. A common proxy for such outputs is the number and quality of patents, which provide an indication of the development of new technologies and, by extension, the ecosystem's capacity to generate commercially and socially valuable innovations.

Across both indicators, developing countries are falling behind. On average, and relative to each group's gross domestic product (GDP) (see Figure 3.4, Panel A), developing countries spend about 20 per cent of the amount that advanced countries invest in R&D. In most regions, this gap has increased in the last 25 years. The other side of the coin is that the propensity to innovate (that is, to file new patents) is much lower in industrial firms in developing countries compared to those in high-income industrial economies. Among developing regions, only East Asia and the Pacific perform above the global average, primarily driven by China.

Supporting technological innovation in the manufacturing sector generates positive spillovers across the wider economy. As a key engine of scientific progress, manufacturing drives innovation well beyond its own boundaries. Recent evidence indicates that industrial firms account for six out of every ten global patent applications for climate change mitigation technologies. A similar pattern is observed in digital technologies, where the manufacturing sector contributes 65 per cent of global patents.[46]

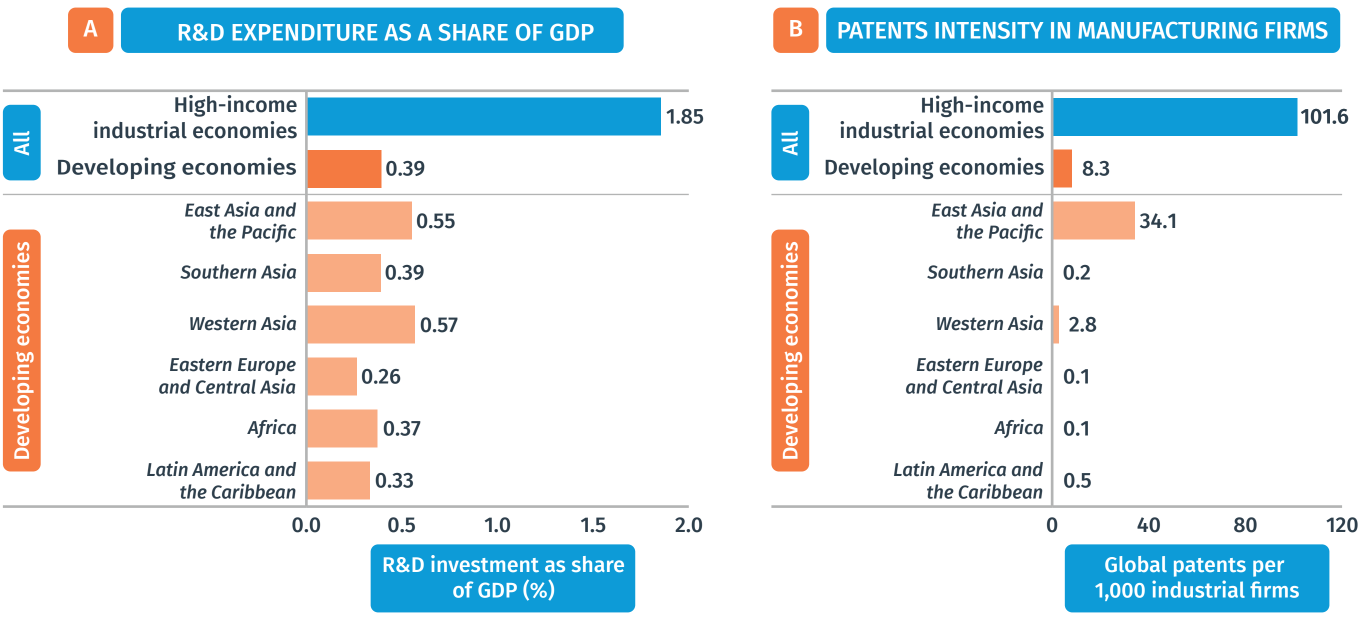
The adoption of technology in manufacturing also generates spillovers. In advanced economies, the introduction of industrial robots by manufacturing firms has been associated with employment growth in non-manufacturing industries.[47] Participation in

GVCs can amplify technology diffusion and facilitate access to higher-quality capital and intermediate goods while strengthening inter-firm collaboration.[48] Supporting the adoption of new technologies is particularly critical in developing economies, especially when manufacturing firms focus on innovation that are new to the firm or the market, driven by the absorption and imitation of foreign technologies, and complemented by domestic learning efforts. [49]

Spillovers are becoming increasingly significant as new digital technologies reshape the boundaries between manufacturing and the rest of the economy. As digital technologies become more integrated, they become increasingly dependent on components from a wide range of industries. AI, for instance, requires both hardware (chips and data centres) and intangibles (software to operate). These inputs originate from both the manufacturing and services sectors such as programming.[50] The same observation applies to EV production, which relies on a complex web of suppliers spanning from customer relationship management to software development. As servification advances, spillovers between sectors deepen. As discussed in Chapter 2 (Section 2.5), knowledge generated in manufacturing is also increasingly spilling over and expanding into agriculture.

Strengthening the functioning of industrial ecosystems requires enhancing both innovation and absorptive capacity through coordinated, cross-cutting policy action. This implies strengthening the foundations of ecosystems, namely skills, infrastructure and institutions, while fostering strong linkages between firms, universities and the public sector. Research institutions in key technological domains need to be strengthened. Encouraging collaboration between universities and the private sector is central to facilitating the translation of R&D into market products. This is particularly critical in many developing countries, where research is largely publicly funded but rarely commercialized. Enhancing stakeholder engagement is equally crucial to building trust, aligning objectives and promoting collaboration across the innovation ecosystem.[51] Finally, establishing AI-driven digital innovation hubs and smart manufacturing centres of

Figure 3.4 **Developing countries have weak industrial innovation ecosystems**



Notes: Panel (A) presents R&D expenditure as a share of GDP in 2021, calculated as the unweighted average across countries within each region. Panel (B) illustrates the patent intensity of global patents produced by manufacturing firms between 2021 and 2023, according to BvD (2025) Database. Patent intensity is calculated as the ratio between the number of patents and the total number of firms in the sample for each country group. Global patents refer to IP5 patent families, defined by the OECD as patents protected in at least two intellectual property offices worldwide, one of which is among the five intellectual property (IP) offices (IP5): the European Patent Office (EPO), the Japan Patent Office (JPO), the United States Patent and Trademark Office (USPTO), the Korean Intellectual Property Office (KIPO), or the China National Intellectual Property Administration (CNIPA).

Source: UNIDO elaboration based on UNIDO (2025a) [Panel A] and Delera et al. (2025) [Panel B].

excellence can accelerate the adoption of emerging technologies, enhance competitiveness and drive technological upgrading.

Developing industrial clusters can enhance local innovation capacity, while targeted support for startups can foster more innovative ecosystems. Young innovative startups play a critical role in the development of new technologies. Recent examples include the electronics ecosystem in Europe, where major firms are partnering with startups to co-develop sustainable solutions, while industry associations are fostering partnerships to integrate new sustainability technologies into semiconductor operations.[52] For developing economies, expanding support for young innovative startups may offer a strategic pathway to translate public research into market-driven solutions.[53]

Effective mechanisms for technology transfer both within and across sectors are essential to ensure the widespread adoption of new technologies throughout the economy. Policies that incentivize R&D investment can support this process, while awareness-raising initiatives, such as conferences, advisory services and networking events, can help firms, particularly small and medium enterprises (SMEs), recognize the potential of digital technologies. To close gaps in technological capacity, governments should invest in training, reskilling and technical assistance. Institutions such as innovation agencies and development banks play a central role in implementing these tools and creating an enabling framework. From the production perspective, technology transfer agreements and joint ventures can further support diffusion. From the adoption perspective, policy tools such as grants, tax reduction schemes, advisory services, as well as demonstrations and pilots for new technologies are crucial to ensure that firms, particularly micro, small and medium enterprises (MSMEs), can effectively adopt new technologies and modernize their equipment (see Box 3.3).

Box 3.3 **Brazil: Supporting industrial ecosystems to boost firms' competitiveness**

Launched in 2016 and significantly expanded in 2023, Brasil Mais Produtivo is Brazil's flagship initiative to boost the productivity, competitiveness and digital maturity of MSMEs across industry, commerce and services. Coordinated by the Ministry of Development, Industry, Trade and Services, the programme is implemented through a wide network of partners, including SEBRAE, SENAI, ABDI, EMBRAPII, BNDES and FINEP.

The programme combines low-cost, high-impact consultancy and training services with a national digital platform for productivity enhancement. Participating firms receive tailored diagnostics and technical assistance in areas such as lean manufacturing, energy efficiency, innovation management and digitalization. Support is provided and segmented by sector. Industrial MSMEs benefit from hands-on consultancy provided by SENAI, while commerce and service firms are supported through SEBRAE's network of local innovation agents.

The initiative also includes subsidies to facilitate technology adoption. Micro and small industrial firms receive fully subsidized consultancy, while medium-sized firms benefit from up to 70 per cent coverage of consultancy costs. In the services sector, firms receive guidance on process improvements and may claim reimbursements of BRL 2,000 (USD 400) for digital tools.

Following a successful pilot (2016 to 2018), which achieved average productivity gains of over 50 per cent among 3,000 industrial MSMEs, the revamped programme aims to reach 200,000 firms and deliver over 90,000 consultancy engagements by 2027. In São Paulo alone, an early version of the programme (named Jornada de Transformação Digital) served around 18,000 firms and delivered over 700 industrial consultancies.

Brasil Mais Produtivo is a cornerstone of Brazil's Nova Indústria Brasil industrial strategy (2024 to 2033), and serves as the primary vehicle for Mission 4: Digital Transformation of Industry. The programme aligns with broader efforts to modernize Brazil's productive base, enhance energy and resource efficiency, and foster innovation-driven growth among smaller firms. Its scale, institutional coordination and cost-effectiveness makes it a compelling model for other emerging economies seeking to upgrade their MSMEs' competitiveness.

Source: Labrunie et al. (2025), policy brief produced for the IDR 2026.

3.6 COORDINATING INDUSTRIAL EFFORTS AT THE REGIONAL LEVEL

Amid growing uncertainty in global trade, regional integration can serve as a catalyst for industrial development. Escalating trade tensions and the ongoing decoupling between the United States and China (see Section 2.4) introduce new risks to export-led industrialization strategies. As advanced economies pursue greater self-reliance, many developing countries risk being excluded from GVCs. In this context, South-South trade and regional integration offer a key alternative. By reducing dependence on extra-regional markets and buffering against external shocks, regional integration can boost resilience.

If ongoing trade tensions persist, the future of industrialization will increasingly hinge on regional rather than global market integration. This trend is already evident, as intra-regional trade is growing faster than total global trade.[54] Given that much of this trade occurs within cross-border supply chains, the relevance of regional value chains (RVCs) is likely to grow. Embedding production networks in a regional context allows countries to leverage geographic proximity, shared infrastructure and cultural affinities that facilitate coordination and investment. This has proven a key stepping stone in several cases towards full integration into GVCs.[55]

RVCs can offer opportunities to strengthen industrial capabilities and enhance international competitiveness. In many developing countries, limited domestic market size and a low level of income create serious constraints to industrialization. Regional trade can help address this bottleneck by increasing market size, stimulating effective demand and enabling economies of scale, vertical integration and horizontal specialization.[56] Moreover, neighbouring countries often share similar consumer preferences, regulations, standards and production technologies, which can lower transaction costs. By integrating production and markets regionally, countries can unlock new avenues for industrial expansion that are difficult to realize through domestic efforts alone.

Beyond market access, regional integration can also facilitate technology transfer and foster knowledge spillovers. When firms engage in cross-border production networks, particularly as suppliers to multinational enterprises (MNEs), they are frequently exposed to higher production standards, improved managerial practices and new technologies. Recent empirical evidence highlights the productivity gains associated with firm-to-firm linkages with regional MNCs.[57] These interactions can serve as important channels for capacity development and upgrading, especially for firms in smaller economies that might otherwise lack access to such learning opportunities.

By reducing exposure to disruptions in global trade, RVCs can strengthen industrial resilience. Since RVCs rely on partners in close geographic proximity, they are generally less vulnerable to shocks that can affect long-distance supply chains, such as those experienced during the COVID-19 pandemic or the 2021 Suez Canal obstruction.[58] These events exposed the fragility of GVCs that depend heavily on a small number of distant suppliers or involve complex logistical routes. In contrast, regional production networks benefit from shorter transport distances and greater regulatory and market alignment, which enhances coordination and adaptability in times of crisis and helps to maintain production continuity.

Despite their growing relevance, industrial RVCs remain limited in developing countries. The latest available data on manufacturing trade indicate that intra-regional trade between developing countries typically accounts for less than 15 per cent of total trade, flagging a generally low level of regional integration (Figure 3.5). Even in regions with higher shares of intra-regional trade, some of it is driven by demand from extra-regional markets. By contrast, intra-regional trade in regions with predominantly high-income industrial economies (such as Western Europe) accounts for more than 25 per cent of total manufacturing trade.

RVCs are production networks led by major firms within a specific region. These lead firms source a large share of their inputs from local suppliers, ensuring value is added locally. While the final products are often sold within the region, they can also be exported to international markets.

Source: UNIDO elaboration based on Kozul-Wright and Fortunato (2019).

What are RVCs?

The pace of regional integration has varied across developing regions in recent years. Some regions are integrating faster than others. Western Asia is the region with the fastest regional integration, with the share of regional trade in manufacturing rising by 40 per cent between 2017 and 2023. This is followed by Africa with a 30 per cent increase. In Latin America and the Caribbean (LAC) and South Asia, participation in intra-regional trade has declined over the same period.

Unlocking stronger RVCs requires addressing the policy and institutional barriers that are limiting regional trade. One major obstacle is the persistence of tariff and non-tariff barriers, which hamper the smooth flow of goods and investment across borders and constrain the development of integrated networks. In this context, comprehensive trade agreements are critical for fostering regional industrial integration. What matters is not only having trade agreements in place, but how enforceable and how effective these agreements are. Recent empirical evidence suggests that agreements that extend beyond tariff liberalization, covering behind-the-border provisions such as the harmonization of competition policy, intellectual property (IP) rights, and investment protection, are more successful in supporting the growth of RVCs.[59]

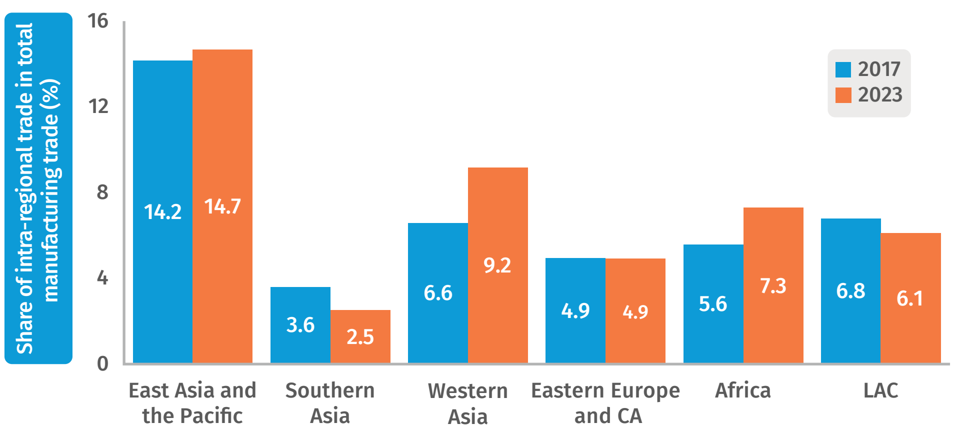
The low maturity of industrial ecosystems restricts the potential to strengthen industrial RVCs in developing regions. Many developing regions possess inadequate intra-regional infrastructure, which significantly impedes the efficient movement of intermediate and final goods (see Section 3.2), while weak national innovation systems restrict the capacity for local value addition.

Existing industrial structures can limit regional integration among neighbouring developing countries. When regional partners produce similar goods, incentives for trade are weakened, and competition tends to outweigh collaboration.[60] Addressing this challenge requires coordinated regional industrial policies aimed at diversifying regional specialization and creating productive complementarities. Regional cooperation plays an essential role in addressing these bottlenecks and fostering the development of RVCs.[61]

Strategies for developing industrial RVCs must avoid creating core-periphery structures, where benefits concentrate in a few countries while others remain marginalized.[62] Regional free trade agreements, such as the Southern Common Market (MERCOSUR) or the African Continental Free Trade Area (AfCFTA), are key to reducing trade barriers, but they should extend beyond tariff reductions to include provisions such as regional content requirements and harmonized rules of origin, which can incentivize intra-regional sourcing.[63]

Cooperation on investment is equally critical, particularly to channel capital flows towards infrastructure and underdeveloped areas. Establishing shared standards, such as harmonized regulatory frameworks, unified customs procedures and standardized data protocols, can reduce transaction costs and facilitate smoother cross-border operations. The creation of special economic zones across multiple countries can provide both physical and institutional platforms for RVCs to flourish, attract investment and encourage firm-level linkages in the region. Finally, establishing boards for regional planning and coordinating industrial policy can foster productive complementarities and distribute gains more evenly across countries.

Figure 3.5 **Intra-regional trade in manufacturing goods between developing countries remains low**



Notes: The figure shows the share of intra-regional manufacturing trade between developing countries as a percentage of total manufacturing trade for different regions in 2017 and 2023. Intra-regional manufacturing trade is defined as the total trade flows between countries that belong to the same region and development group, while total manufacturing trade is defined as the region's total imports plus exports of manufacturing goods. Developing countries are defined as those not classified as high-income industrial economies. CA = Central Asia; LAC = Latin America and the Caribbean.

Source: UNIDO elaboration based on CEPII-BACI Database (Gaulier and Zignago, 2010).

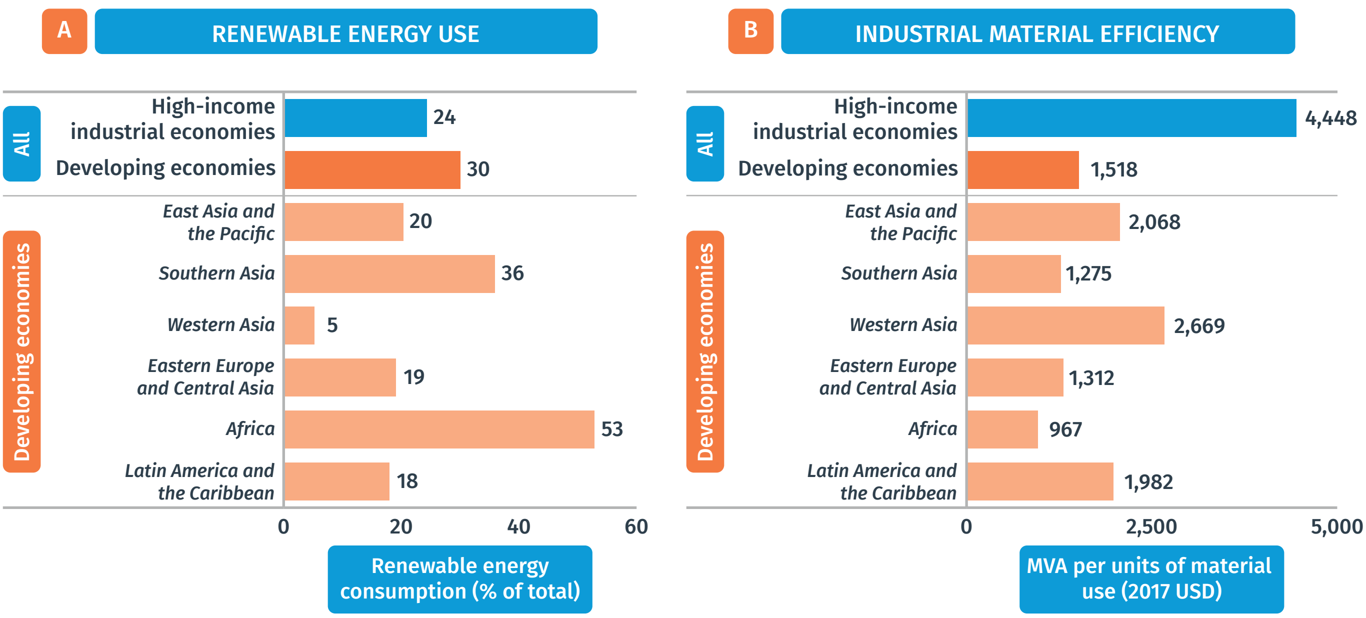
3.7 GREENING INDUSTRIAL ECOSYSTEMS

Greening industrial ecosystems is essential for protecting the environment while ensuring the long-term sustainability of industry. Achieving this transition requires countries to deploy and scale new technologies, processes and organizational models, both within factories and across the wider ecosystem that sustains them – from the energy grid to product design and recycling. Importantly, these efforts must be systemic. If, for instance, firms adopt green technologies and sustainable practices while continuing to rely on fossil-fuel-based electricity or the extraction of virgin materials, the overall impact of greening will remain limited.

Despite recent progress, industrial ecosystems remain major contributors to global emissions.[64] While developing economies have made substantial gains in renewable energy adoption and, on average, now consume more renewable energy than advanced economies, they continue to lag behind in regions such as LAC and Western Asia (Figure 3.6). The manufacturing sector's carbon footprint has also not improved, especially in developing countries. Accelerating the green transition will require countries to step up their decarbonization efforts and reduce material use through the adoption of circular economy practices in manufacturing industries.

Greening industrial ecosystems requires coordinated action on three interrelated and equally important fronts. First, decarbonizing power generation is essential: industrial ecosystems should be powered by renewable energy. Other emerging innovations, such as alternative and sustainable fuels and green feedstock, play an important role as well. Second, emissions accounting and greater circularity should be introduced throughout production networks. Industrial ecosystems are built on dense supply chains, which should strive towards greater accountability and climate alignment through emissions reporting. Supply chains can also become more circular by keeping material inputs in use for longer periods through recycling, while regulating product design to extend products' lifecycles to facilitate remanufacturing and recycling. Finally, manufacturing processes must become more material- and energy-efficient through the adoption of advanced technologies, improved management practices and adherence to higher standards.

Figure 3.6 **Developing countries are leading in renewable energy use, but lag behind in industrial material efficiency**



Note: Material footprint refers to domestic material consumption, which is calculated as the gross physical domestic extraction of materials from the environment within a nation's territory, plus direct physical imports, minus direct physical exports. For this analysis, material flows were restricted to six categories most relevant to manufacturing: ferrous ores, non-ferrous ores, non-metallic minerals (industrial or agricultural dominant), products mainly from metals (nec.), products mainly from non-metallic minerals, and other products mainly from fossil fuels (e.g. plastics). The values represent simple averages for countries within each group. See Annex A.2 for detailed descriptions of indicators and data procedures.

Source: UNIDO elaboration based on UNSD (2025a) [Panel A] and the Global Material Flows Database, UNEP IRP (2025) [Panel B].

Decarbonizing power generation requires the deployment of clean and renewable energy technologies at scale. With international support, developing countries can leverage the rapid global diffusion of solar and wind energy. To green the energy sector, countries should adopt both new and established technologies tailored to local production conditions. These may include low-emission hydrogen, bioenergy, small hydropower and geothermal energy, depending on the country's characteristics and natural endowments.[65] There is also a need to scale-up long-duration energy storage solutions to support firms' use of renewable electricity for industrial electrification, the decarbonization of low- and medium-temperature industrial processes, and to maintain the reliability of low-carbon electricity.

Digitalization can support the decarbonization of power generation in developing countries. Countries should capitalize on the synergies between renewable energy generation and digital technologies to optimize the operations of both traditional as well as mini-grids.[66] This is particularly important in rural areas, which remain underserved by the grid, and where renewable-powered mini-grids can support industrial activities such as food processing. Additionally, combining digital innovations with mall-scale energy deployment to enable new models of green energy provision.[67] When designing mini-grid frameworks, policymakers must carefully balance trade-offs between government control, fiscal costs and affordability, as no single delivery model can fully achieve all three objectives.[68]

Decarbonization can be further advanced by scaling up emissions accounting and reporting across supply chains. Supply chains are often highly complex, with fragmented emissions accounting practices and inconsistent definitions and boundaries that limit comparability.[69] Moving towards harmonized emissions standards, interoperable data systems, and shared primary emissions data across supply tiers will enable more accurate reporting, enhance comparability and create stronger incentives for suppliers to outperform industry averages.[70] Industries in developing countries must be supported in their shift towards more robust and harmonized emissions accounting standards, to drive decarbonization, support credible low-carbon markets and align with climate policies.

Decarbonization is not only essential for greening industrial ecosystems but can also unlock opportunities for industrial development, depending on a country's technological capacity. In established value chains such as solar and wind power, countries with growing clean energy demand can leverage public procurement to foster the development of domestic clean-tech manufacturing capabilities. In emerging value chains, such as green hydrogen, countries can take advantage of their natural endowments to attract investment and secure a competitive edge as markets evolve.[71] Pilot projects and international research collaborations can further support the development of green hydrogen value chains.[72]

Achieving circularity requires measures that extend the lifecycle of manufacturing inputs and prioritize waste management strategies, such as reuse and remanufacturing. Recycling is used only after these options have been exhausted. Evidence shows that firm-level efforts alone are insufficient; a circular economy demands ecosystem-wide policy interventions.[73] From the input perspective, countries can incentivize reuse, remanufacturing and recycling, with extended producer responsibility regulations playing a critical role in improving the circularity of industrial ecosystems.[74] Fiscal incentives also play an important role. For example, governments can phase out subsidies and increase taxes on virgin raw materials while reducing taxes on alternative materials and products, making circular alternatives more affordable.[75]

From the output perspective, countries should implement regulations that promote product design to minimize waste and pollution while extending products' lifecycles. Well-designed extended producer responsibility schemes and right-to-repair legislation can incentivize producers to create products suitable for reuse and recycling. These laws can also help counter planned obsolescence, the practice of designing products with a limited lifespan. Beyond regulation, demand-side instruments can further enhance the circularity of product design. Governments can adopt a lifecycle approach in public procurement by favouring products that are efficient, durable, repairable, reusable and made with recycled or residual materials.[76] A mix of awareness campaigns, certification schemes, eco-labels and fiscal tools, ranging from tax exemptions to rebates, can also be introduced to build consumer trust, encourage consumption and raise the competitiveness of product reuse and remanufacturing.[77]

Increasing resource and energy efficiency in manufacturing is another critical building block for greening industrial ecosystems. Technology standards and energy efficiency labels are among the most effective policy measures to achieve energy efficiency in industry. Supporting firms in adopting energy management systems such as ISO 50001 can significantly enhance energy efficiency.[78] In addition, resource efficient and cleaner production practices are a set of circular economy practices that can help prevent or reduce solid waste and pollution generated during the extraction of raw materials, their processing into finished products and their distribution to consumers. Alongside energy efficiency and circular practices, renewable energy applications in manufacturing are a key element of green industrial ecosystems. Various manufacturing sectors are increasingly adopting technologies such as heat pumps, solar thermal systems and biomass as substitutes for fossil-based heat and power.

Bringing it all together, eco-industrial parks exemplify the greening of industrial ecosystems. Eco-industrial parks are strategic groupings of industries that capitalize on economies of scale by co-locating, sharing infrastructure and fostering collaboration among stakeholders. They integrate social, economic and environmental considerations into every aspect of location decisions, including site selection, planning, management and operations. Built around dedicated environmental and energy management systems, eco-industrial parks prioritize, among other actions, energy efficiency in industrial processes and shared services, integrating renewable or low-carbon sources and establishing networks for waste heat recovery.[79]

Other key elements of green industrial ecosystems include the establishment of green industrial hubs, which are clusters focused on cleantech innovation and industry decarbonization, as well as hydrogen industrial clusters.

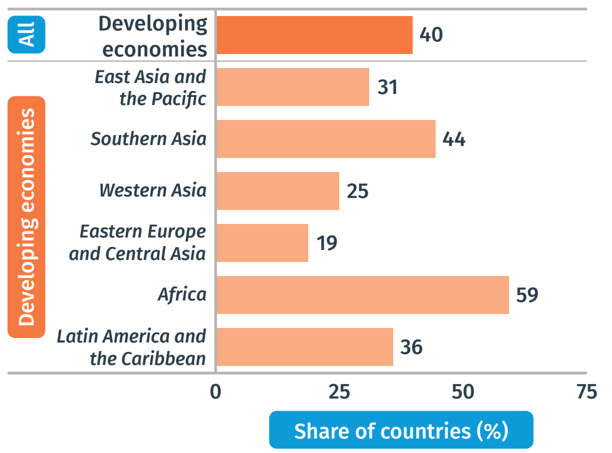
These measures must be included in long-term planning, with specific targets for renewable energy, circularity, industrial energy efficiency, infrastructural development and international collaboration. Synergies between digital and green infrastructure are particularly important, as digital technologies can support renewable energy deployment and circular economy initiatives through resource monitoring, process optimization and supply chain transparency.[80] Developing countries should also promote collaboration and knowledge sharing with advanced economies, while adapting external approaches to suit local contexts.

3.8 FINANCING FUTURE INDUSTRIAL TRANSFORMATION

The measures outlined in this chapter can only be realized if countries have adequate financial resources. Achieving the Sustainable Development Goals (SDGs) requires an estimated USD 4 trillion in annual investment, up from USD 2.5 trillion in 2015, reflecting years of underinvestment and growing needs.[81] For SDG 9, which focuses on industry and innovation, the funding gap is particularly severe. Infrastructure alone requires around USD 400 billion per year,[82] yet investment in industry, innovation and R&D has plummeted in recent years, making SDG 9 one of the most underfunded goals.[83] At the same time, most developing countries lack sufficient domestic resources to adequately finance industrial policies.

Limited public resources and high external debt are further constraining the fiscal space of developing countries. Debt servicing costs have increased in the wake of successive global shocks—from the COVID-19 pandemic to heightened geopolitical tensions—that have tightened macroeconomic conditions worldwide. The share of countries classified as being in debt distress or at high risk of it is growing, and now includes nearly 40 per cent of developing countries (Figure 3.7). Even countries not formally classified as being in debt distress face elevated borrowing costs and limited fiscal capacity, restricting their ability to make the long-term investments needed to advance industrial development.[84]

Figure 3.7 **A significant share of developing countries is in, or at high risk of, debt distress**



Note: The numbers refer to the share of countries eligible for borrowing at the International Development Association (IDA), and the International Bank for Reconstruction and Development (IBRD) classified as being at high risk of or in debt distress compared to all countries in the region.

Source: UNIDO elaboration based on data from the World Bank (2025c).

Given these constraints, prioritizing the financing of industrial development is essential. Industrialization not only reduces poverty and improves living standards, it also strengthens a country's capacity for domestic resource mobilization. As workers transition from informal to formal employment, governments can expand their tax base, while industrial growth boosts production and export capacity, raising national income and foreign exchange earnings. This accumulation of domestic resources can create a virtuous cycle, enabling reinvestment in critical development priorities such as infrastructure, education, healthcare and climate adaptation. Fintech offers new opportunities to mobilize domestic savings and channel them into productive industrial activities.[85]

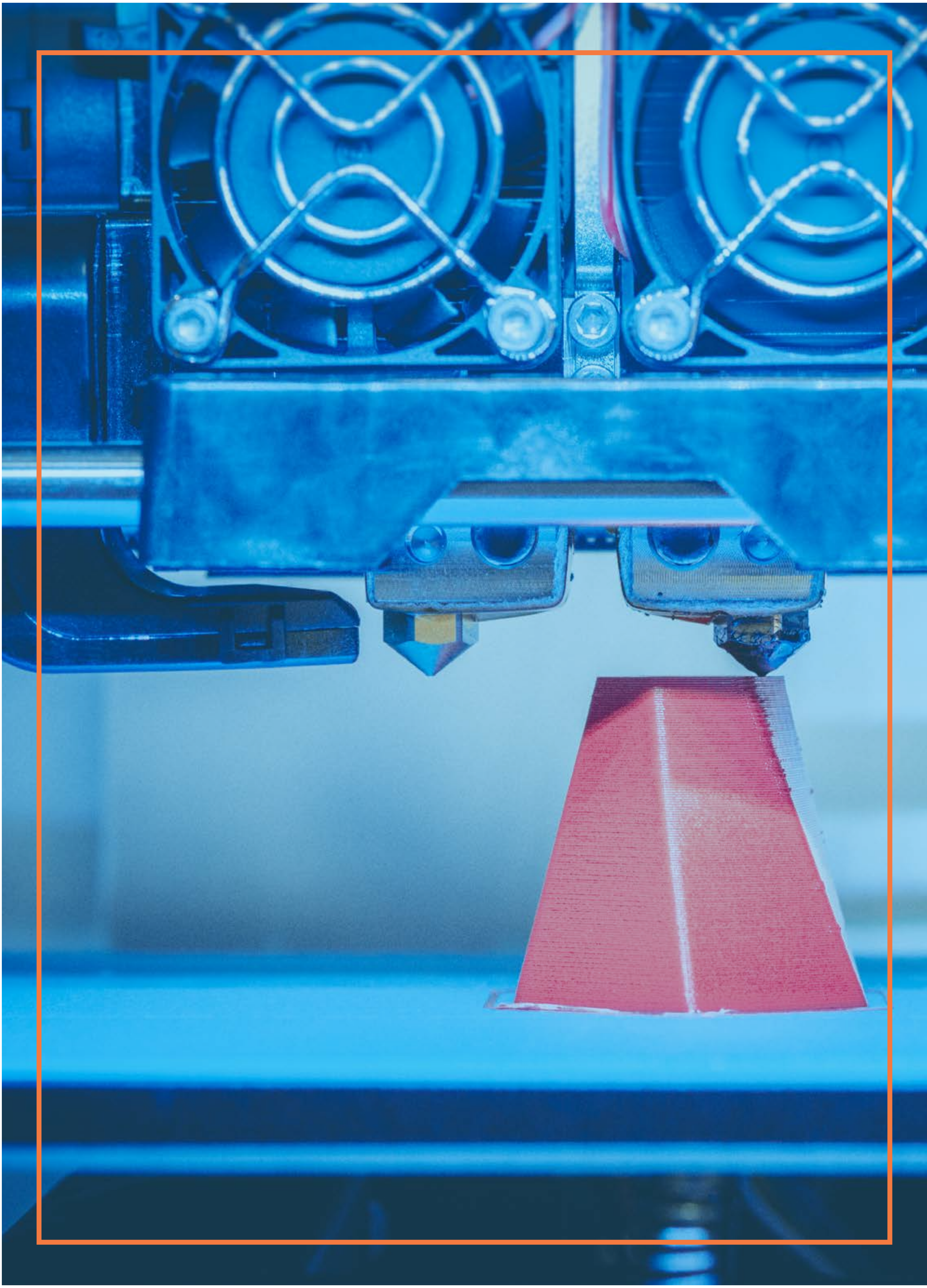
Industrial development is inherently capital-intensive, long-term and high-risk, making financing a central challenge. Securing adequate funding requires not only stable financial resources but also financial instruments tailored to the unique needs of industrial planning, infrastructure investment and working capital cycles. Historically, domestic development banks have played a crucial role in supporting latecomer countries by providing long-term financing to industrial firms.[86] Today, development banks remain a cornerstone of industrial development.[87]

In addition, industrial development can leverage both traditional and innovative sources of finance, each offering distinct advantages and limitations. Since public resources remain strained, overseas development assistance and foreign direct investment (FDI) remain critical complementary sources of funding. A decline in either could considerably slow or even reverse industrial progress in lower-income countries. Despite its slowdown since the Great Recession, FDI continues to play a central role in financing industrial development.[88] However, it remains inherently selective, cyclical and profit-driven, often bypassing the countries most in need of industrial investment.

While still modest in scale, blended finance holds significant potential to become a key driver of industrial development in the future. To date, its growth has been limited by complex deal structuring, a narrow pipeline of bankable projects and low investor risk appetite. Yet, blended finance can advance early-stage industrial projects, frontier technologies and investment in less-developed markets by mobilizing private capital, which is the largest source of global financial assets.[89] Its catalytic role in sustainable industrial development could expand through more targeted de-risking instruments, stronger coordination mechanisms, enhanced public-private partnerships and closer alignment with cost-cutting innovations.[90] Investment promotion agencies and ministries can also build capacity to prepare projects, standardize contracts and collaborate more effectively with development finance institutions. Other instruments include green bonds, insurance, guarantee schemes and sovereign development funds which, unlike traditional sovereign wealth funds, invest domestically to generate both financial returns and socioeconomic development.

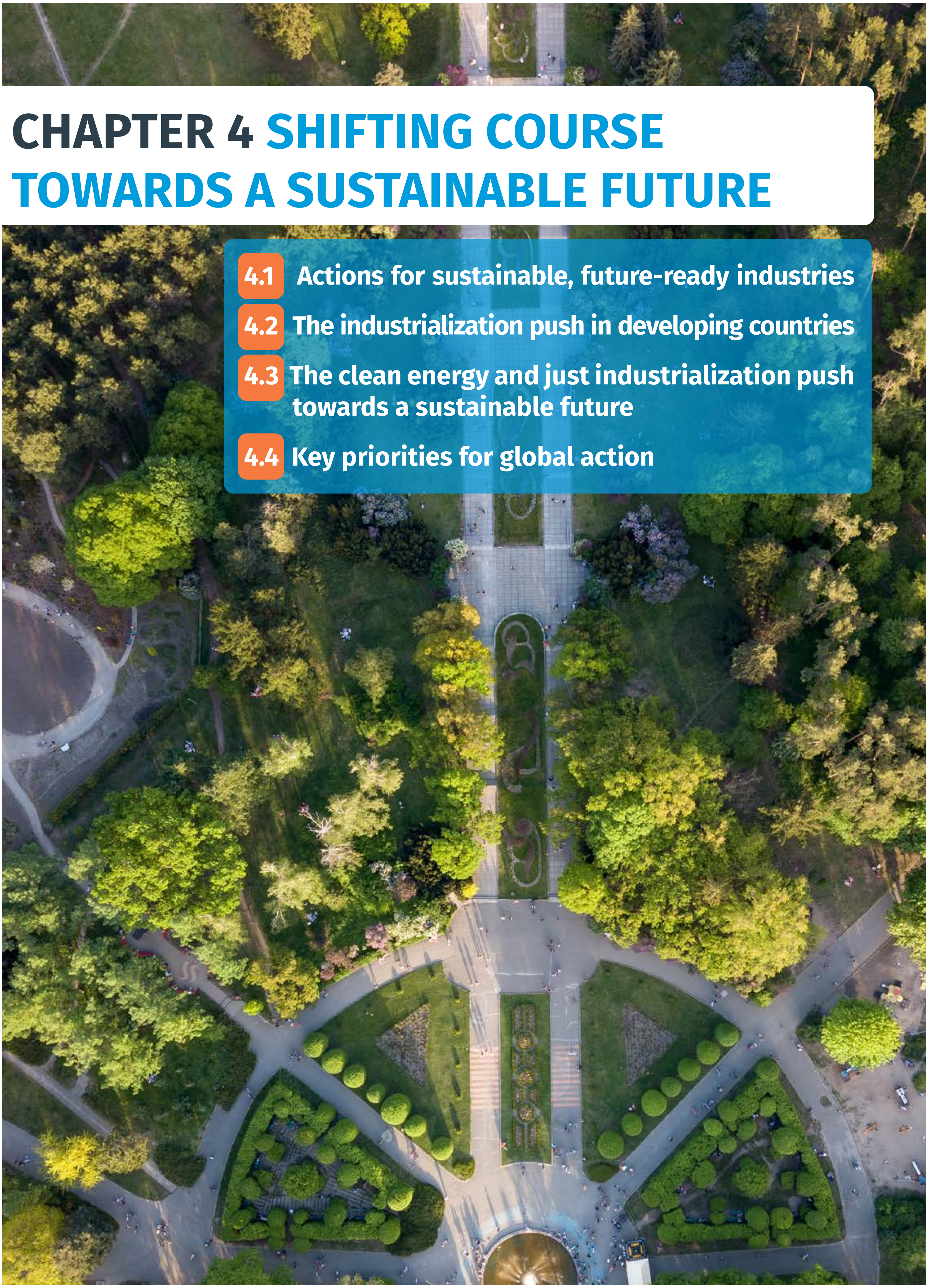
Looking ahead, as global priorities shift and the aid landscape continues to evolve, developing countries will need to strengthen domestic resource mobilization and attract a more diversified mix of capital. While aid will remain important for emergency response and capacity development, it is not sufficient to drive structural transformation. Industrial development, driven by domestic savings, entrepreneurial reinvestment, commercial credit, public investment in infrastructure and enterprise support, can help break the cycle of aid dependency and spur long-term economic growth. To achieve this, financing tools must be better aligned with the needs of industrial transformation. This means providing patient, risk-tolerant capital and flexible financing instruments that can support long-term investment. Without policy reforms to strengthen the business environment, such as sound macroeconomic policies, domestic capital will continue to seek safer destinations for investment.

To maximize these benefits, investments in sustainable industrial transformation must be large in scale, strategically targeted and effectively coordinated between the public and private sectors. At the same time, systemic reform of the international financial architecture is urgently needed. Among others, such reform should aim to reduce the high cost of debt and the risk of debt distress, while expanding access to affordable, long-term financing for sustainable development and supporting macroeconomic stability. More broadly, it should seek to expand the fiscal space of developing countries, enabling them to adequately finance industrial policies and build resilient, future-ready industrial ecosystems.



ENDNOTES

[1] See UNIDO (2019).
[2] See Thun et al. (2022).
[3] See Andreoni (2018); Calza et al. (2022).
[4] See Andreoni (2018).
[5] This subsection builds on Wang et al. (2025), policy brief produced for the IDR 2026.
[6] IEA (2022a).
[7] UNIDO (2022a).
[8] UNCTAD (2021a).
[9] Hinane El-Kadi (2024).
[10] IEA (2024d).
[11] UNIDO et al. (2021).
[12] Daum (2025).
[13] Doner et al. (2021); Lee (2024).
[14] See, for example Section 3.4 on the case of the *Brasil Mais Produtivo* initiative.
[15] See, for example Section 6.3 on the development of renewable energy equipment in India; and Section 7.3 on clean energy technology manufacturing in Eastern Europe.
[16] See, for example Section 8.3 on ongoing efforts to leverage lithium reserves in Chile and Argentina.
[17] Haraguchi and Kamiya (2025).
[18] Kaplinsky and Morris (2025).
[19] Ibid.
[20] See UNIDO (2023a).
[21] Juhász and Lane (2024).
[22] See, for example Di John (2011).
[23] See, for instance Kohli (2004).
[24] See, for instance Nem Singh and Ovadia (2018).
[25] Santiago and Zagato (2024).
[26] Amsden (2001).
[27] Nem Singh and Ovadia (2018).
[28] This subsection builds on Kraemer-Mbula (2025), policy brief produced for the IDR 2026..
[29] See, for instance Hofmann Trevisan et al. (2024).
[30] See, for instance Acemoglu and Autor (2011); Holm et al. (2021).
[31] Koundouri et al. (2023).
[32] Auktor (2020).
[33] Popp et al. (2024); Vona et al. (2018).
[34] The survey was a collaboration between DSI and NRF Trilateral Chair in Transformative Innovation at the University of Johannesburg, CSIR-STEPRI in Ghana and UNCTAD. It was conducted in 2021 and 2022 and covered over 1,000 firms in the manufacturing and services sectors in Ghana and South Africa. See Kraemer-Mbula (2025).
[35] In contrast, data from South-East Asia, particularly Viet Nam and Thailand, indicate a less critical situation, with 30 per cent and 20 per cent of firms, respectively, identifying shortages of skilled human resources as a key barrier to the adoption of digital production technologies. See UNIDO (2019).
[36] Andreoni and Anzolin (2019); UNIDO (2019).
[37] LinkedIn (2022).
[38] LKDF (2024).
[39] OECD (2023).
[40] For instance, the automation risk for female workers is 2.9 per cent times higher than for their male counterparts. UNIDO (2019).
[41] UNIDO (2025c).
[42] UNESCO (2024).
[43] Hartwich et al. (2025b).
[44] Kaplinsky and Kraemer-Mbula (2022); Kraemer-Mbula (2023).
[45] This section builds on the background paper produced for the IDR 2026 by Delera et al. (2025).
[46] Delera et al. (2025).
[47] See, for instance Dauth et al. (2021); Jestl (2024); Klenert et al. (2023).
[48] See, for instance Delera and Foster-McGregor (2023); Onur Biyik (2023).
[49] See, for instance Fu and Shi (2023).
[50] These industries correspond to codes C26 and J62 in the ISIC Rev. 4 classification.
[51] See UNIDO (2024).
[52] European Commission (2024a).
[53] See Dechezleprêtre et al. (2023).
[54] WTO (2024).
[55] Djafar and Milberg (2020).
[56] Kozul-Wright and Fortunato (2019).
[57] Alfaro-Ureña et al. (2022).
[58] Kaplinsky and Morris (2025).
[59] Delera and Foster-McGregor (2020); Mattoo et al. (2020).
[60] See, for instance Scholvin et al. (2022); UNCTAD (2021b).
[61] UNIDO (2023d).
[62] Marcato (2023).
[63] Black et al. (2021).
[64] UNIDO (2023c).
[65] See, for instance, UNIDO (2022b); (2021).
[66] Fritzsche et al. (2019).
[67] Heinemann (2022).
[68] UNIDO (2020).
[69] Kaur et al. (2023).
[70] Stenzel and Waichman (2023).
[71] UNIDO et al. (2023).
[72] Alternburg and Strohmaier (2025).
[73] Albaladejo et al. (2023).
[74] GACERE (2023).
[75] GACERE (2024).
[76] For an overview of how demand-side policy instruments can be implemented to foster a process of green industrial development, see European Commission (2017); UNIDO (2017).
[77] GACERE (2024).
[78] See, for instance Industrial Decarbonization Accelerator (2022).
[79] UNIDO et al. (2021).
[80] GACERE (2025).
[81] UN (2024).
[82] The estimate excludes energy infrastructure. See OECD (2025c).
[83] Dalberg (2024).
[84] See, for instance Horas et al. (2025).
[85] See, for instance Volz et al. (2024).
[86] Amsden (2001). For a more recent treatment see, for instance Guadagno (2016); Juhász et al. (2024).
[87] UN (2024).
[88] Ibid.
[89] FSB (2024).
[90] UNIDO (2025d).



CHAPTER 4 SHIFTING COURSE TOWARDS A SUSTAINABLE FUTURE

Building future-ready industrial ecosystems in developing countries is crucial to shifting the global trajectory towards a more sustainable and inclusive future. Projections of alternative development pathways, where developing countries take decisive action to strengthen the seven key areas outlined in the previous chapter, supported by international efforts to advance sustainability and equity alongside industrial growth reveal a far brighter outlook than the current trajectory. A *clean energy and just industrialization* push in developing countries could lift over half a billion people out of poverty by 2050, including 150 million escaping extreme poverty. It could also reduce global CO_2 emissions and lead to over 50 million fewer people suffering from hunger and malnutrition. Developing countries could regain ground in global manufacturing, narrowing the gap with the technological frontier. Achieving this vision, however, requires global solidarity in three priority areas: (i) building fair and sustainable supply chains; (ii) mitigating climate breakdown through renewable energy, clean technology and circularity; and (iii) reducing poverty and hunger by boosting manufacturing productivity, creating quality jobs, and promoting inclusive, sustainable agro-industrialization.

Jeffrey Sachs

"Solutions to the great sustainable development challenges must be pursued not only at the national level but also at the regional and global levels. No country can efficiently decarbonize by itself. An efficient net-zero energy system should also be pursued through regional-scale infrastructure and long-term strategic planning at the regional level. Regional strategies and cooperation also play a vital role in achieving economies of scale in research and development. My advice to all countries is to get along with your neighbours! Regional-scale cooperation and global cooperation across regions is our real path to success."

Director of the Center for Sustainable Development at Columbia University

4.1 ACTIONS FOR SUSTAINABLE, FUTURE-READY INDUSTRIES

The current development path is not set in stone: actions taken today can shape future trajectories and guide the world towards a better future. A business-as-usual path is only one possibility, extrapolating today's trends and policy choices into tomorrow. Deliberate action, however, can markedly alter this trajectory. The direction countries take in the coming decades will depend on the choices they make today. Decisions regarding infrastructure, skills development, governance and trade can either entrench the status quo or shift countries' path towards a more inclusive, productive and sustainable future.

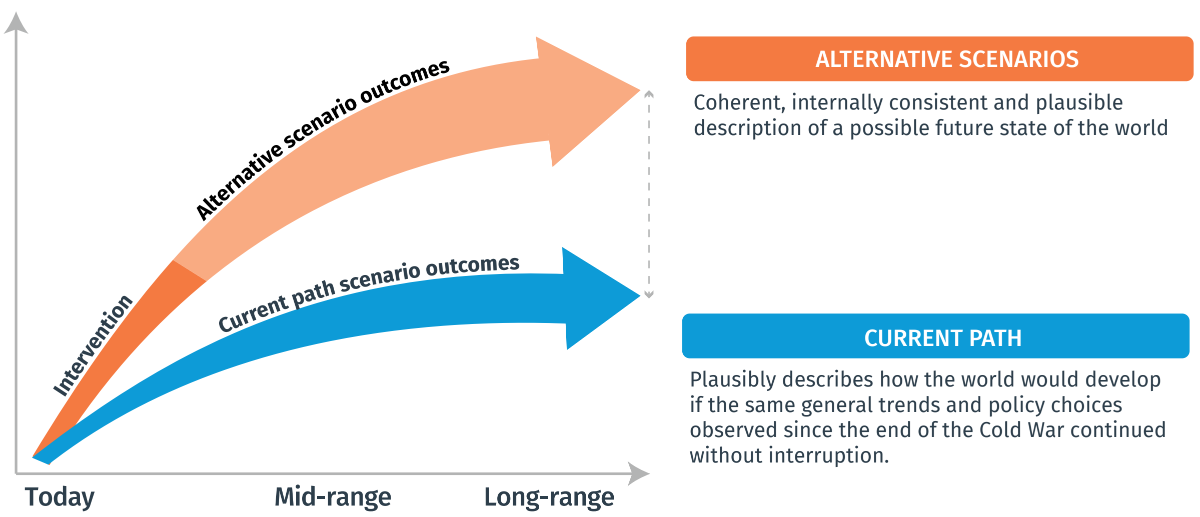
The implications of industrialization for developing economies are clear. Ensuring well-functioning industrial ecosystems requires continued investment in enabling infrastructure, ranging from robust transport networks to renewable energy systems, connectivity and cybersecurity. Equally important is prioritizing education and training systems that include digital and green skills. Supporting lifelong learning, apprenticeships, flexible training pathways and recognition of previous learning schemes can go a long way in preparing the future workforce for the labour market's transformation.

Manufacturing must remain at the centre of development strategies. The development and adoption of new technologies in manufacturing can unlock productivity gains and competitiveness, generate substantial spillovers to the rest of the economy—from services to agriculture—and create employment opportunities in the long run. Strengthening industrial ecosystems requires support for public research institutions, fostering multi-stakeholder dialogue, and designing effective mechanisms for technology transfer and diffusion. Supporting startups can foster more innovative industrial ecosystems, while targeted support for micro, small and medium enterprises (MSMEs) can unlock industrial modernization and upgrading.

Shifting trajectories in industry also requires a clean, fair and inclusive energy transition. Future industrial ecosystems must be powered by renewable energy and underpinned by innovations that reduce emissions in hard-to-abate industries. Circularity and efficient resource and material use are equally important priorities. Active labour market policies and social protection need to be strengthened to ensure greater gender equality and to protect workers at risk of technological displacement.

This chapter explores two different scenarios to determine the impact of the trends described above. The *industrialization push* scenario considers what developing countries could achieve by collectively pursuing an ambitious, coordinated effort to accelerate industrial development. The *clean energy and just industrialization push* scenario goes one step further by embedding sustainability and equity as explicit goals alongside rapid industrialization. These scenarios are modelled using Denver University's International Futures (IFs) model, allowing simulations of long-term socioeconomic and environmental outcomes under alternative sets of interventions (Figure 4.1).

Figure 4.1 **Analysing alternative future scenarios**



The scenarios are built by simulating a series of interventions across all developing countries that have yet to fully industrialize. For this, interventions are applied to economies that are not currently classified as high-income industrial economies (HIIEs) and in which the share of manufacturing value added (MVA) in gross domestic product (GDP) is below 25 per cent. This set of criteria targets countries with both the need and the potential for further industrialization. For these countries, industrialization remains a critical pathway to job creation, economic upgrading and sustainable growth. Throughout the rest of this chapter, this group of countries is referred to as "intervened countries".[1]

The interventions modelled in these scenarios are grounded directly on the enabling conditions and policy priorities discussed in Chapter 3. Building on the areas identified as fundamental for governments to prepare their industries for the future, the scenarios illustrate how specific actions could influence long-term outcomes. To structure the analysis, interventions have been grouped into four clusters: [2]

1. **Direct interventions in the manufacturing sector** focus on expanding productive capacity and enhancing industry competitiveness. They capture policies that directly target the sector's performance, such as stimulating productive investment and scaling up industrial capital. Together, these measures represent a deliberate effort to deepen the country's manufacturing capabilities and accelerate structural transformation.

2. **Interventions to strengthen the entire industrial ecosystem** focus on the broader conditions that enable the manufacturing sector to flourish. This cluster includes measures that address systemic enablers highlighted in Chapter 3, namely:

   a. **Infrastructure:** ensuring reliable transport, energy and digital connectivity.

   b. **Institutions:** strengthening governance, regulation and the rule of law.

   c. **Skills:** expanding access to quality education and vocational training.

   d. **Technology:** enhancing research and development (R&D) capacity and the diffusion of new technologies.

   e. **Trade:** increasing participation in global markets and value chains.

   f. **Investment:** mobilizing public and private resources for productive transformation.

3. **Interventions to support the green transition** ensure that industrial expansion aligns with global climate objectives. This cluster includes measures to decarbonize production and energy systems, such as accelerating the deployment of renewable energy, improving energy efficiency and phasing out coal dependence.

4. **Interventions to make the transition fairer** aim to ensure that the benefits of industrialization are shared broadly. This cluster includes measures to promote gender equality in the workforce, expand welfare transfers and social protection and reduce informality.

All of these interventions require substantial financial resources. Securing these resources entails improvements in domestic resource mobilization and international financial reforms to reduce the high cost of debt for developing countries and mitigate the risk of debt distress, while expanding access to affordable, long-term capital for inclusive and sustainable industrial development.

4.2 THE INDUSTRIALIZATION PUSH IN DEVELOPING COUNTRIES

The first alterative scenario, *the industrialization push*, explores the potential outcomes if developing countries collectively pursue a shift towards a more dynamic industrial future. Focusing on the first two clusters of interventions, this scenario simulates a future in which developing country governments simultaneously address the most critical constraints to industrial development. In this scenario, governments act boldly to remove structural bottlenecks and enable industrial upgrading by investing in human capital, strengthening institutions, expanding infrastructure, promoting exports and innovation and attracting productive investment (Table 4.1).

Taken together, these interventions will significantly improve developing countries' industrial performance by 2050. The immediate results of this scenario are illustrated through the trajectory of intervened countries alongside the three indicators presented in Chapter 1 to characterize the future industrial landscape. Compared with the *current path* trajectory, the *industrialization push* scenario shows a significant increase in intervened countries' average industrial intensity, with a simultaneously strong reduction in the productivity gap (Figure 4.2).

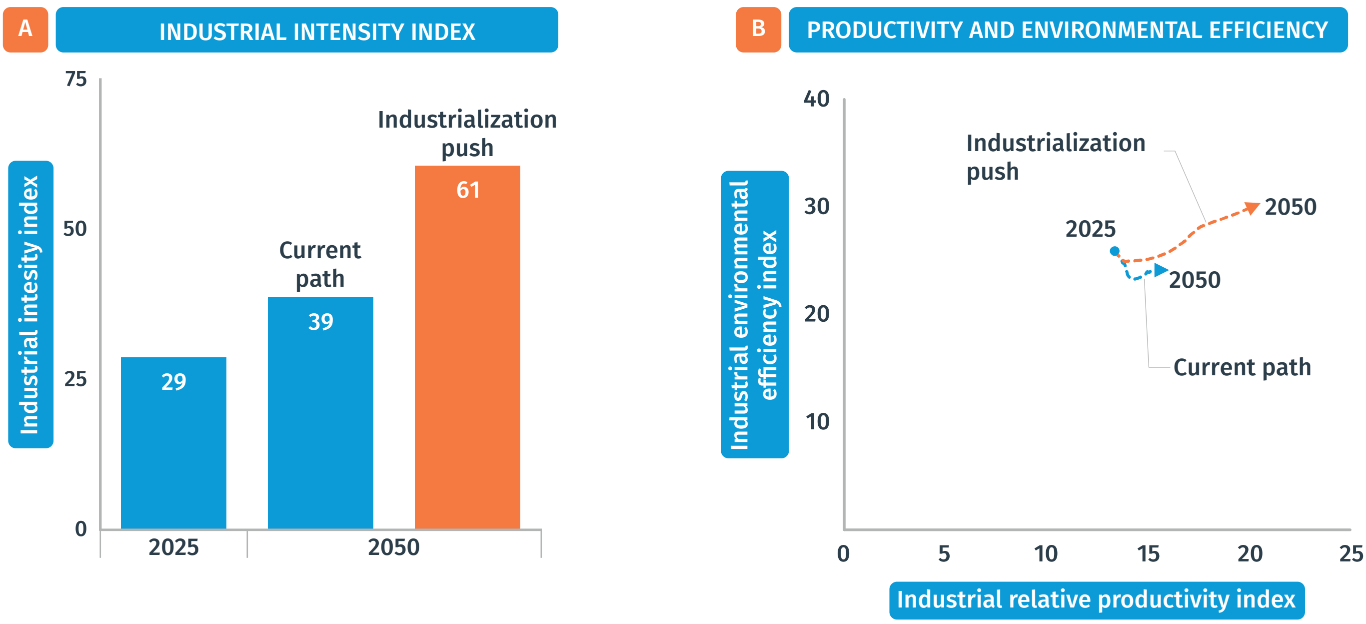
Table 4.1 **Industrialization push in developing countries**

Scenario	Narrative
Industrial push	In this scenario, developing countries achieve widespread and sustained industrialization by prioritizing manufacturing-led growth and expanding their share of global manufacturing exports. Governments implement strategies to build an enabling environment by investing heavily in human capital, stronger governance and institutions, upgraded infrastructure and enhanced research and innovation. These interventions reduce barriers to industrial activity, boost productivity and attract foreign direct investment, complementing domestic resources and accelerating technology transfer. As a result, industries flourish, job creation rises and economic diversification deepens, laying the foundation for more resilient and inclusive development.

An *industrialization push* would markedly enhance developing countries' position in the global industrial landscape. The industrial intensity indicator, which captures the relationship between a country's share of global industrial production and its share of world population, presents a significant leap forward under this scenario (Figure 4.2, Panel A). As discussed in Chapter 1, most developing regions currently exhibit industrial intensity far below parity. Under the *current path*, structural imbalances persist and by 2050, the average industrial intensity index for developing countries would only increase modestly, from the current value of 28 per cent to 37 per cent. In contrast, under the *industrialization push* scenario, the index would increase to 59 per cent by 2050, effectively doubling the current level. This represents a shift towards a more balanced industrial landscape, in which developing countries obtain a share of global manufacturing output that is more closely aligned with their demographic population.

Stronger industrial intensity in developing countries is achieved with a significant reduction in technology gaps. Panel B of Figure 4.2 summarizes the results in terms of industrial sophistication and environmental sustainability, combining the industrial relative productivity index (horizontal axis) and the industrial

Figure 4.2 **A shift towards stronger industrialization in developing countries**



Note: Bars in *Panel A* show the average value for the industrial intensity index for the group of intervened countries during the reference years. Lines in *Panel B* show the average annual values of the industrial environmental efficiency index (vertical axis) and the industrial relative productivity index (horizontal line) during the period of reference (2025–2050) under the two scenarios. Averages are weighted by each country's share of total manufacturing value added (MVA) of the intervened group. The industrial intensity index is defined as the percentage ratio of the intervened countries' share in global MVA and their share of world population. The industrial relative productivity index is defined as the percentage ratio of the intervened countries' MVA per worker and high-income industrial economies' (HIIEs) average. The industrial environmental efficiency index is defined as the percentage ratio of the intervened countries' MVA per unit of CO_2 emissions and the average value of HIIEs.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

environmental efficiency index (vertical axis). A process of sustainable industrialization would imply higher industrial intensity as well as a simultaneous reduction of gaps along both dimensions of the figure, i.e. a movement in time towards the "northwest" part of the figure. Under the *current path*, progress stalls after 2025, with only modest productivity gains and little improvement in environmental efficiency, leaving developing countries far behind the frontier. In contrast, under the *industrialization push* scenario, developing countries embark on a dynamic upward trajectory, with both indicators improving by 2050. However, the projected gains are stronger in productivity than in environmental efficiency, suggesting that while an industrial push can help close the technology gap, additional measures are needed to accelerate the greening of industrialization.

Positive industrial outcomes translate into substantial socioeconomic gains. Under the *industrial push* scenario, poverty declines sharply, while incomes increase and hunger reduces (Figure 4.3). Compared with the *current path*, by 2050, 403 million fewer people are projected to live in poverty (under USD 8.30/day), and 115 million fewer in extreme poverty (below USD 3.00/day). Africa alone accounts for 80 per cent of the reduction in extreme poverty, with 92 million fewer people affected. The number of people experiencing hunger also declines by 33 million people, with strong gains in Africa and Southern Asia. In economic terms, global GDP grows by 5.8 per cent, equivalent to USD 12.5 trillion in cumulative gains. USD 10,000, an increase of 6 per cent and 22 per cent, respectively, relative to the *current path*.

Industrial development accelerates rapidly in the countries that need it most. In the group of intervened countries, MVA increases by USD 6.9 trillion, a 57 per cent jump compared with the *current path*. The average share of manufacturing in GDP also grows by 6 percentage points, reaching 24 per cent in 2050. In terms of employment, 124 million additional jobs are created in manufacturing, raising the share of industrial employment in total employment from 18 per cent to 22 per cent. These results reflect not only faster industrial growth but also more inclusive participation in the benefits of industrialization.

Figure 4.3 **Projected outcomes in developing countries by 2050 under an industrialization push scenario**

	1 NO POVERTY	2 ZERO HUNGER	8 DECENT WORK AND ECONOMIC GROWTH	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	13 CLIMATE ACTION
Compared to *current path*	• **403 million fewer people** living in poverty, with 46% in Southern Asia and 36% in Africa • **115 million fewer people** living in extreme poverty, with 80% (92 million) in Africa	• **33 million fewer** people facing undernourishment • **60% of hunger reduction** in Africa (19 million), with 28% in Southern Asia (9 million)	• **5.8% higher global GDP**, with USD 12.5 trillion in cumulative gains • **GDP per capita** grows 6% globally and 22% in intervened countries	• **MVA rises by 57%** in intervened countries • **MVA reaches 24% of GDP**; and 124 million additional manufacturing jobs are created in intervened countries	• **CO_2 emissions increase by over 2% globally** due to faster industrial expansion • **Manufacturing CO_2 emissions** rise 25% in the intervened countries

Notes: Extreme poverty is measured by the number of people projected to be living under the USD 3.00 poverty line. Middle-income poverty is measured by the number of people projected to be living under the USD 8.30 poverty line. Food insecurity is measured by the population projected to be malnourished.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

Despite these socioeconomic gains, environmental outcomes remain unsustainable under the industrialization push scenario. Global CO_2 emissions rise by 2.2 per cent compared with the *current path*, while emissions from manufacturing in the countries experiencing industrial expansion increase by 25 per cent. While this reflects the energy intensity nature of industrial growth, it also highlights the risk of lock-in in carbon-intensive production models. Without a decisive shift towards cleaner technologies, the gains in income and productivity could come at the expense of environmental sustainability.

A new wave of industrialization can drive inclusive growth, but only if it is guided by sustainability from the outset. The *industrialization push* scenario underscores that inclusive industrial development is achievable, but it must be accompanied by deliberate efforts to ensure green industrial processes. International support will be essential, whether through technology transfer and sustainable finance or institutional partnerships and policy coherence. The path to sustainable development is not just about accelerating industrialization – it is about transforming how industrialization is pursued.

4.3 THE CLEAN ENERGY AND JUST INDUSTRIALIZATION PUSH TOWARDS A SUSTAINABLE FUTURE

An uncoordinated industrialization push risks undermining global sustainability. If developing countries pursue the expansion of their industrial sector in an uncoordinated manner, the outcome may be neither environmentally sustainable nor socially inclusive. Industrial expansion without a clear direction can generate jobs and income, but at the cost of exacerbating climate change and deepening existing inequalities. Avoiding these pitfalls requires aligning industrial policies with environmental sustainability and social inclusion from the outset. Efforts must focus on shifting the direction of these efforts towards a green trajectory that leaves no country or population behind.

Achieving this requires strong international coordination and support. No country can transform its industrial base alone. A global transition towards clean and inclusive industrialization depends on multilateral support through technology transfer, climate finance, knowledge sharing and fair rules in global trade and investment. Global coordination will be essential to ensure that industrial growth remains within planetary boundaries.

The *clean energy and just industrialization push* represents the best-case scenario for both people and the planet. Building on the *industrialization push* (by similarly modelling a large-scale push towards industrialization in developing countries), this scenario introduces targeted interventions that make the industrialization process compatible with planetary boundaries, while ensuring fairness and social protection for all. These interventions focus on accelerating the green transition and making it fairer, complemented by the measures already included in the *industrialization push* scenario related to expanding productive capacity in the manufacturing sector and strengthening the broader industrial ecosystem.

Table 4.2 **Clean energy and a just industrialization push in developing countries**

Scenario	Narrative
Clean energy and just industrialization push	Achieving a just and inclusive industrial transformation by 2050 requires not only accelerating industrialization but also reshaping its direction. Being "just" means that industrial growth broadens opportunities and cushions vulnerable groups from the adjustments implied by the industrial transformation; while being "inclusive" ensures that all segments of society can participate and benefit from industrial growth. This scenario envisions an industrialization path that is both environmentally sustainable and socially fair. It ensures that new production capacity is powered by clean energy, that productivity gains are decoupled from emissions and the benefits of industrialization are more evenly distributed across society. The *clean energy and just industrialization push* scenario not only accelerates industrial expansion, but also steers the transition towards green energy, low-emissions technologies and more equitable outcomes across gender and income levels.

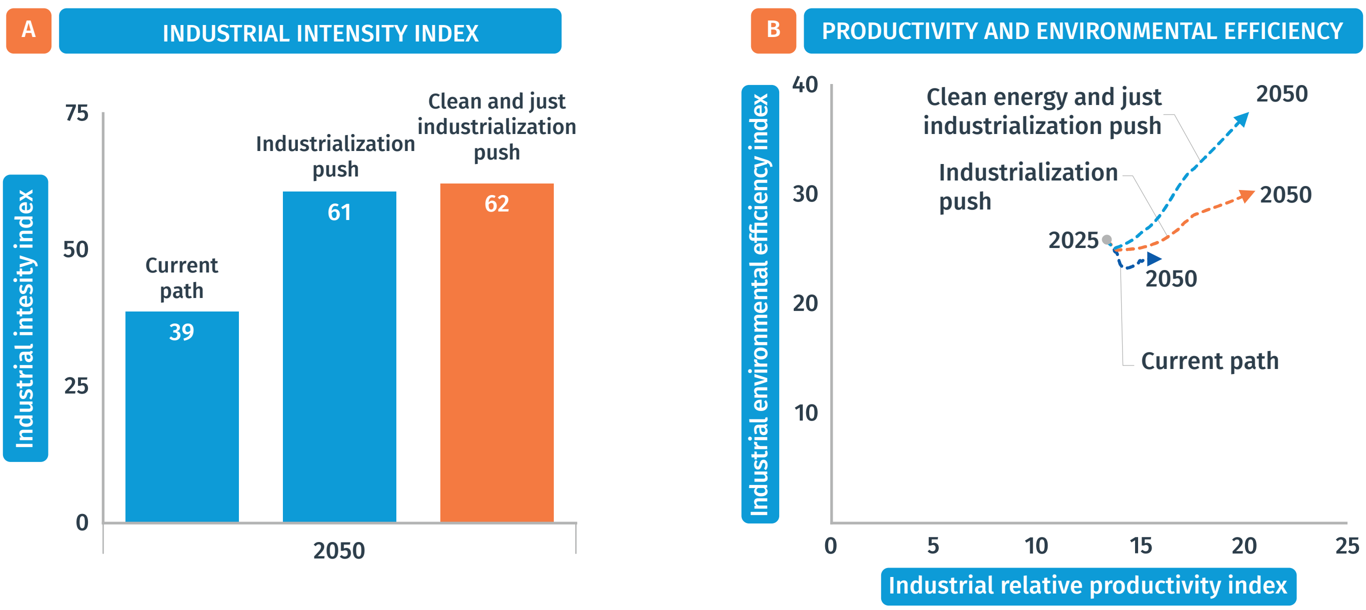
The *clean energy and just industrialization push* scenario builds on the *industrialization push* and targets the same group of countries, but with a different focus. This scenario includes clean energy, reduced coal dependence and more inclusive labour markets. Key additions in this scenario include reducing electricity transmission losses, lowering the capital cost of renewable energy (especially solar and wind), disincentivizing coal production, expanding welfare transfers to vulnerable households and increasing female labour force participation. These measures reduce emissions, enhance access to reliable energy and increase social equity to mitigate the impacts of industrial transformation.

The results of this scenario confirm that aligning industrial policies with sustainability goals does not impede industrial progress but rather enhances it. In terms of industrial intensity, developing countries maintain the gains achieved under the *industrialization push* scenario, with the index reaching 60 by 2050, slightly higher than in the previous scenario (Figure 4.4). This demonstrates that integrating clean energy and social inclusion measures does not slow the expansion of manufacturing; rather, it supports a more resilient and balanced industrialization process.

This scenario illustrates that industrialization can advance at full speed while significantly decoupling growth from emissions, placing developing countries on a truly sustainable path. The benefits of *the clean energy and just industrialization push* are particularly evident when looking at the trajectory of industrial productivity and environmental efficiency. Compared with both the *current path* and the *industrialization push* scenario, the trajectory of intervened countries moves further towards the "northwest" part of the figure, reflecting simultaneous improvements in technological upgrading and environmental efficiency. Productivity continues to grow steadily, but is now accompanied by a much clearer improvement in environmental efficiency, driven by renewable energy deployment, reduced coal dependence and energy efficiency investments.

A *clean energy and just industrialization push* would lift over half a billion people out of poverty by 2050. The scenario's aggregated results show strong social benefits, particularly in poverty reduction. By 2050, 525 million fewer people will live below the poverty line (USD 8.30/day) compared with the *current path*, and 155 million people will be lifted out of extreme poverty (USD 3.00/day). As in the *industrialization*

Figure 4.4 **Towards a stronger, fairer and greener industry in developing countries**



Note: Bars in *Panel A* show the average value for the industrial intensity index for the group of intervened countries under the three scenarios for the year 2050. Lines in *Panel B* show the average annual values of the industrial environmental efficiency index (vertical axis) and the industrial relative productivity index (horizontal line) during the period of reference (2025–2050) under the three scenarios. Averages are weighted by each country's share of total manufacturing value added (MVA) of the intervened group. The industrial intensity index is defined as the percentage ratio of the intervened countries' share in global MVA and their share of world population. The industrial relative productivity index is defined as the percentage ratio of the intervened countries' MVA per worker and the average of high-income industrial economies (HIIEs). The industrial environmental efficiency index is defined as the percentage ratio of the intervened countries' MVA per unit of CO_2 emissions and the average value of HIIEs.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

push scenario, Africa and Southern Asia account for the majority of this reduction, representing over three-quarters of the global decline in extreme poverty. Global hunger will also fall sharply, with 52 million fewer people facing undernourishment, most of them in Africa (31 million) and Southern Asia (14 million). These gains surpass those achieved in the *industrialization push* by an additional 122 million people lifted out of poverty and 19 million fewer facing hunger (Figure 4.5).

Economic and industrial gains are also substantial under the *clean energy and just industrialization push*. Global GDP rises by 6.6 per cent compared with the *current path* and is 2.4 per cent higher than in the *industrialization push* scenario in the interevened group. Developing countries' GDP per capita reaches USD 10,310 by 2050, representing a 25 per cent increase over the baseline. The *clean energy and just industrialization* scenario also generates a cumulative gain of USD 6.5 trillion in MVA for developing countries, a 60 per cent increase compared with the *current path*, and USD 422 billion more than in the *industrialization push*. The share of manufacturing in GDP rises by six percentage points, reaching 24 per cent by 2050, while employment expands to 152 million additional manufacturing jobs (28 million more than in the *industrialization push* scenario).

The results confirm that industrial growth can be decoupled from carbon emissions. At the global level, under this scenario, CO_2 emissions decline by 6 per cent relative to the *current path*, reversing the upward trend observed under the *industrialization push.* In the group of intervened developing countries, the decline is even more pronounced, with total CO_2 emissions falling by 9 per cent below the *current path* and 16.5 per cent below the *industrialization push* scenario. Despite industrial expansion, the global manufacturing-related emissions only increase by 3 per cent above the *current path*. Additionally, global carbon emissions peak in 2038, two years earlier than under the *current path*, driven by reduced reliance on coal and faster deployment of renewables.

Figure 4.5 **Projected outcomes in developing countries by 2050 under a clean energy and just industrialization push scenario**

	1 NO POVERTY	2 ZERO HUNGER	8 DECENT WORK AND ECONOMIC GROWTH	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	13 CLIMATE ACTION
Compared to *current path*	• **525 million fewer people** living in poverty, with 47% in Southern Asia and 35% in Africa • **155 million fewer** living in extreme poverty, with 80% in Africa	• **52 million fewer people** facing undernourishment, with 60% inAfrica and 27% in Southern Asia	• **6.6% higher global GDP,** with USD 14.2 trillion in cumulative gains • **GDP per capita grows 6.7%** globally and 25% in the intervened countries	• **MVA rises by 60%** in intervened countries • **MVA reaches 24% of GDP;** and **152 million additional manufacturing jobs** are created	• **CO_2 emissions decrease by 6% globally** and 9% in the intervened countries • **Manufacturing CO_2 emissions** decrease 3% globally
Compared to *industrialization push*	• **122 and 41 million fewer people** living in poverty and extreme poverty	• **19 million fewer people** face undernourishment	• **2.4% higher GDP and GDP** per capita in the intervened countries	• **MVA rises by 2.5%** in the intervened countries and there are 28 million more manufacturing jobs	• **CO_2 emissions** decrease by 8% **globally** • **Manufacturing CO_2 emissions** fall by 17% in the intervened countries

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

4.4 KEY PRIORITIES FOR GLOBAL ACTION

A green and inclusive industrialization path is possible, but only through decisive action. The *clean energy and just industrialization push* demonstrates that developing countries can pursue ambitious industrial development without compromising sustainability or equity. However, this trajectory will not happen automatically. It requires deliberate international support, a strong role for public institutions and coherent strategies that integrate climate and industrial policy. As the global economy approaches 2050, this represents the path with the greatest potential to deliver a fairer and more sustainable future for all.

Global solidarity and coordinated efforts are indispensable. The megatrends reshaping the industrial landscape and the challenges they bring are global in nature and have an impact on all countries. While much can be achieved domestically, no country can secure a clean and just transition in isolation. At least three areas demand collective action: (i) making supply chains fairer and greener; (ii) limiting climate breakdown by accelerating the adoption of clean technologies and sustainable business practices; and (iii) strengthening international cooperation to eradicate poverty and hunger.

While tomorrow's manufacturing sector is likely to become more regional, supply chains will continue to span multiple borders – and so must the solutions to make them fair and sustainable. Participation in GVCs remains a powerful driver of industrial development for countries that successfully enter and move up within them. Yet GVCs are also associated with unsustainable practices, including transport-related emissions and carbon leakages and inadequate protection for vulnerable workers, particularly in the lowest tiers of global production. Without global coordination on standards, monitoring and access to skills and technology, supply chains cannot be made truly sustainable or fair.

The climate emergency is inherently global, but its burdens fall heaviest on those least responsible for it. While the impacts of climate change are universal, the responsibility, resources and capacity to respond to it are unevenly distributed. The international community has a special responsibility to ensure that all countries can access the technologies, finance and skills required for decarbonization. A clean and just transition will not be achieved by isolated national efforts, but through solidarity, knowledge sharing and a global commitment to fairness.

Finally, global coordination and solidarity are essential to harness the potential of industrial development for job creation and the transformation of food systems. The international community must support developing countries in strengthening their industrial ecosystems by, among others, facilitating the development and diffusion of new technologies across both the manufacturing and agriculture sectors and by investing in quality infrastructure. At the same time, the international community must ensure that developing countries have the policy space to implement industrial policies that, in alignment with regional and global coordination efforts, can lift millions out of poverty and hunger.

4.4.1 Supporting sustainable supply chains

The transition from the current trajectory to a sustainable scenario calls for global action to ensure that supply chains are both environmentally sustainable and socially inclusive. While GVCs are essential for trade and development, they are often associated with unsustainable practices. When left unchecked, these practices can exacerbate inequalities, undermine decent work conditions, and involve human rights violations such as child labour, forced labour and human trafficking. Compounding these issues, GVCs remain heavily dependent on unsustainable energy use, land use, lifestyles and patterns of production and consumption. For instance, the supply chains of 157 large multinational enterprises (MNEs) alone account for 60 per cent of the world's industrial carbon emissions.[3]

To achieve green industrialization, developing economies must upgrade their economic and production systems, mitigate environmental impacts, ensure decent work and move towards higher value added activities. Economic upgrading involves transitioning to higher value added activities and increasing value capture within the global production system, supported by skills development, investments in critical infrastructure and the transfer of technology and knowledge. Social upgrading focuses on promoting decent work and ensuring compliance with international labour standards.[4] Environmental upgrading entails mitigating or preventing environmental damage and adhering to international environmental standards. This encompasses enhancing eco-efficiency, developing new, climate-friendly products and services and improving environmental management.

In recent years, significant advances have been made in both mandatory and voluntary due diligence standards. The global governance framework for sustainable supply chains is a complex web, ranging from legally binding multilateral instruments to a wide range of private voluntary sustainability standards. More recently, a wave of new mandatory due diligence legislation in several countries has aimed to improve the protection of both human rights and the environment, enhance transparency for consumers and provide greater legal certainty for businesses. These measures can also benefit industrializing countries by encouraging better private sector practices and alignment with international standards.

Despite progress, sustainability measures may risk excluding producers in developing countries from supply chains. Power asymmetries between supply chain actors often shift costs and risks onto subcontractors, producers and workers further down the supply chain.[5] Hence, due diligence legislation may adversely affect small-scale suppliers, smallholder farmers and workers in industrializing countries, who may be unable to absorb the costs of certification. Lead companies may respond by reducing their suppliers, favouring larger firms, or even disengaging from high-risk areas to avoid reputational and other costs. This could create a perverse shift in the market, with domestic or regional supply chains absorbing non-compliant suppliers, potentially intensifying market concentration and informality in certain sectors.[6]

At the same time, the most vulnerable workers may see no improvements. Due diligence mechanisms often focus only on the first tier of supply chain, overlooking second- and third-tier suppliers where decent work deficits and human rights violations are most prevalent.[7] Despite technological advancements, companies often lack effective traceability systems to assess suppliers' sustainability performance beyond their direct suppliers, which limits transparency and accountability. Consequently, while due diligence can improve income and working conditions for formal workers, these benefits rarely reach irregular or lower-tier workers. This highlights the limited reach and effectiveness of current legislation and the need to extend protection to the supply chains' most vulnerable segments.

The transition towards fair and sustainable GVCs requires a more equitable distribution of value and a reduction of environmental impacts. Achieving this depends first on compliance with standards that promote greater alignment and harmonization, while ensuring interoperability across national, multilateral and voluntary frameworks. Robust monitoring mechanisms are also needed to track and disclose the impacts of mandatory due diligence laws across countries, supply chains and tiers.[8]

For producers to comply with standards and move up in supply chains, they must be supported with access to finance, skills and technology. Enhanced support for MSMEs is key to helping them meet standards, adapt to new measures, such as carbon border taxes, and comply with environmental, social and governmental requirements. Regulators also need assistance in building robust legal frameworks aligned with international norms, strengthening enforcement capacity, and equipping public institutions with internationally recognized quality infrastructure. By enabling producers to meet standards and acquire new skills, the international community can help promote fairer value distribution, create decent employment and reduce environmental impacts across GVCs.[9]

4.4.2 Limiting climate breakdown

Decoupling industrial growth from environmental degradation is essential to fully harness industry's potential as a driving force of sustainable development. As discussed in Chapter 3, decarbonization, circularity and resource efficiency are central to this process. Decarbonization begins with aligning industrial policies with global climate and development objectives, such as the Paris Agreement and the 2030 Agenda. Such alignment requires setting clear national targets, including emissions standards and energy efficiency requirements, while integrating indicators into development plans aligned with the Sustainable Development Goals (SDGs).

While greening industrialization is a shared objective, countries differ in their capacity to achieve it and in the level of international support they require to accelerate progress towards this goal. Capacity development in policy design and formulation is an important first step. Least developed countries contribute little to global emissions but are among the most vulnerable to climate change and need sustained international assistance to develop effective nationally determined contributions and national adaptation plans, to help identify medium- and long-term adaptation priorities and align them with national industrial strategies and infrastructure planning. Middle-income countries also need support as they modernize their industrial strategies and phase out high-emission technologies, adopt cleaner production standards and foster innovation ecosystems that promote inclusive growth and economic diversification.

The international community can also help accelerate the transition to renewable and clean energy sources. This requires scaling up investments in renewable energy, energy efficiency and low emission infrastructure to support manufacturing and emerging value chains globally. Beyond domestic instruments ranging from public procurement, feed-in tariffs and efficiency standards, additional policy support is needed to assist early movers in often not-yet-cost-effective initiatives to foster demand for low-carbon products and technologies, establish certification schemes for green goods to strengthen market trust and competitiveness, and set ambitious emission reduction targets in hard-to-abate industries.

Globally, investment must prioritize innovation, the engine of sustainable energy and industrial transformation. New technologies can drive deep decarbonization and economic diversification, ranging from renewable-powered electrification, energy efficiency and circular production to emerging solutions such as green hydrogen, bio-based materials and AI-powered resource optimization. In lower- and middle-income countries, support is needed to strengthen ecosystems by linking universities with industry, backing clean-tech startups and scaling context-specific pilot projects and solutions, from low-cost electrolysis to AI-enabled efficiency tools. Smart procurement and regulatory sandboxes can accelerate technology uptake, while global partnerships and industrial alliances are critical for knowledge sharing, co-developing technologies, ensuring equitable access to new value chains, and supporting responsible innovation safeguards against environmental and social harms.

Regional and global coordination can catalyse decarbonization. At the regional level, initiatives such as clean energy hubs, cross-border clean energy grids, and sustainable transport corridors can further strengthen resilience and competitiveness. By creating clear market signals through carbon pricing, advanced economies can guide the global industrial sector towards lower emissions and higher efficiency, while also supporting innovation and job creation. Importantly, mechanisms such as carbon pricing must be accompanied by robust support systems to help developing countries manage compliance costs; as without such measures, these policies could deepen existing inequalities and disproportionately burden their economies.

The decarbonization of industry and the global eco-nomy must also create pathways for economic transformation in developing countries. Otherwise, the energy transition risks widening global disparities and intensifying energy security concerns due to undiversified supply chains. Developing countries can expand the production of clean technologies and low-carbon industrial goods. To seize these opportunities and promote green industrialization, countries need support in adopting long-term, interlinked industrial and energy strategies, including investment in green industrial skills and infrastructure. Co-developing technology with international partners can foster the emergence of green industrial hubs. Advancing these priorities requires international collaboration in financing, technology deployment and policy guidance, while recognizing the climate imperative for diversified green innovation and production.

Promoting justice, inclusivity and climate resilience is essential to ensure a sustainable energy transition. Social inclusion and climate resilience objectives must be explicitly integrated into industrial strategies. This includes prioritizing decent work opportunities for youth, women and marginalized groups, while supporting MSMEs in adopting sustainable practices and integrating into green value chains. Policymakers should address regional disparities by fostering industrial hubs in underdeveloped areas, integrating gender equity into industrial policy, and investing in training and recruitment initiatives for women in manufacturing, clean technology and digital industries. Building local capacity is crucial, and requires investments in education, technical training and skills development for emerging green and technology-intensive jobs.

At the same time, resilience strategies must anticipate climate risks and external shocks to ensure that industrial infrastructure is climate-ready. Measures can include flood protection, heat-resistant buildings and improved water management, while diversifying supply chains and embedding risk assessments into planning. The international community must support global equity by securing access to finance, technology sharing and employment opportunities to achieve sustainable supply chains that benefit all.

Inclusive finance and investments must be mobilized through coordinated global efforts. Funding should prioritize long-term value by supporting projects that link clean energy to adaptation plans, productive uses and local job creation. Above all, climate finance must serve several goals and accelerate global decarbonization while fostering domestic value creation, decent work and resilience. By embedding principles of just financing into industrial and climate policy, countries can unlock the investments needed to drive inclusive growth through 2050 and beyond.

4.4.3 Helping to reduce poverty and hunger

Industrial development is critical for reducing poverty and ending hunger. It contributes to poverty reduction both directly by creating jobs, raising incomes and supporting households in the manufacturing sector, and indirectly, through the sector's broader impact on economic growth.[10] Industrialization also helps reduce hunger and undernourishment by promoting technology adoption in agriculture and strengthening food production and processing capabilities.[11]

To unlock industry's potential as a tool for inclusive development and poverty reduction, developing countries must pursue two intertwined objectives: fostering productivity growth in the manufacturing sector and creating more and better jobs. Productivity growth is the main driver of poverty reduction in developing countries, as evidenced by research covering more than 40 developing countries between 1990 and 2018.[12] Industrial policy is key to unlocking productivity gains in developing countries. When time-bound and accompanied by appropriate monitoring mechanisms, measures such as tariff protection can provide infant industries the space to learn, accumulate capabilities and catch up. Importantly, such measures must be complemented by credible incentives to ensure domestic industries actively pursue learning and productivity improvements.[13]

Growth only effectively reduces poverty when new jobs are accessible, especially to low-income workers. To foster job creation, policy interventions should focus on at least two complementary areas.[14] First, strengthening industrial ecosystems through measures that support and protect infant industries, develop clusters and industrial parks with strong local linkages, promote quality management and certification, and invest in technical and vocational education and training to expand opportunities for stable, well-paid employment. Second, steering technological progress towards labour-creating rather than labour-replacing pathways. Directed innovation programmes and support for indigenous and context-appropriate technologies and policies can incentivize product innovation and ensure that digital and industrial transformation strengthens, rather than undermines employment.

Industrial development is also essential for ending hunger, primarily through its potential to generate income. By driving productivity growth and value addition across agrifood value chains, it provides vulnerable populations with the economic means to access nutritious food.[15] The international community should support developing countries in the development and diffusion of mechanization and digital technologies among agricultural producers, including through agricultural extension programmes. Mechanization and the adoption of yield-increasing technologies are essential for boosting agricultural productivity and income while also promoting efficient resource use and reduced environmental impacts. Efforts to support the mechanization and digitalization of agriculture should include extension programmes that build digital and agritech skills, especially in rural areas, while prioritizing gender, youth and other forms of inclusivity.

Investing in food processing capabilities and improving supply chains is a critical intervention for adding value, generating income and ensuring food security. This should be accompanied by strong advocacy for the adoption of sustainable practices in agro-industry, including the use of renewable and clean energy sources and the implementation of circular production models. Investment can take various forms, including the establishment of integrated agro-industrial parks (IAIPs) – centrally managed clusters of agro-industrial and allied firms that provide high-quality infrastructure, utilities, logistics and specialized facilities to achieve economies of scale.[16] Countries such as Ethiopia and India have demonstrated that agro-industrial parks can help local manufacturers benefit from shared infrastructure, services and other synergies among farmers, input producers and agri-processors.[17]

Another important area for action is the development of improved infrastructure for supply chains and distribution. Poor rural infrastructure, particularly roads, irrigation, storage and electrification, poses a significant obstacle for agricultural development and distribution. Inadequate infrastructure increases transaction costs for farmers and limits market access. Targeted interventions to reduce losses across the value chain are crucial for meeting rising food demand, especially for nutritious and perishable foods such as fruits and vegetables. Cold storage plays a key role by reducing post-harvest losses, extending shelf life and preserving quality.

It is also essential to ensure access to skills and finance for food processing enterprises. Access to finance remains one of the biggest challenges in transforming agrifood systems, particularly for the "missing middle" which includes small-scale producers and agrifood MSMEs seeking loans between USD 25,000 and USD 2 million.[18] Tailored financial solutions, such as factoring, supply chain finance, outcome financing, real estate investment trusts, priority sector lending, asset monetization and guarantees can reduce risk and help these actors overcome financing challenges.

Finally, strengthening quality infrastructure systems—including metrology, standardization and accreditation—is essential for producers to meet international food safety and quality standards, enhancing their global competitiveness and aligning with market requirements. Food security cannot be achieved without addressing food safety and hygiene. By reinforcing food control systems and improving compliance along key value chains, quality standards can protect consumers while also promoting trade and encouraging the safe consumption of locally produced food. However, rising certification costs and diverse regulatory requirements pose serious challenges for agribusinesses, often acting as barriers and increasing the risk of supply chain disruptions. To address these challenges, efforts must focus on harmonizing safety standards and providing targeted support to producers in meeting them. At the same time, developing global frameworks for sustainable food sourcing can further align agro-industries with international protocols, ensuring responsible sourcing practices and enhancing the long-term sustainability of food production systems.

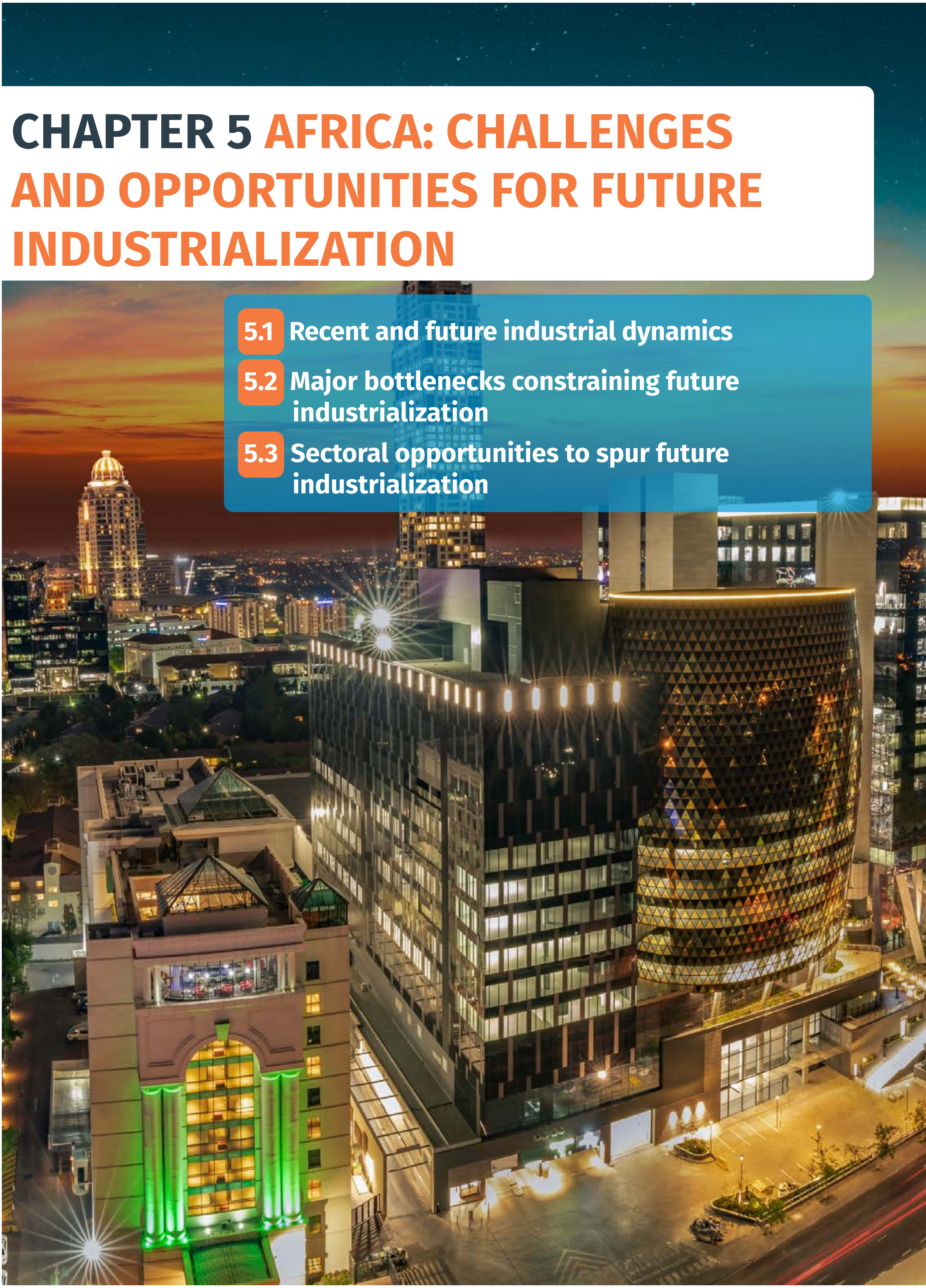
For these actions to be effective, developing countries must have access to sufficient policy space. Multilateral action is needed to ensure the design of equitable and fit-for-purpose rules. Policy space allows developing countries to formulate policies that respond to local needs, address local bottlenecks and seize relevant sectoral opportunities while continuing to align with regional and global coordination efforts.

ENDNOTES

[1] See Annex A.1 for the full list of intervened countries.
[2] See Annex A.1 for more details on the methodology and full list of interventions included in each cluster.
[3] UNIDO (2023c).
[4] The International Labour Organization's (ILO) conventions, protocols and recommendations are central to the global governance framework for sustainable supply chains. They provide the foundational legal and normative basis for labour conditions and human rights. Upholding these standards and integrating them into national legislation is an essential step towards ensuring decent and fair work.
[5] UNIDO (2023c).
[6] UNIDO (2023c), see also van der Ven et al. (2025).
[7] Delera (2022).
[8] UNIDO (2023c).
[9] UNIDO (2025e).
[10] Lavopa and Donnelly (2025b).
[11] Daum (2025).
[12] Erumban and De Vries (2024).
[13] Lee (2024).
[14] UNIDO (2023a).
[15] Hartwich et al. (2025a).
[16] The primary objective of IAIPs is to create investment opportunities in agribusiness by leveraging economies of scale, lowering costs and strengthening supply chain linkages. The IAIPs attract investment in agro-industries by reducing initial investment costs by providing shared facilities and services such as warehouses, waste treatment plants, security, information and communication technologies and logistics services. IAIPs are designed to reduce post-harvest losses by improving storage and handling facilities, ensuring efficient logistics and market access, enabling on-site value addition and processing, and fostering capacity development and technology transfer.
[17] UNIDO and FAO (2024). See also Alemnew and Seyoum Taffesse (2024).
[18] UNIDO and FAO (2024).

PART B
Regional perspectives

CHAPTER 5 AFRICA: CHALLENGES AND OPPORTUNITIES FOR FUTURE INDUSTRIALIZATION



The megatrends outlined in Part A of this report present both challenges and opportunities for the future of Africa's industrialization. Although a degree of heterogeneity exists across subregions, African economies continue to face structural gaps in productivity, especially when compared with other developing regions. Advancing industrialization across the continent will require addressing both structural and emerging bottlenecks. These include persistent political and institutional challenges, inadequate physical and digital infrastructure, which limit technology adoption, and structural weaknesses in industrial ecosystems and human capital. The concentration of productive activities in lower value-added segments, high levels of informality, and the prevalence of small, fragmented markets further limit opportunities for industrial upgrading.

Forward-looking industrial policy can play a decisive role in reshaping Africa's development trajectory by addressing existing bottlenecks and identifying industries with strong potential for future industrialization. This chapter highlights several promising sectoral opportunities for the continent, underpinned by growing domestic and external demand, existing foundational capabilities and region-specific competitive advantages. These opportunities include critical minerals processing and mining machinery production, renewable energy equipment and hydrogen, green textiles and apparel, agroprocessing and agricultural equipment. By prioritizing these industries, African countries can harness megatrends, strengthen industrial capabilities, generate decent jobs, and achieve deeper integration into global value chains.

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"Africa has the potential to become a global leader in green industrialization, renewable energy deployment and climate-smart agriculture. These five priorities—trade, investment, industrialization, domestic resource mobilization and climate resilience—are not isolated. They are interconnected levers for structural transformation."

United Nations Under-Secretary-General and Executive Secretary of the UN Economic Commission for Africa (UNECA)

5.1 RECENT AND FUTURE INDUSTRIAL DYNAMICS

Over the past 25 years, Africa has lagged behind other developing regions in relative manufacturing growth. During this period, African countries' manufacturing value added (MVA) per capita grew at an average annual rate of just 0.8 per cent, significantly below the average for all developing countries (1.9 per cent),[1] comparable only to the performance of economies in Latin America and the Caribbean (LAC). This aggregate value, however, conceals important variations across the continent in terms of recent trends, structural challenges and future prospects. By grouping countries according to their stage of development and geographical location, the analysis in this section captures these subregional specificities and sets the stage for the following sections, which provide a more detailed analysis of the challenges and opportunities shaping Africa's future industrialization.

Eastern and Northern Africa show the most dynamic industrial performance on the continent. During the first quarter of the 21st century, countries in these subregions recorded, on average, the fastest growth rates in MVA per capita across the continent (Figure 5.1). This trend was observed across all income categories analysed. In contrast, low- and lower middle-income economies in Central Africa and upper middle-income economies in Southern Africa experienced weak industrial growth. In the latter group, MVA per capita by 2025 was, on average, lower than in 2000, indicating a process of premature deindustrialization.

By 2050, Africa's low- and lower middle-income economies are projected to gain substantial ground in the continent's industrial production. At present, low- and lower middle-income economies account for 74 per cent of Africa's total MVA, with Northern and Western African economies each contributing around one-quarter of total MVA in Africa (Figure 5.2). Projections to 2050 under the *current path* scenario suggest that the share of low- and lower middle-income economies will continue to grow, driven primarily by a strong increase in manufacturing output in Eastern African countries.[2] This group's contribution to total MVA is expected to rise from currently 14 per cent to 24 per cent by 2050. In contrast, upper middle-income economies in Central and Southern Africa are projected to lose nearly ten percentage points of their share in continental MVA over the next 25 years.

Africa will remain underrepresented in the global industrial landscape unless decisive action is taken. The industrial intensity index illustrates that, by 2050, the continent is projected to contribute to global industrial production at a rate far below its share of the world's population, with the index expected to remain well below parity across all country groups (Figure 5.3, Panel A). Although all regions are anticipated to see improvements in their index scores over the next 25 years, progress will unlikely be sufficient to close existing gaps. The largest increases are expected in Northern Africa, especially among upper middle-income economies.

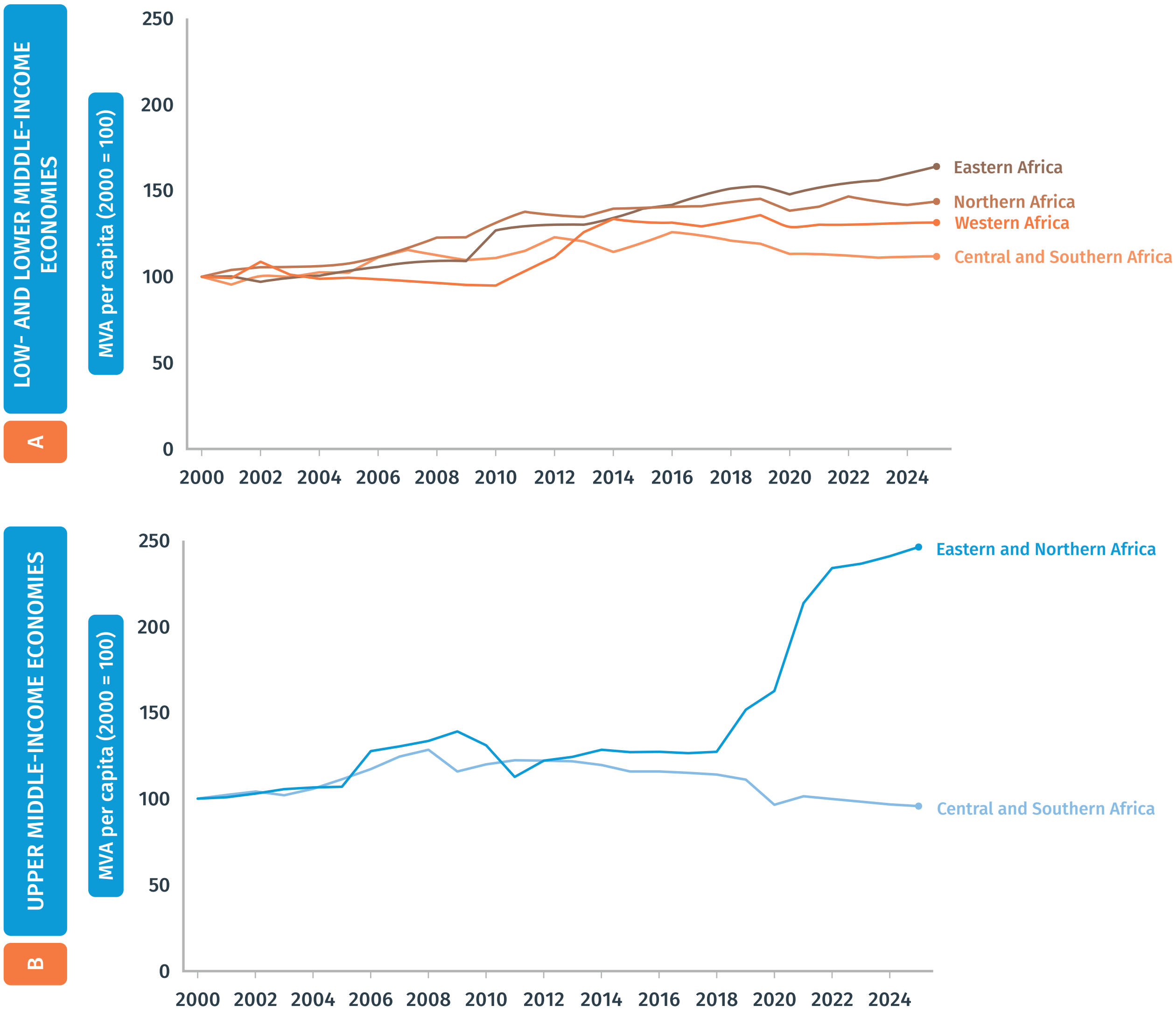
Table 5.1 **Africa: List of economies by geographical area and stage of industrial development**

Low- and lower middle-income economies (LLMIEs)			
Central Africa	Ethiopia	**Northern Africa**	Gambia
Angola	Kenya	Egypt	Ghana
Cameroon	Madagascar	Morocco	Guinea
Central African Republic	Malawi	Sudan	Guinea-Bissau
Chad	Mozambique	Tunisia	Liberia
Congo	Rwanda	**Southern Africa[a]**	Mali
D.R. of the Congo	Somalia	Eswatini	Mauritania
Sao Tome and Principe	South Sudan	Lesotho	Niger
Eastern Africa	Uganda	**Western Africa**	Nigeria
Burundi	Tanzania	Benin	Senegal
Comoros	Zambia	Burkina Faso	Sierra Leone
Djibouti	Zimbabwe	Cabo Verde	Togo
Eritrea		Côte d'Ivoire	
Upper middle-income economies (UMIEs)			
Central Africa[b]	**Eastern Africa[c]**	**Northern Africa**	**Southern Africa**
Equatorial Guinea	Mauritius	Algeria	Botswana
Gabon	Seychelles	Libya	Namibia
			South Africa

Note: In the analysis of this chapter, country groups with a small sample size (fewer than three economies) or a small population share (less than 2 per cent of the regional population) are merged with neighbouring groups at a similar stage of industrial development to limit outlier effects from low representation and/or inconsistencies in country-level data: a) presented together with Central Africa due to small sample size; b) presented together with Southern Africa due to small sample size; c) presented together with Northern Africa due to small sample size.

Source*:* UNIDO elaboration based on UNIDO country classification (see Annex A.3).

Figure 5.1 **Africa: Industrial dynamics in the first quarter of the 21st century**



Note: Regional averages calculated using population weights. Values indexed to 2000 (2000 = 100). MVA = Manufacturing value added. See Table 5.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, some country groups were merged.

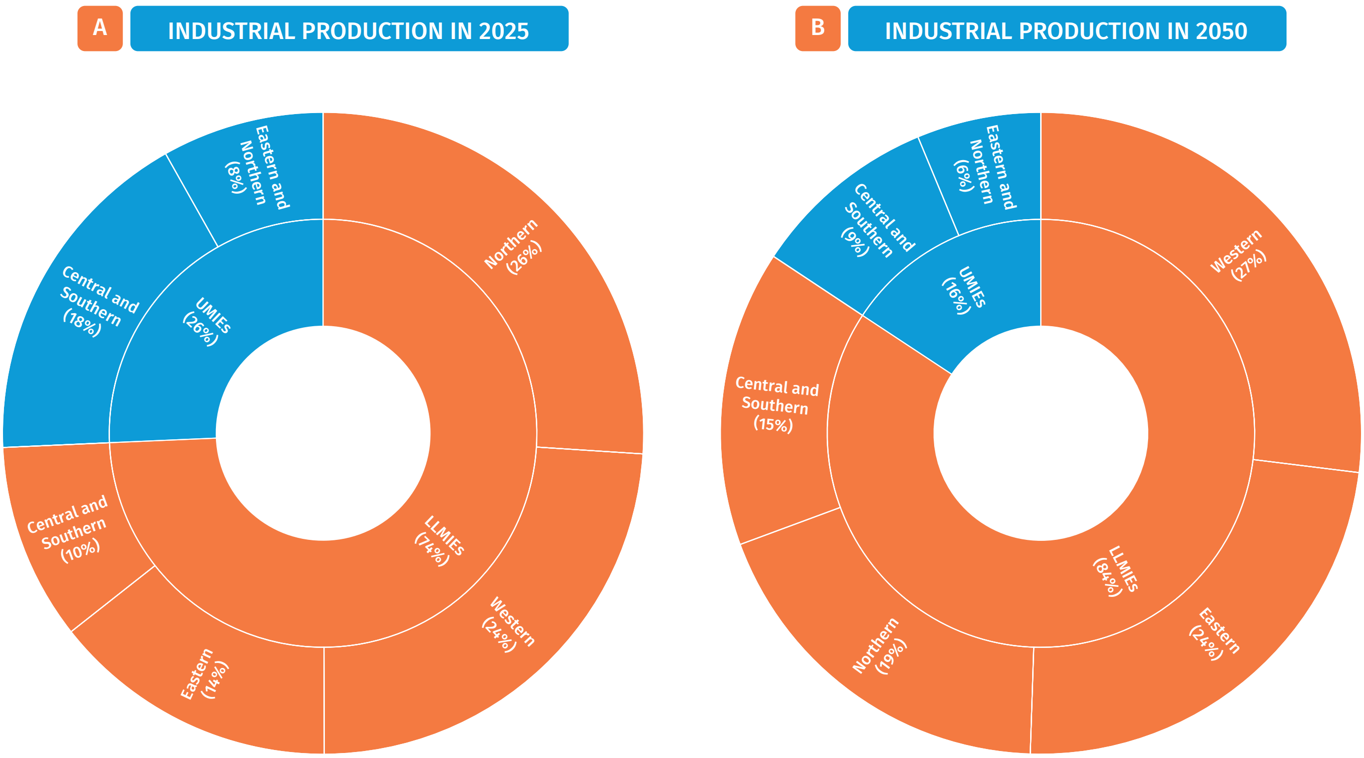
Source: UNIDO elaboration based on UNIDO (2025a)

By 2050, technological gaps in Africa's industrial production are projected to remain substantial and to widen further in some regions. Under the *current path* scenario, the continent's relative manufacturing productivity is expected to show only limited convergence (Figure 5.3, Panel B). Low- and lower middle-income economies are projected to narrow their productivity gaps only marginally, reaching around one-third of those projected for high-income industrial economies by 2050. In contrast, African upper middle-income economies are expected to witness a further widening of their technological gaps over the next 25 years, with productivity remaining at approximately 20 per cent of the global frontier. As discussed in the following section, urgent measures will be needed to reverse this trend and accelerate technology absorption and innovation in Africa's manufacturing sector.

As African countries upgrade their industrial structures, average emissions per unit of MVA are expected to rise. These environmental efficiency dynamics vary across subregions (Figure 5.3, Panel C). Current gaps in industrial environmental efficiency are relatively small among many of the continent's subregions, with most countries at early stages of industrialization—most notably in Central and Southern Africa—performing better than high-income industrial economies worldwide. By 2050, the environmental efficiency of low- and lower middle-income economies is projected to deteriorate in Eastern, Northern and Western Africa. This largely reflects a typical pattern of development, whereby countries at early stages of industrialization tend to concentrate in labour-intensive industries that are relatively less polluting; as they industrialize, they shift towards more polluting, capital-intensive industries.[3] Avoiding this trajectory will require robust measures to decarbonize hard-to-abate industries, as discussed in Chapter 3.

Widening gaps in Africa's future industrial performance call for decisive action to address persistent bottlenecks. The continent's weak industrialization record over the past 25 years has resulted in gaps in industrial intensity, productivity and environmental efficiency. Under the *current path* scenario, these gaps are expected to remain substantial or widen even further across all country groups analysed. Reversing this trajectory will require addressing structural and emerging bottlenecks that limit Africa's potential to fully leverage the transformative potential of industrialization.

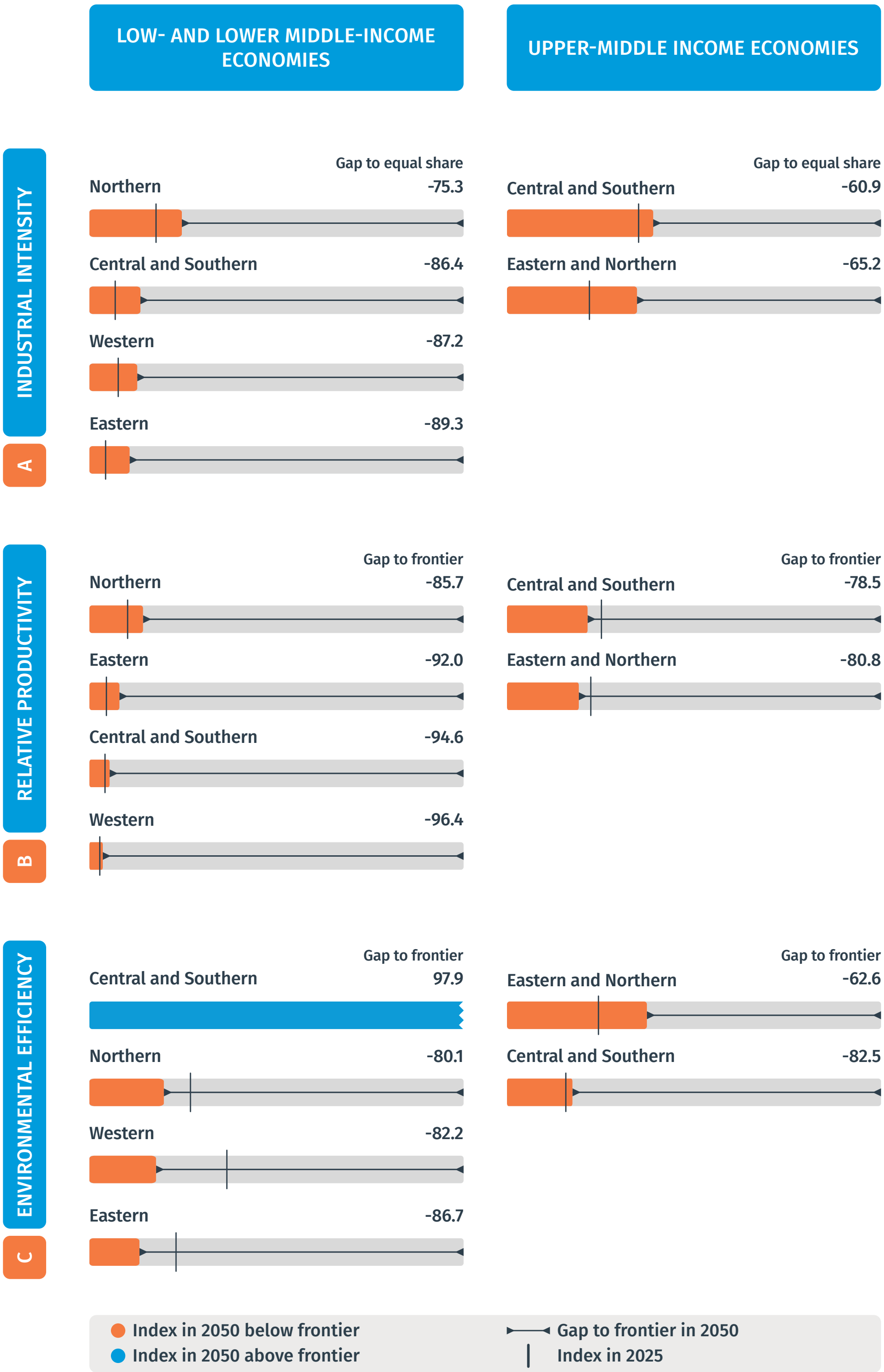
Figure 5.2 **Africa: Current and projected distribution of industrial production in the region**



Note: LLMIEs = Low- and lower middle-income economies; UMIEs = Upper middle-income economies. See Table 5.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, some country groups were merged.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

Figure 5.3 **Africa: Industrialization gaps by subregions, current values and projections for 2050**



Note: Bars show projections for 2050 and vertical lines denote 2025 values. Regional averages are weighted by countries' share of manufacturing value added (MVA) in each subregion. The indicators reported in each panel are defined as follows: A) Industrial intensity index = percentage ratio of each subregion's share of global MVA to its share of the world population. A value of 100 indicates equal share. Values below 100 reflect industrial underrepresentation. B) Industrial relative productivity index = manufacturing labour productivity (MVA per worker in constant 2017 US dollars) of each subregion relative to high-income industrial economies' average manufacturing labour productivity. A value of 100 indicates that the region stands at the frontier in terms of industrial labour productivity. C) Industrial environmental efficiency index = MVA per unit of CO_2 emissions in constant 2017 US dollars relative to the average value of high-income industrial economies. A value of 100 indicates that the region stands at the frontier in terms of industrial environmental efficiency. See Table 5.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, some country groups were merged.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

5.2 MAIN BOTTLENECKS CONSTRAINING FUTURE INDUSTRIALIZATION

Unlocking Africa's future industrialization potential requires addressing bottlenecks across various enablers.[4] The continent's industrial growth prospects depend on effective deployment of technologies within broader industrial ecosystems, a cross-sectoral approach that emphasizes the interdependence of industries and the synergies that arise when they develop together (see Chapter 3). Successfully advancing along this trajectory will require countries to establish a solid foundation across various key enablers that can translate industrialization goals into tangible outcomes.

Seven areas of action to prepare for the future. The analysis conducted for IDR 2026 identifies a set of indicators to assess Africa's performance across key industrialization enablers relative to advanced and other developing economies. These indicators are grouped into seven dimensions: (i) institutions; (ii) infrastructure; (iii) labour force; (iv) technology; (v) trade and integration; (vi) production greening, and (vii) finance. For each dimension, two indicators were selected based on their relevance and the availability of comparable cross-country data over the past decade (see Figure 5.4).

5.2.1 Institutions

Africa's industrialization faces deep-rooted political and institutional challenges. Many of these challenges are rooted in the colonial legacy of path-dependent, extractive institutions,[5] which have contributed to low rankings—often below the developing-country average—in indicators such as government effectiveness and political stability (see Figure 5.4). Weak horizontal and vertical coordination often results in fragmented interventions that fall short of driving sustained structural transformation.[6] This leads to recurring policy inconsistencies and incoherence, with industrialization initiatives often conflicting with other development initiatives. In an environment of fiscal constraints that limit states' implementation capacity, corruption and rent-seeking further deplete scarce resources,[7] erode trust between the public sector and productive actors, and undermine coalitions of interest to promote industrial development.

Institutional rigidity in adapting to change is a major bottleneck in many African countries. The megatrends shaping the future of industrialization, discussed in Chapter 2, require agile institutions capable of swiftly adjusting policies. However, many African institutions are characterized by inertia, and fail to respond quickly to evolving economic conditions and technological advances.[8] This represents a major constraint in the continent's low- and lower middle-income economies, where government effectiveness is, on average, about half that of upper middle-income countries. Strengthening government capacities to formulate and implement future-ready industrial policies will be essential to alter the current trajectory and narrow the gaps outlined in the previous section.

5.2.2 Infrastructure

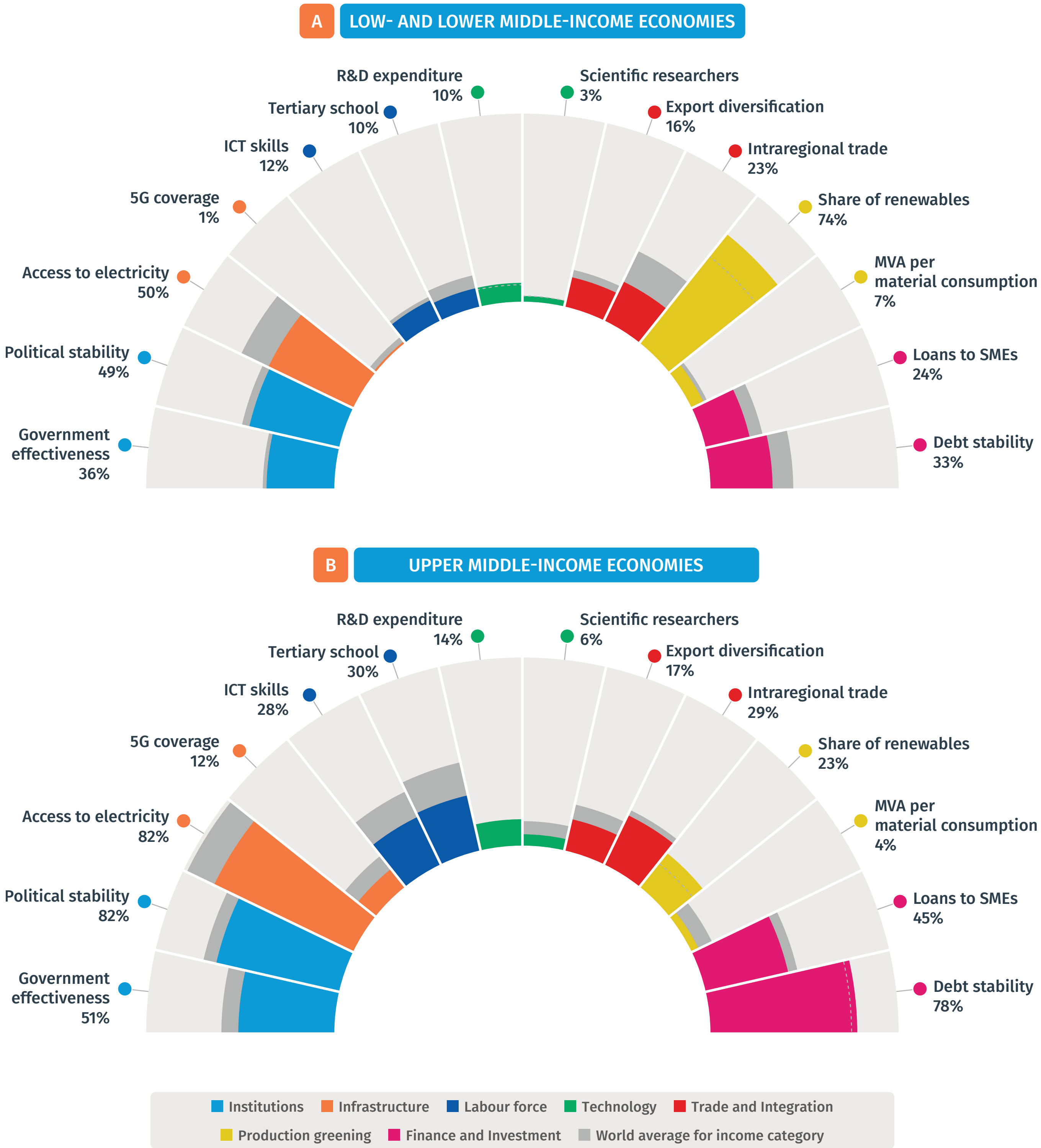
Infrastructural constraints pose significant barriers to Africa's industrialization. Physical infrastructure—including power generation, transport networks, ports and logistics systems—remains inadequate and often unreliable, severely constraining industrial productivity and growth, while also impacting households.[9] Energy insecurity, characterized by limited power generation capacity, high energy costs and frequent supply disruptions, is particularly detrimental and significantly undermines industrial competitiveness. The gap is particularly pronounced among lower-income economies in Africa.

Although infrastructure supporting earlier digital applications is in place, the infrastructure required to support the Fourth Industrial Revolution (4IR) and advanced digital technologies remain severely underdeveloped. Many African countries have achieved relatively broad access to 3G connectivity, though they still lag behind other developing regions. This infrastructure has played a key role in supporting positive outcomes from earlier generations of digital technologies, such as the successful adoption of mobile money.[10] However, infrastructure for newer technologies remains extremely limited. For example, 5G connectivity, a critical enabler of 4IR technologies, currently reaches only a very small share of the population across all income groups (see Figure 5.4).

5.2.3 Labour market

Structural weaknesses in capabilities and human capital continue to constrain industrial development across the continent. Domestic innovation capabilities, including research and development (R&D), remain severely underdeveloped due to insufficient investment in human capital, particularly in technical education and vocational training (TVET) (see Figure 5.4). Low overall skill levels, compounded by brain drain of highly skilled individuals, contribute to persistently low labour productivity in the private sector.[11] In the public sector, these skill shortages undermine state capacity and reinforce the limitations of the entrepreneurial state.

Figure 5.4 **Industrialization enablers: Africa compared to the world frontier and other developing regions**



Note: Indicators are reported as the ratio of regional values to those of the world's best-performing country, defined as the country at the 95th percentile of the global distribution. A value of 100 indicates that the continent, on average, is at the frontier for the respective enabler. Values are calculated as simple averages across all countries in Africa with available data for each indicator. Country-level data correspond to the average value over the last three years for which data are available (typically, 2021–2023). See Annex A.2 for a detailed description of indicators and data methodology.

Source: UNIDO elaboration based on data from the UN Sustainable Development Goals Database, UNSD (2025a), the World Development Indicators World Bank (2025a) the Worldwide Governance Indicators World Bank (2025b), the World Bank Group Scorecard World Bank (2025c), CEPII Gaulier and Zignago (2010), and UNCTAD (2025a).

The digitalization of industrial production has exacerbated skills mismatches, highlighting the shortcomings of existing education and training systems. Most African countries face acute skill shortages in key transition sectors.[12] Current education and training systems are ill-equipped to rapidly adapt curricula to evolving industrial needs, resulting in significant skill obsolescence. Despite its large young population, Africa may be unable to effectively capitalize on this potential demographic dividend, partly due to limited access to quality education and training.

5.2.4 Technology

Weak innovation ecosystems and limited technological capabilities constrain Africa's manufacturing sector. Many African economies have weak and fragmented innovation ecosystems, as evidenced by low ratios of scientific researchers to population size (see Figure 5.4). Much of the continent's industrial base remains concentrated in low-technology industries that rely heavily on imported technologies, hampering the accumulation of technological know-how embedded in machinery and equipment.

The diffusion of 4IR technologies across African economies remains limited. The continent faces challenges in achieving technological sovereignty in artificial intelligence (AI) and other 4IR technologies, and many firms lack the digital capabilities and complementary assets needed to integrate these technologies into their operations. Infrastructural deficiencies, as previously noted, further exacerbate these challenges, preventing African industries from achieving global competitiveness.[13]

5.2.5 Trade and integration

Productive concentration in low value-added and low-technology segments of GVCs significantly constrains Africa's potential for industrial upgrading. Domestic economic structures remain specialized in primary products and low-tech manufacturing.[14] Combined with low export diversification, this results in unfavourable terms of trade and limits the resources available for industrialization.

Demand constraints are particularly pronounced in small and poorly integrated countries. Many economies, especially small, landlocked ones, have low purchasing power and small domestic markets, making it difficult to achieve the scale necessary for structural transformation. Opportunities to benefit from economies of scale are further curtailed by fragmented regional markets.[15] Weak regional capacity and limited coalitions for intra-regional trade, compounded by outdated customs systems and high tariff and non-tariff barriers, further impede market integration.[16] Broader participation in GVCs has failed to generate substantial upgrading opportunities, and limited integration into green industries is now further constrained by new trade barriers due to emerging global environmental standards and regulations.

5.2.6 Greening of production

Africa's potential for green industrialization lies in its vast renewable energy endowments, including solar, wind, hydro and geothermal. The continent outperforms other developing regions in renewable energy use (Figure 5.4), driven by low- and lower middle-income economies, which are leapfrogging into renewable energy – a trend that African upper middle-income countries, which historically have been more reliant on fossil fuels, have yet to replicate. However, capitalizing on this resource wealth requires 'parallel investments': the simultaneous development of renewable energy generation and industrial manufacturing capacity.[17] Large-scale infrastructure investments are essential not only to support the transition to cleaner energy in industrial processes, but also to enhance adaptation and resilience against increasingly extreme climate conditions. While innovation to address climate change is crucial for Africa's long-term prosperity, it adds complexity and additional costs to the continent's industrialization pathways.[18]

Finance and institutional challenges further limit Africa's ability to achieve the green transition in manufacturing. Unequal access to financing for both energy and industrial projects undermines the commercial viability of green industrial initiatives, while high capital costs, driven by the perceived 'Africa risk premium', create additional barriers. Moreover, high external debt severely constrains the fiscal space available to address climate-related priorities.[19] Internal challenges also persist, including complex energy constraints, limited availability of investor-ready data, and difficulties in implementing effective and modern green industrial policies.[20]

5.2.7 Finance and investment

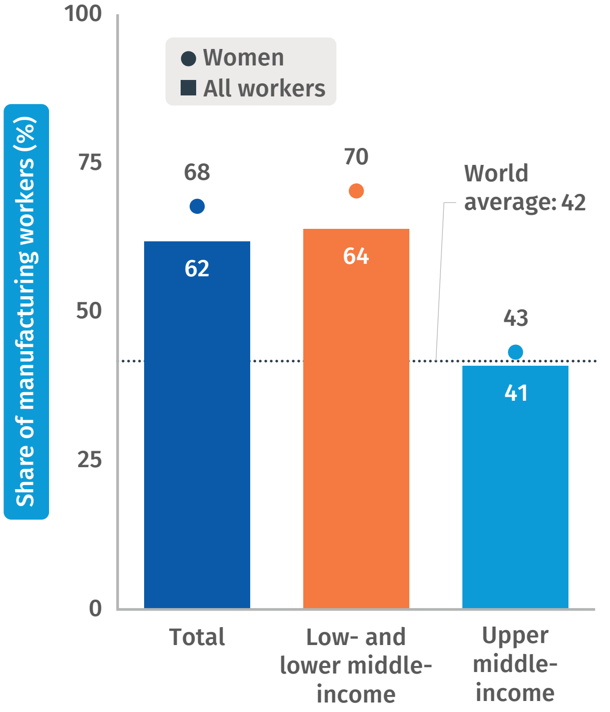
Limited access to finance inhibits industrial growth in Africa. Underdeveloped capital markets restrict local firms' ability to secure funding for industrial expansion.[21] Consequently, the continent ranks low in terms of access to loans or credit for small-scale industries, with the largest gaps concentrated in low- and lower middle-income economies in Africa (see Figure 5.4). These financial constraints not only have an impact on production but also on trade[22] and innovation. Underdeveloped venture capital and private equity ecosystems influence innovation.[23] Persistent fiscal constraints, compounded by high national debt levels, further limit governments' capacity to make strategic investments in infrastructure and industrial policies.[24]

5.2.8 Cross-cutting issues

The prevalence of informal activities across the continent represents a major bottleneck to Africa's future industrialization potential. Around 60 per cent of workers in the continent's manufacturing sector are, on average, currently engaged in informal employment (Figure 5.5). High levels of informality limit domestic resource mobilization and impede technology adoption and productivity. Evidence from African economies suggests that informal employment tends to be more widespread among small-scale, survivalist firms.[25]

Formal-informal disparities are further amplified by pronounced gender imbalances within manufacturing. Globally, women are more likely than men to be engaged in informal than formal manufacturing activities, with negative implications for wages, employment security and social protection. The gap between the share of women and men engaged in informal employment in African economies is nearly ten percentage points.

Figure 5.5 **Informality and gender imbalances in Africa's manufacturing sector**



Note: Values represent the share of informal workers in total manufacturing workers by country group and gender. They are calculated as simple averages for all countries in the region with available data and refer to the last three years for which data are available (typically, 2021–2023). See Table 5.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, no subregional distinction is made.

Source: UNIDO elaboration based on ILO (2025).

5.3 SECTORAL OPPORTUNITIES TO SPUR FUTURE INDUSTRIALIZATION

The megatrends discussed in Part A of this report present both challenges and opportunities for Africa's current and future industrialization trajectory.[26] Megatrends intersect with regional capabilities, resource endowments and changing demand dynamics, creating new pathways for industrial development. The digital transition, for instance, is generating increased demand for critical minerals, which can be leveraged to promote mineral beneficiation and strengthen domestic value addition. It is also driving innovation in agroprocessing and climate-smart agricultural (CSA) technologies, while demographic shifts, urbanization and changing consumer preferences are stimulating growth in processed foods and pharmaceuticals.

Megatrends can also reinforce one another. The green transition, for instance, is accelerating the development of e-mobility – a shift that is supported by the reconfiguration of GVCs and the emergence of new regional markets. Countries across the continent can seize these opportunities to build industrial capabilities, create decent jobs and strengthen Africa's position in GVCs. Achieving these objectives, however, will require strong and adaptive industrial policies to help producers overcome the long-standing bottlenecks outlined in the previous section. The detailed case studies presented in the following subsections illustrate how these trends are being translated into tangible sectoral development opportunities across the continent (see Table 5.2).

5.3.1 Critical minerals processing and manufacturing of mining equipment

Rising global demand for critical minerals provides an opportunity for industrial development in Africa, a continent with abundant mineral reserves. Unlocking this opportunity, however, requires shifting from raw materials export towards value-added processing and manufacturing. Mineral reserves are broadly distributed across the continent. In North Africa, Algeria, Egypt, Morocco and Tunisia possess substantial reserves of phosphate rocks and tantalite.[27] In Central Africa, the Democratic Republic of Congo (DRC) holds the world's largest cobalt reserves, an essential input for lithium-ion batteries,[28] while in West Africa, Guinea is a leading producer of bauxite. Resources in Southern Africa include copper and cobalt in Zambia, graphite in Mozambique and uranium in Namibia. South Africa is a global leader in platinum production, a critical input for hydrogen fuel cells.[29]

The continent already possesses capabilities in the value chain's mid- and downstream segments. North Africa has developed an end-to-end value chain in fertilizer and specialty chemical production. The production of mining capital equipment is currently concentrated in Southern Africa. South Africa, for instance,

Table 5.2 **Africa: Megatrends, drivers and sectoral opportunities for future industrialization**

Main Megatrends	Sectoral opportunities	Drivers	Case studies
Energy and the green transition	• Critical minerals processing and manufacturing of mining equipment	• Global demand for inputs to digital and green technologies (e.g. processed lithium, copper, nickel)	**Morocco**: Towards an electric mobility ecosystem
	• Renewable energy equipment and hydrogen	• Strategic location close to end-markets • Growing regional and domestic demand	-
	• Electric mobility	• Large regional market for electric vehicles (EVs) designed for local conditions • Proximity to the European Union (EU) market, where demand for EVs is growing	**Kenya**: Emerging ecosystem for electric two- and three-wheelers
	• Green textiles and apparel	• Rising demand for sustainable textiles and apparel	-
Population growth and the changing nature of work	• Pharmaceuticals	• Population growth, urbanization, rising incomes and increased health awareness • Awareness of vulnerability to global supply chain disruptions due to COVID-19	**Nigeria**: Scaling up production for essential medicines
	• Artisanal manufacturing of creative arts and crafts	• Growing global demand for ethical, low-carbon, culturally distinctive products	-
The transformation of food production systems	• Agroprocessing and agricultural equipment	• Higher demand for processed foods due to the continent's demographic boom, urbanization and rising incomes	**South Africa**: Promoting agroprocessing through climate-smart technology

Source: UNIDO elaboration.

produces mining machinery for regional markets. International and domestic original equipment manufacturers (OEMs) have established subsidiaries in Zambia to serve its mining industry.[30] These developments highlight the potential for building regional value chains in mining-related industries. In other parts of the continent, where productive capabilities remain more limited, countries can participate in the value chain through simpler activities where specialization is more attainable, such as aftermarket services and component manufacturing.[31]

Unlocking the potential of resource-based industrialization remains a major challenge for many resource-rich African countries. Persistent infrastructure deficits, particularly in energy, logistics and transport, undermine the feasibility of scaling mineral processing and strengthening industrial linkages. The widespread prevalence of informal and artisanal mining activities keeps raw material extraction underdeveloped, inefficient and environmentally harmful. Developing mining-related value chains also requires advanced metallurgical expertise, process automation and robust environmental management systems, all of which remain constrained by skill shortages and weak technological capabilities. Broader challenges, including restricted access to finance and political instability, further impede progress.

Addressing these challenges calls for a coordinated set of policy actions. Regional and domestic value chain strategies should align upstream mineral extraction with downstream manufacturing, supported by cross-border collaboration. This, in turn, must be supported by integrated transport master plans that connect mining sites with refineries, industrial clusters and ports, ensuring efficient and integrated logistics from extraction to export. Strengthening mining operations, including through improved environmental practices to reduce the industry's ecological footprint, will be essential to securing a sustainable supply for beneficiation plants. Governments can facilitate these objectives by streamlining licensing procedures, enhancing data transparency and formalizing small-scale mining activities. Continuous workforce development through training programmes and public-private partnerships (PPPs) should be prioritized to build local capabilities, while targeted incentives for joint ventures with technology leaders and equipment manufacturers can accelerate technology transfer.

5.3.2 Renewable energy equipment and hydrogen

As the global energy system shifts away from fossil fuels, demand for alternative energy sources is expected to rise sharply, creating new industrialization opportunities in the production of related equipment. Africa is well positioned to capitalize on this opportunity owing to its abundant renewable resources, extensive land availability and strategic location. The continent accounts for around 60 per cent of the world's most suitable sites for solar power generation,[32] providing a strong foundation for developing a photovoltaic (PV) industry. Its rich renewable energy potential could support some of the world's lowest electricity costs,[33] creating favourable conditions for cost-competitive renewable hydrogen production. Positioned at the crossroads of Europe and Asia, and supported by existing pipelines and port infrastructure, Africa has the potential to become a leading hub for renewable hydrogen.

Momentum in renewable energy and hydrogen is building, with several national initiatives already underway. North African countries, particularly Morocco and Egypt, are partnering with international firms to attract foreign direct investment (FDI) and establish initial PV and renewable hydrogen facilities, leveraging their abundant land, favourable climate and special economic zones (SEZs). In Southern Africa, both Namibia and South Africa are developing hydrogen capabilities. South Africa, a regional frontrunner, is projected to double its current share of global hydrogen production from 2 per cent to 4 per cent by 2050.[34] Namibia, with three projects currently under construction, aims to produce 10–12 million tonnes of hydrogen equivalent annually by 2050, primarily for export. Beyond exports, renewable hydrogen can stimulate growth in fertilizer production and strengthen the resilience and sustainability of heavy industries.[35] In Central Africa, countries such as Sudan are addressing rural energy deficits through off-grid solar systems, creating anchor markets that could support downstream industrialization.[36]

Despite ambitious initiatives, many renewable hydrogen projects have yet to reach final investment decisions due to uncertainty and structural bottlenecks. Long-term demand and pricing signals remain unclear: while Europe and Asia are emerging as key off-takers, evolving regulatory frameworks and stringent sustainability criteria may limit imports from developing economies. Rapid technological advances further increase risks, particularly in electrolyser systems, which remain at an early stage of maturity and are associated with high deployment costs. These challenges are compounded by structural constraints, including limited domestic skills, inadequate infrastructure, and dependence on foreign intellectual property for core technologies such as electrolysis, ammonia cracking and hydrogen transport. Without timely and coordinated action, many planned projects risk stalling before reaching commercial operation.[37]

For the renewable hydrogen industry to mature, governments must reduce risks while fostering a viable ecosystem. Long-term offtake agreements and credible certification schemes can strengthen investor confidence, while incentivizing hydrogen use in domestic industries would help establish an anchor market. Targeted R&D in electrolysis, ammonia cracking and storage can enhance technological sovereignty and capture greater local value. Infrastructure upgrades are also critical: ports must be retrofitted to accommodate ammonia exports at scale, and desalination capacity expanded to meet the water requirements of electrolysis, ensuring that hydrogen development underpins a genuinely sustainable energy transition.

5.3.3 Electric mobility

Demographic shifts, rapid urbanization and the urgency of the green transition are fuelling growing demand for sustainable urban transport solutions in Africa. At the regional level, demand for motorcycles, tricycles and buses, which are critical for last-mile mobility in African cities, is expected to increase substantially in the near future. Local adaptation needs, such as terrain-appropriate chassis and vehicles designed to withstand extreme heat, dust and sandstorms, are already encouraging a transition from fully imported vehicles towards local assembly and partial manufacturing.[38]

Box 5.1 **Morocco: Towards an electric mobility ecosystem**

In less than two decades, Morocco has leveraged a deliberate mix of industrial policies to build a dynamic automotive ecosystem, positioning the country to enter the EV value chain. In 2024, total vehicle sales exceeded half a million units. While EV production remains at an early stage, sales grew by more than 50 per cent that year, with production capacity reaching about 50,000 EVs. Sales are projected to increase to 100,000 units by 2025. Recent investment plans extend beyond EV assembly to include the production of key inputs, with leading global companies announcing multi-billion-dollar projects in cathode materials and batteries.

Morocco's success is rooted in a comprehensive industrial strategy that progressively established the enabling conditions for a competitive and integrated automotive ecosystem. The process began in 1959 with the creation of SOMACA (*Société Marocaine de Constructions Automobiles*), a joint venture between Morocco's government and European manufacturers Fiat and Simca. Subsequent joint ventures and agreements attracted FDI, initially focused on serving the domestic market in the 1990s before expanding towards exports in the early 2000s.

Investment in infrastructure has contributed to this process: Morocco's strategic geographic position within global logistics corridors was leveraged through substantial road and rail investments, linking the Atlantic Free Zone (AFZ) in Kenitra to Tanger Med Port, a major gateway to Europe and the Mediterranean basin. Market access was further enhanced by institutional frameworks, including Morocco's Association Agreement with the European Union (EU) and participation in the African Continental Free Trade Area (AfCFTA). The industry also benefitted from forward-looking sustainability measures, such as the introduction of renewable energy systems and wastewater recycling in the AFZ, enhancing compliance with the EU's Carbon Border Adjustment Mechanism (CBAM), and giving Morocco a competitive advantage over other developing producers. Finally, a robust human capital base underpins the industry's success. Morocco's technical and vocational education and training (TVET) system is structured around strong public-private partnerships to ensure curricula are industry-driven, aligning training with firms' evolving skill needs.

Despite strong foundations and promising growth trends, Morocco's transition to electric mobility must overcome emerging and structural challenges. The industry remains dependent on the EU as a destination market, which accounted for between 80 per cent and 90 per cent of Moroccan vehicle exports between 2004 and 2023. This limited market diversification poses a significant risk amid growing trade uncertainty and GVC reconfigurations. Further industrial upgrading will require investment in capital- and technology-intensive segments, notably battery systems and electronic connectors. Equally important is strong coordination among TVET stakeholders to update workers' training curricula and integrate EV-specific competencies, such as battery management systems and embedded software engineering.

Source: UNIDO elaboration based on a background report produced by Boucetta et al. (2025).[39]

At the global level, the reconfiguration of GVCs and efforts to diversify import sources are creating new strategic opportunities for Africa. As discussed in Chapter 2, Africa's proximity to the European market represents a major advantage that could spur industrial exports from both domestic and foreign companies operating on the continent. Building on these regional and global dynamics and the continent's endowment of critical minerals, electric mobility emerges as a promising opportunity to enhance living standards while advancing the transition to green and sustainable modes of transport.[40]

Several African countries have made initial strides in local EV assembly. North African economies, such as Morocco, are leveraging their automotive capabilities, mineral endowments and partnerships with European and Chinese manufacturers to develop a relatively advanced EV ecosystem spanning multiple value chain segments (see Box 5.1).[41] Moreover, South Africa is investing heavily to expand domestic EV and battery manufacturing,[42] while in East Africa, Kenya and Ethiopia have recently launched electric motorcycle assembly facilities (see Box 5.2). Cross-border initiatives, such as the DRC-Zambia SEZ for batteries and EVs, highlight the potential for establishing regional value chains. Recent estimates suggest that the production of battery precursors in the DRC could be more cost-competitive and less polluting than production in major manufacturing hubs.[43]

Despite these opportunities, the EV industry's development faces headwinds. Electricity access across Africa remains limited, impacting both the feasibility of EV deployment and the energy required for domestic production.[44] In addition, policy uncertainty, such as unclear import tariffs and taxation for EV imports, further undermines investor confidence.[45] Underdeveloped R&D ecosystems and technical skill shortages impede technology adoption and development, leaving producers largely dependent on imported technologies. Compounding these issues, the industry's export-oriented nature increases vulnerability to external shocks.

Box 5.2 **Kenya: Emerging ecosystem for electric two- and three-wheelers**

Kenya is emerging as a continental frontrunner in e-mobility, with a thriving industry for electric motorcycles and e-buses centred around Nairobi. Electric motorcycle registrations increased from fewer than 50 units in 2020 to nearly 5,000 in 2024, with EVs now accounting for over 7 per cent of new motorcycle registrations. Three major firms, Roam, Ampersand and Spiro, are establishing large-scale assembly plants, which are expected to raise Kenya's total manufacturing capacity to around 100,000 units per year by 2026. Backed by private investors and international institutions, these firms are consolidating Kenya's position as a regional e-mobility hub. Leveraging established trade routes for motorcycle exports to Tanzania, Uganda and Somalia, Kenya's manufacturing ecosystem is well-positioned to serve neighbouring markets.

Domestic demand, driven by urbanization, demographic change and the need for affordable transport, is a key engine of Kenya's e-mobility growth. The country's more than two million boda bodas (motorcycle taxis) constitute a large and immediate market for electrification. Demand for e-buses is also rising in Nairobi, where congestion and pollution create opportunities for cleaner public transport fleets. Affordability challenges are being addressed through innovative financing models, including pay-as-you-go and lease-to-own schemes, as well as battery swapping services. Policy measures provide additional incentives, such as reductions in excise duty (from 20 per cent to 10 per cent), value-added tax exemptions on electric motorcycles, and Completely Knocked Down (CKD) allowances. A draft National E-Mobility Strategy is currently under review. Development finance institutions and bilateral donors have also played an important role by providing investments and supporting pilot projects, helping to de-risk and scale early-stage companies.

Challenges remain, particularly across the supply chain. Kenyan manufacturers continue to rely heavily on CKD imports, resulting in a limited local supplier base for batteries and components. This dependence risks locking Kenya into low-value assembly activities, limiting domestic value addition. Infrastructure gaps further compound these challenges, with transmission and distribution constraints limiting last-mile charging. Additionally, the expansion of charging networks beyond Nairobi is hampered by land acquisition and permitting. Sustaining the industry's momentum will depend on coordinated policy action, innovative financing solutions, supplier development and targeted infrastructure investment.

Source: UNIDO elaboration based on a background report produced by Avenyo et al. (2025).[46]

Coordinated industrial policy packages are essential to address these constraints. First, national EV policies should not only regulate production and imports but also lifecycle issues, such as battery disposal and infrastructure replacement, both of which are critical for environmental sustainability. Second, targeted investments in technical and vocational training are needed to build a skilled workforce capable of scaling EV manufacturing and maintenance across Africa. Third, African countries should increase investment in innovation to strengthen technological sovereignty. Fourth, regional cooperation is crucial to promote complementarities, prevent uneven development and enhance Africa's collective bargaining position in global markets.

5.3.4 Green textiles and apparel

The shift towards more sustainable textiles and apparel, driven by the green transition, aligns with Africa's established cotton-growing capabilities and young labour force. Rising environmental concerns and evolving consumer preferences are fuelling demand for natural fibres such as organic cotton, raffia and jute, with certified suppliers gaining a competitive edge.[47] African countries can harness this opportunity by complementing their abundant fibre production with renewable energy systems and certification schemes, thereby enhancing both competitiveness and market access. The production of textiles from organic cotton is particularly promising, given the continent's growing raw material base: in 2020, Africa accounted for 7.3 per cent of global production, a 90 per cent increase compared to 2019.[48]

African economies are increasingly adopting greener manufacturing practices to strengthen their participation in the textiles and apparel value chain and capture greater value added. In Southern and Eastern Africa, integrating renewable energy into textile production has not only reduced emissions but has also enhanced competitiveness, increased value retention, and supported upgrading within the value chain.[49]

Ethiopia, for instance, has attracted sustained foreign investment into textile parks powered by renewable energy, demonstrating how the region's comparative advantage in renewables can underpin the development of low-emission industrial zones.[50] Sustainability credentials and recycling initiatives also offer important entry points: Kenya has pioneered the world's first green garment factory built entirely from upcycled shipping containers, showcasing both innovation and environmental ambition.[51] These developments highlight Africa's potential to move into higher-value segments through clean production technologies and green branding.[52]

Africa's textiles and apparel industry faces several entrenched bottlenecks that must be addressed to unlock its full potential. Firms face stiff competition from established global exporters—primarily in Asia—that benefit from better infrastructure, lower production costs and stronger brand recognition. Gaps in energy, water and transport infrastructure, coupled with limited access to green finance, hamper the adoption of sustainable practices and certification schemes. Branding remains another challenge, as many African firms operate as OEMs and lack marketing capacity, thus reducing their ability to capture higher value in global markets.

To address these challenges, governments must invest in green industrial parks, eco-certification schemes and skills development in design, while promoting PPPs to drive innovation and scale. Intra-African trade under the AfCFTA could further strengthen regional textile value chains, linking raw material producers such as Benin and Tanzania with manufacturing hubs in Ethiopia and Kenya, and design centres in Ghana – creating an integrated, pan-African strategy for sustainable fashion. Effective implementation of such a continental strategy requires harmonized standards, coordinated policies and integrated regional logistics. Initiatives to reinforce branding, such as the "Made in Rwanda" policy framework, can help strengthen the country's position in value chains. However, urgent action is needed: slow transformation could leave Africa's textile industry trailing global competitors, jeopardizing a key source of manufacturing employment and foreign exchange earnings across the continent.

5.3.5 Pharmaceuticals

Population growth, urbanization and increasing investment in healthcare systems are projected to drive Africa's pharmaceutical market beyond USD 70 billion by 2030.[53] Rising demand for pharmaceuticals, both domestically and regionally, presents opportunities for horizontal and vertical expansion of the industry. However, the continent currently produces less than 3 per cent of the medicines it consumes, with particularly limited capacity to manufacture active pharmaceutical ingredients (APIs).[54] Localizing pharmaceutical production represents not only a strategic opportunity for industrialization but also a critical step towards enhancing health security and autonomy – a lesson underscored by the COVID-19 pandemic. Several countries, including South Africa, Egypt and Nigeria, have started developing vaccine manufacturing capabilities (see Box 5.3), while Kenya, Rwanda and Sudan are establishing pharmaceutical parks and integrating pharmaceutical production into their national industrial strategies.[55]

Africa already hosts several strong industry leaders capable of jumpstarting pharmaceutical production and related industries. In North Africa, Egypt alone has over 200 pharmaceutical establishments, supplying more than 90 per cent of domestic demand. Complementary industries, such as precision medical devices, offer additional industrialization opportunities.[56]

However, regional specialization in pharmaceuticals remains limited due to several structural bottlenecks, including weak regulatory frameworks, import-biased trade regimes and underfunded R&D.[57] Despite its potential, the pharmaceutical industry is often bypassed by multinational firms that prioritize distribution over local manufacturing or technology transfer. Reliance on imported APIs and raw materials increases the continent's economic and health vulnerabilities while limiting opportunities for value addition. These challenges are further compounded by infrastructure gaps, such as inadequate quality testing labs, cold chain logistics and reliable utilities, as well as shortages in skilled pharmaceutical professionals.

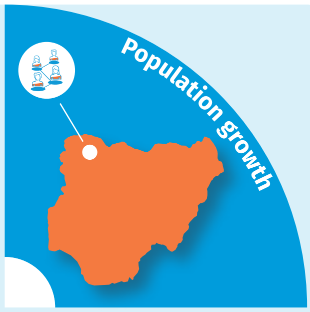
Robust industrial policies are essential for Africa to fully leverage its pharmaceutical potential. Key policy actions include supporting SEZs for pharmaceuticals, providing incentives for API production, investing in digitalized, traceable supply chains, and fostering strategic partnerships with countries in the Global South with established industrial capabilities in the industry, such as Brazil and India, to facilitate technology transfer.

Box 5.3 Nigeria: Scaling up production of essential medicines

With a population exceeding 230 million, Nigeria faces growing demand for both essential and chronic-care medicines. The domestic pharmaceutical market is potentially very large, as the country reports a high prevalence of infectious diseases, driving the need for antimalarial and antiretroviral treatments, while rising rates of non-communicable diseases are increasing demand for chronic-care pharmaceuticals. The country's position within the Economic Community of West African States (ECOWAS) provides additional opportunities for regional expansion.

In this context, Nigeria has a strategic opportunity to localize the production of active pharmaceutical ingredients (APIs), excipients and finished dosage forms, building on preexisting capabilities in digital infrastructure and logistics to support pharmaceutical innovation. While industrial and technological capabilities in the industry remain nascent and unevenly distributed, the country already hosts pockets of excellence. Nigerian firms produce key anti-infectives and maternal-health medicines, as well as specialized products such as cephalosporins, aerosols and bilayer malaria formulations.

Yet at the same time, the diffusion of good manufacturing practices remains uneven, and most plants are only partially automated, with selective progress in parenteral drugs and API development. Weak university-industry linkages and gaps in quality infrastructure exacerbate these challenges. A critical structural bottleneck is the lack of accredited domestic bioequivalence and bioavailability laboratories. As a result, firms have to outsource these costly studies abroad, which discourages investment in complex generics and limits opportunities for value chain upgrading.



Policy measures are being introduced to support the industry's upgrading. The Federal Government has set ambitious targets to reduce import dependency and increase the domestic share of medicine supply. The National Agency for Food and Drug Administration and Control has implemented the "Five-Plus-Five" validity policy, which limits import registrations when local production is feasible, aiming to gradually shift the pharmaceutical market from import dependence to domestic manufacturing. Complementing these efforts, the Presidential Initiative for Unlocking the Healthcare Value Chain coordinates procurement, standards and investment, aligning donor and public purchasing with credible local capacity while addressing bottlenecks that delay market entry or inflate costs.

Despite these efforts, several challenges persist. The industry faces substantial macroeconomic headwinds, including exchange-rate volatility and inflation, which increase production and financing costs. Access to finance remains constrained by short-term, high-cost loans and stringent collateral requirements. Furthermore, the industry continues to rely heavily on imports, while high energy costs undermine local manufacturers' competitiveness. The development of industrial parks, stronger regional linkages, and the attraction of FDI and joint ventures in advanced pharmaceutical production could play a crucial role in supporting the industry's further growth.

Source: UNIDO elaboration based on a background report produced by Avenyo et al. (2025).[58]

South-South cooperation with Brazil, for example, has recently helped Mozambique establish a major pharmaceutical plant serving the southern African market.[59] Over time, such initiatives could strengthen public health outcomes while driving economic transformation across the continent. Coordinated regional integration, complemented by PPPs, shared regulatory facilities, pooled procurement and specialized training institutions, can further enhance economies of scale and reduce costs.[60] AfCFTA can play an important role by facilitating the creation of regional value chains (RVCs) in the pharmaceutical industry by reducing tariffs and non-tariff barriers on healthcare products. [61]

5.3.6 Artisanal manufacturing of creative arts and crafts

Global demand for ethically produced and culturally distinctive goods is on the rise, **positioning Africa's artisanal and creative industries as a promising avenue for inclusive industrialization**. African artisanal goods, such as handwoven textiles, jewellery, ceramics and woodwork, not only embody cultural heritage but also provide a foundation for locally rooted production. Tourism offers a natural channel for distribution and promotion, with cultural festivals, heritage sites and destination markets connecting local producers to global consumers. Experiences from countries such as Rwanda, Sudan, Senegal, Ghana and Kenya highlight the benefits of linking tourism with craftsmanship: increased income and participation for women and youth,[62] strengthened community ties,[63] and enhanced market visibility and pricing power for artisans.

Nonetheless, the industry remains largely informal and undercapitalized. Most artisanal goods producers and creative entrepreneurs operate outside formal regulatory frameworks, limiting access to both finance and their ability to enforce contracts or scale production commercially. Infrastructure deficits in rural or peri-urban areas impose high costs and logistical barriers on producers, hampering the movement of goods. Opportunities to integrate artisanal production with the tourism industry also remain significantly underdeveloped. Although artisanal work is deeply embedded in tourism economies and local livelihoods, it is often overlooked in policy frameworks and industrial planning.[64]

To address these gaps, governments can establish dedicated support funds for the creative economy, complemented by design schools and business training programmes tailored to artisans. Legal reforms are also essential to protect indigenous designs, for example through digital intellectual property (IP) registries and certification systems, while promoting access to global markets through participation in international trade fairs. Further investment in e-commerce infrastructure and closer integration with the tourism industry would help formalize supply chains, boost exports and scale up the creation of decent jobs.

5.3.7 Agroprocessing and agricultural equipment

Africa's demographic boom and rising incomes are fuelling demand for processed foods.[65] Agroprocessing can provide a strategic entry point for Africa's industrialization. Opportunities exist both in developing downstream industries linked to key agricultural products and in expanding the production of agricultural equipment. The continent already plays a significant role in crops such as soybeans, cocoa and coffee. Soybeans and other strategic crops, where South Africa, Zambia and Sudan are becoming increasingly important,[66] support the production of cooking oil and animal feed for the livestock industry, including poultry.[67] In cocoa and coffee value chains, economies in West and East Africa might upgrade into processing activities to strengthen the continent's industrial base and capture higher value addition.

Complementary opportunities also exist in the manufacturing of CSA technologies and locally produced biofertilizers. As discussed in Chapter 2, agricultural machinery and other inputs are essential for unlocking both productivity gains and improved food security.[68] In response to this growing demand, South Africa is leveraging its manufacturing capabilities to become a regional hub for CSA equipment (see Box 5.4). AfCFTA could further amplify the benefits of these technologies, with food exports across the continent projected to grow by up to USD 1.8 billion in additional revenue.[69]

Despite progress, structural and emerging bottlenecks continue to constrain agroprocessing across African economies.[70] Key challenges include low levels of technology adoption, which limits yields and productivity,[71] restricting the scope of structural transformation and the potential for agro-industrialization. Additional constraints include weak rural infrastructure, inadequate cold storage and logistics capacity, limited access to regional markets, and increased vulnerability to climate-related shocks.[72] Addressing these barriers requires active policy interventions to strengthen agro-industrial ecosystems. Key measures include the development of agro-industrial parks, investment in processing infrastructure, improved access to finance for farmers and 'agripreneurs', and the enforcement of standards and compliance systems throughout the value chain.[73]

African economies can harness this and other emerging opportunities, driven by global megatrends, to forge new pathways towards future industrialization. Achieving this requires coordinated action among businesses, governments and civil society to design and implement goal-oriented industrial strategies. Industrial policy should build on existing capabilities, areas of excellence and natural endowments, while ensuring that greater value is captured locally. In an evolving global landscape, African economies will need to tap into both global and, increasingly, regional markets to sustain and accelerate growth.

Box 5.4 **South Africa: Promoting agroprocessing through climate-smart technologies**

Agriculture remains a critical sector in South Africa, but it is increasingly exposed to climate-related risks. Projections suggest that average temperatures across the continent could rise substantially by the end of the century, causing shifts in rainfall patterns and increasing the frequency of extreme weather events, posing serious threats to agricultural productivity and food security. As climate change intensifies, climate-smart technologies (CSA) equipment can help mitigate these impacts. Examples include silo bags for grain storage, soil and air sensors, conservation agriculture practices, early-maturing and drought-tolerant seed varieties, smart breeding techniques, precision agriculture, rainwater harvesting systems, drone technology and blockchain-based traceability tools.

Driven by climate change and the growth of horticultural export markets, domestic and regional demand for CSA solutions has risen significantly in recent years, positioning South Africa as an emerging hub for CSA equipment. Existing manufacturing capabilities in products such as shade nets and drip irrigation pipes, coupled with the availability of key inputs, provide a strong foundation for CSA innovation. These capabilities support not only domestic production but also the potential for South Africa to serve as a regional hub for CSA technologies. Moreover, AfCFTA presents a significant opportunity for further expansion.

Although there is no overarching policy framework for the sector, several targeted policy instruments have supported its development. The Agriculture and Agroprocessing Masterplan, a multi-stakeholder initiative, aims to enhance sustainability in agriculture and agroprocessing by promoting research and the adoption of sustainable practices. Complementing this, programmes such as the Western Cape's CASP and Limpopo's Farmer Support Programme facilitate technology adoption on farms by providing funding for the acquisition of machinery including planters, fertilizer applicators and tractors. The Department of Trade, Industry and Competition's Manufacturing Support Programme offers incentives for local production of CSA-related technologies. Additionally, the 2019 National Climate Change Adaptation Strategy outlines national priorities for building climate resilience, including support for the development of CSA equipment.

Source: UNIDO elaboration based on a background report produced by Avenyo et al. (2025).[74]

ENDNOTES

[1] Weighted average excluding China.
[2] The projections presented in this chapter are based on the *current path* scenario of the IFs model, which represents a "development as usual" trajectory in which countries continue to follow historical patterns without major policy shifts or unexpected disruptions. This scenario is not a simple extrapolation of past trends but rather dynamic projections that unfold within the model, in which variables interact across the model's development systems, including demographics, economy, health, education, environment and technology. It incorporates some of the megatrends discussed in Chapter 2, such as demographic transitions, climate change and gradual technological diffusion, but assumes no major breakthroughs or coordinated global interventions to alter current pathways. As such, the *current path* scenario provides a benchmark for assessing how the future may unfold if no significant course corrections are undertaken. See Annex A.1 for details.
[3] Cantore et al. (2018).
[4] This section builds on the background reports of Avenyo et al. (2025) and Boucetta et al. (2025), produced for IDR 2026. It also benefited from the insights provided by the following experts during a regional Expert Group Meeting organized at the University of Johannesburg on March 25, 2025: Jakkie Cilliers, Deborah Mekonnen Kefale, Whisper Maisiri, Pamela Mondliwa, Marvellous Ngundu, Emmanuel Olawale Ogunkola, Emmanuel Owusu-Sekyere, Banji Oyelaran-Oyeyinka, Chema Triki, Phyllis Wakiaga and Lesley Wentworth.
[5] McMillan (2016); Michalopoulos and Papaioannou (2020); Naudé and Tregenna (2023).
[6] Haraguchi et al. (2019); Totouom et al. (2019); Xu (2011).
[7] d'Agostino et al. (2016).
[8] AFDB (2017a); Asongu and Odhiambo (2019); Totouom et al. (2019).
[9] AFDB (2017a); (2017a); Naudé and Tregenna (2023); World Bank (2009).
[10] Rodríguez-Castelán and Pierola (2022).
[11] Bocquier et al. (2024); Kanyesigye (2025); Ndombi Avouba et al. (2025).
[12] AFDB (2017a).
[13] Comin and Mestieri (2018); Naudé and Tregenna (2023).
[14] AFDB (2017a).
[15] Naudé and Tregenna (2023); Ndubuisi et al. (2025); Ngwu and Ojah (2024); Turkson et al. (2023).
[16] Oyebamiji (2024); Turkson et al. (2023); Wassie et al. (2024).
[17] Floyd et al. (2022).
[18] Medinilla et al. (2025).
[19] Zalk et al. (2024).
[20] Floyd et al. (2022).
[21] Bridgewater Advisors (2022); UNECA (2020).
[22] AFDB (2017b).
[23] Kabengele and Hahn (2025); Kato and Manchidi (2025).
[24] Bigsten (2003); Diwan (2025); Naudé and Tregenna (2023).
[25] Ngwu and Ojah (2024).
[26] This section builds on the same sources reported in endnote 4.
[27] Alonso et al. (2025); USGS (2025).
[28] Andreoni and Avenyo (2023).
[29] AFDB (2023).
[30] Fessehaie (2017).
[31] Ibid.
[32] IEA (2022b).
[33] IRENA (2022).
[34] GFA Consulting Group GmbH et al. (2025).
[35] Ibid.
[36] Al-Rikabi et al. (2025).
[37] IEA (2023a).
[38] ESCWA (2022).
[39] The data reported in this box is taken from: CleanTechnica (2025); OICA (2025)
[40] Ayetor et al. (2023).
[41] ESCWA (2025).
[42] Dludla (2025).
[43] UNECA (2025).
[44] IEA (2022b).
[45] Nolan (2025).
[46] This case study was developed with the support of Linet Luvai, Tally Einav and Nasiha Swaleh Salim from the UNIDO Field Office in Kenya and benefitted from interviews conducted with Roam electric limited; the Ministry of Trade, Investments and Industry; the Ministry of Energy and Petroleum; the County Government of Nairobi; the Kenyan Association of Manufacturers; Persistent Energy Capital; the African Development Bank; GIZ Kenya; UN Habitat Nairobi and UNEP Nairobi. The data reported in this box is taken from: CleanTechnica (2025).
[47] ITC (2025).
[48] UNESCO (2023).
[49] Nigatu et al. (2024).
[50] McKinsey&Company (2021).
[51] Trademark Africa (2024).
[52] See, for instance Whitfield and Triki (2023).
[53] AFDB (2022).
[54] Narsai and Abudu (2024).
[55] UNCTAD (2025b).
[56] A notable example is Kenya's Revital Healthcare, which has reached an annual production capacity of 300 million syringes, sufficient to meet half of Africa's immunization needs. See AFDB (2025).
[57] UNCTAD (2025c).
[58] This case study was developed with the support of Philbert Abaka Johnson, Bamidele Reuben, Otu Osu and Helen Iji from the UNIDO Field Office in Nigeria and benefitted from interviews conducted with Advantage Health Africa; the Pharmaceutical Manufacturers Group of the Manufacturers' Association of Nigeria; the Development Bank of Nigeria; and LBS Health Initiative.
[59] Oswaldo Cruz Foundation (2021).
[60] Haakuria et al. (2025)
[61] UNECA (2025).
[62] Tapfuma et al. (2024)
[63] Nzei (2024)
[64] Bonner (2024).
[65] Reardon et al. (2021).
[66] Ninkuu et al. (2025).
[67] Soybeans have also provided the backdrop for the growth of a regional value chain related to the poultry industry in Southern African countries. See Ncube (2025).
[68] Economic gains could also be substantial. Producing biofertilizers from animal manure and agricultural residues offers substantial potential, with estimated annual gains of USD 1.76 billion in Zambia alone. See Tandem Circular Consulting Limited (2024).
[69] Fusacchia et al. (2022).
[70] Hamann (2020).
[71] Suri et al. (2024).
[72] Ogunkola and Ancharaz (2025).
[73] SA-TIED (2020).
[74] This case study benefitted from interviews conducted with Casidra, Greencape and the Agricultural Research Council.

CHAPTER 6 ASIA-PACIFIC: CHALLENGES AND OPPORTUNITIES FOR FUTURE INDUSTRIALIZATION

Since the beginning of the century, the Asia-Pacific region has emerged as the most dynamic globally in terms of industrial development. Looking ahead, the region's prospects remain positive. Under the *current path* scenario, most subregions are expected to make steady progress, with low- and middle-income countries gradually narrowing the gap with higher-income economies in industrialization, productivity and emissions performance. However, the region remains highly heterogeneous. The extent to which different subregions achieve these positive outcomes will depend on their capacity to address key bottlenecks to future industrialization. Disparities in physical and digital infrastructure, gaps in future-oriented technical skills, competition from lower-cost imports, and limited regional integration may constrain industrial progress in several countries in the region.

At the same time, however, these challenges coexist with a range of emerging sectoral opportunities driven by global megatrends that are reshaping the global economy. Promising industries include renewable energy equipment and low-emissions hydrogen, electric mobility, critical minerals processing, green textiles and apparel, digital technology equipment and services and bioeconomy, among others. By addressing structural bottlenecks and strategically prioritizing these industries, governments can leverage global megatrends to significantly accelerate the transition towards sustainable and inclusive industrialization.

Armida Salsiah Alisjahbana

"The Asia-Pacific region is advancing and fast-moving with the technological revolution. This transformation is driving the expansion of the digital economy, empowering youth and women entrepreneurs, improving access to finance through fintech, and creating opportunities to advance inclusive and sustainable growth. The Asia-Pacific region's transformation offers valuable lessons for other regions to leapfrog in innovation and service delivery."

United Nations Under-Secretary-General and Executive Secretary of the UN Economic and Social Commission for Asia and the Pacific (UNESCAP)

6.1 RECENT AND FUTURE INDUSTRIAL DYNAMICS

Since the turn of the century, the Asia-Pacific region has experienced the world's strongest industrial growth, but with notable variations across income groups and subregions. As outlined in Chapter 1, the region recorded the highest relative growth in manufacturing over the last 25 years, with manufacturing value added (MVA) expanding at an average rate of nearly 5 per cent, significantly above the 2 per cent average for all developing countries.[1] Yet this aggregate performance masks sharp disparities among country groups, reflecting differences in recent trends, challenges and future prospects. To better capture these subregional dynamics, countries are grouped according to their level of industrial development and geographical proximity within the region (Table 6.1).

Upper middle-income and high-income industrializing economies in Eastern Asia remain the undisputed leaders of industrial development in the region. Over the past 25 years, this group has made remarkable progress, with MVA per capita increasing more than eleven-fold, largely driven by the expansion of Chinese manufacturing. In South-Eastern Asia and the Pacific, economies such as Indonesia and Malaysia have diversified their manufacturing base into higher value-added industries, but at a more moderate pace. Meanwhile, Southern and Western Asia have achieved gradual gains, though these increases remain modest compared with Eastern Asia's dynamism (Figure 6.1).

Among low- and lower-middle income economies, MVA growth has shown diverging trends. East and South-Eastern Asia and the Pacific have recorded sustained increases, with MVA per capita rising more than threefold since 2000. This growth reflects the strong performance of economies such as Viet Nam, which has emerged as one of the fastest-growing manufacturing exporters, successfully integrating into global value chains (GVCs) in electronics, textiles and machinery. Southern Asia also demonstrates robust industrialization, led by India's large domestic market and the rise of Bangladesh as a major garment and textiles exporter. By contrast, economies in Western Asia within this group have experienced stagnation or even contraction in manufacturing, reflecting persistent structural and geopolitical constraints.

High-income industrial economies in the region exhibit limited dynamism overall. While Eastern Asia's industrial leaders such as Japan, the Republic of Korea and Taiwan, Province of China maintained stable growth and advanced technological specialization, economies in Western Asia as well as in South-Eastern Asia and the Pacific, have recorded marginal or stagnant industrial performance. This divergence highlights a broader structural shift in which Asia's industrial momentum is increasingly concentrated in emerging manufacturing hubs, while mature industrial economies are experiencing slower growth.

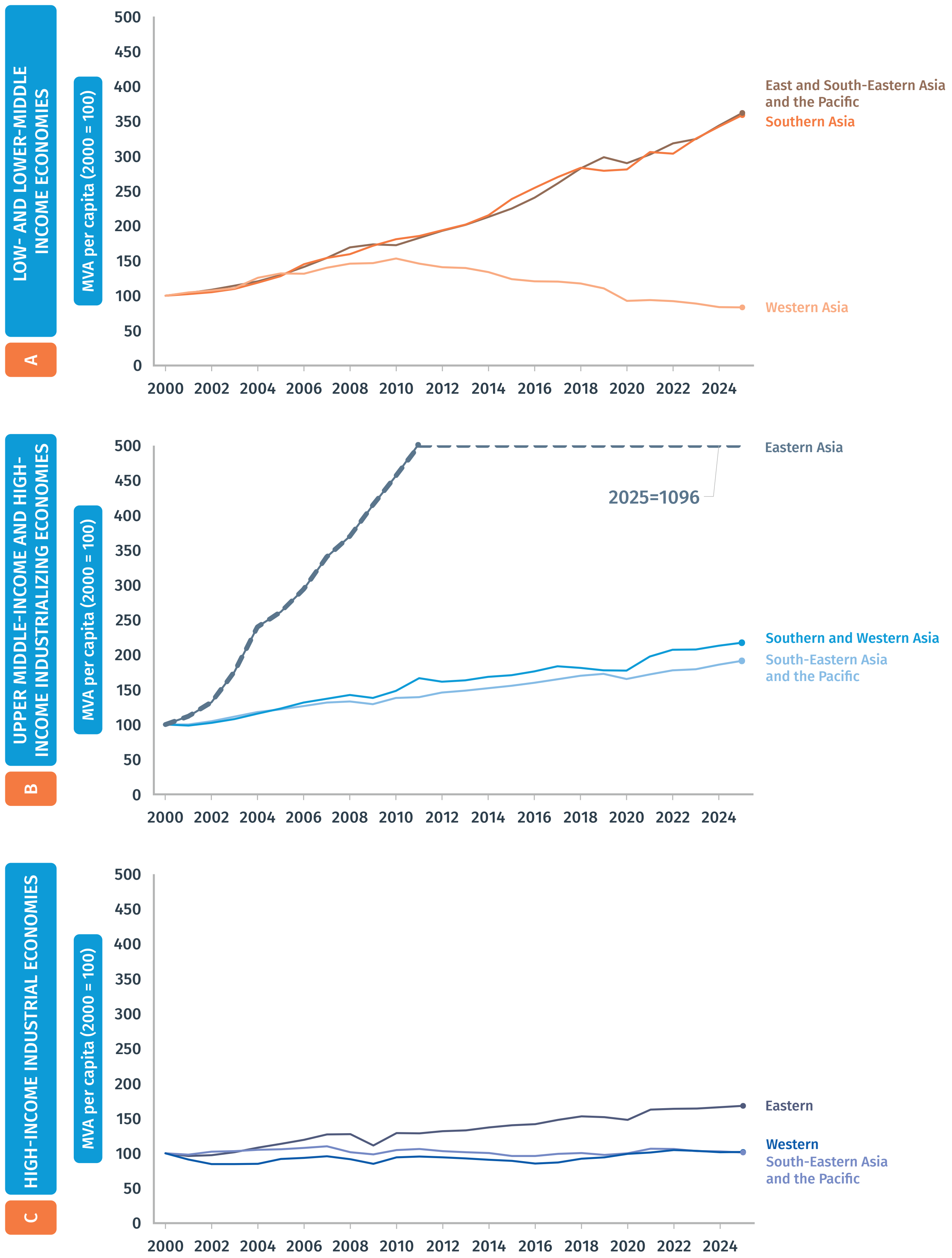
Table 6.1 **Asia-Pacific: List of economies by geographical area and stage of industrial development**

Low- and lower middle-income economies (LLMIEs)			
Eastern Asia[a]	**The Pacific[b]**	**Southern Asia**	**Western Asia**
D.P.R. of Korea	Kiribati	Afghanistan	Jordan
South-Eastern Asia	Micronesia (FS of)	Bangladesh	Lebanon
Cambodia	Papua New Guinea	Bhutan	State of Palestine
Lao People's DR	Samoa	India	Syrian Arab Republic
Myanmar	Solomon Islands	Nepal	Yemen
Philippines	Tuvalu	Pakistan	
Timor-Leste	Vanuatu	Sri Lanka	
Viet Nam			
Upper middle-income and high-income industrializing economies (UMIEs and HINGEs)			
Eastern Asia	Malaysia	Palau	Oman
China	Thailand	Tonga	Qatar
China, Hong Kong SAR	**The Pacific[c]**	**Southern Asia[d]**	Saudi Arabia
China, Macao SAR	Cook Islands	Iran (Islamic Republic of)	Turkey
Mongolia	Fiji	Maldives	United Arab Emirates
South-Eastern Asia	French Polynesia	**Western Asia**	
Brunei Darussalam	Marshall Islands	Iraq	
Indonesia	New Caledonia	Kuwait	
High-income industrial economies (HIIEs)			
Eastern Asia	**South-Eastern Asia[e]**	Nauru	Cyprus
China, Taiwan Province	Singapore	New Zealand	Israel
Japan	**The Pacific**	**Western Asia**	
Republic of Korea	Australia	Bahrain	

Note: In the analysis of this chapter, country groups with a small sample size (fewer than three economies) or small population share (less than 2 per cent of the regional population) are merged with neighbouring groups at a similar stage of industrial development to limit outlier effects from low representation and/or inconsistencies in country-level data: a) presented together with South-Eastern Asia due to a small sample size; b) presented together with South-Eastern Asia due to a small population share; c) presented together with South-Eastern Asia due to a small population share; d) presented together with Western Asia due to a small sample size; e) presented together with the Pacific due to a small sample size and population share.

Source: UNIDO elaboration based on UNIDO country classifications (see Annex A.3).

Figure 6.1 **Asia-Pacific: Industrial dynamics in the first quarter of the 21st century**



Note: Regional averages are calculated using population weights. Values indexed to 2000 (2000 = 100). See Table 6.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, some country groups were merged.

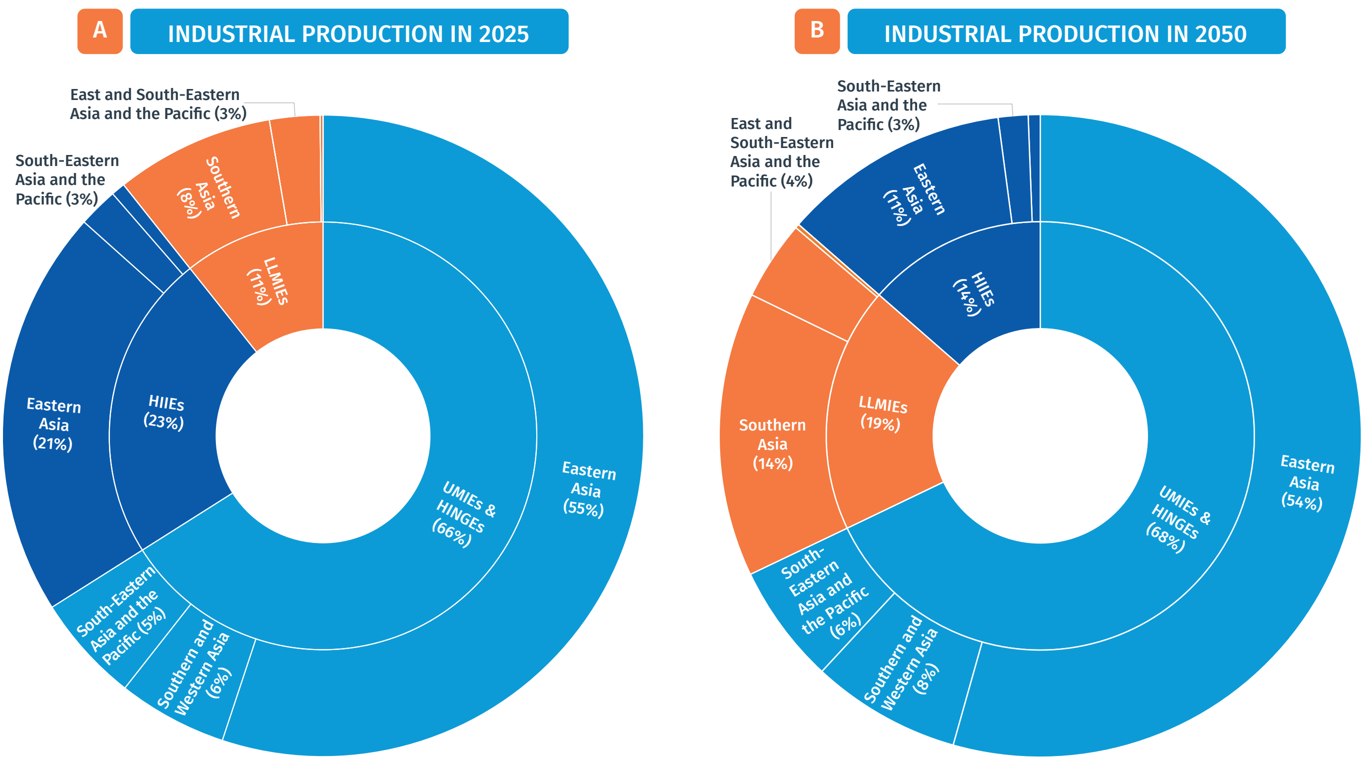
Source: UNIDO elaboration based on UNIDO (2025f).

Eastern Asia dominates the region's MVA distribution, although this lead is expected to moderate by 2050 as Southern Asia is expected to emerge as a major industrial hub. In 2025, Eastern Asia accounts for 75 per cent of the region's MVA, with upper middle-income and high-income industrializing economies contributing 55 per cent, and high-income industrial economies another 21 per cent (Figure 6.2). By contrast, low- and lower middle-income economies account for only 11 per cent, primarily from Southern Asia. Projections under the *current path* scenario indicate that some of these trends will continue, while some changes are anticipated.[2] By 2050, the share of low- and lower middle-income economies in the region is expected to increase by nearly 10 percentage points, largely driven by India's industrial expansion and continued growth across Southern Asia.

Industrial intensity gaps across the region remain highly uneven. By 2050, Eastern Asia is expected to continue leading in industrial intensity across all income categories. The contribution of upper middle-income and high-income economies to global MVA will more than double their share of the global population (FIgure 6.3, Panel A). Other developing economies in the Asia-Pacific region are projected to increase their industrial intensity indices, but at a considerably slower pace. Low- and lower middle-income economies in Southern and Western Asia are expected to achieve only moderate progress from very low baseline values, gradually narrowing the gap yet remaining far from parity. This persistent underperformance reflects deep structural bottlenecks, including deficiencies in infrastructure, skills and technological capabilities, that continue to constrain industrial upgrading in these economies, as discussed in the following section.

Productivity is expected to converge towards the frontier across most of the region, although significant gaps will persist. Catch-up dynamics in relative manufacturing productivity are projected to be positive in most subregions (Figure 6.3, Panel B). The largest reduction by 2050 is expected among upper middle-income and high-income industrializing economies in Eastern Asia, where the current 66 per cent gap relative to the frontier is projected to decline to just 22 per cent, a remarkable achievement over a 25-year period. Low- and lower middle-income economies are also expected to narrow their gaps across subregions, but progress is likely to be modest, as significant and persistent technological constraints will continue through 2050.

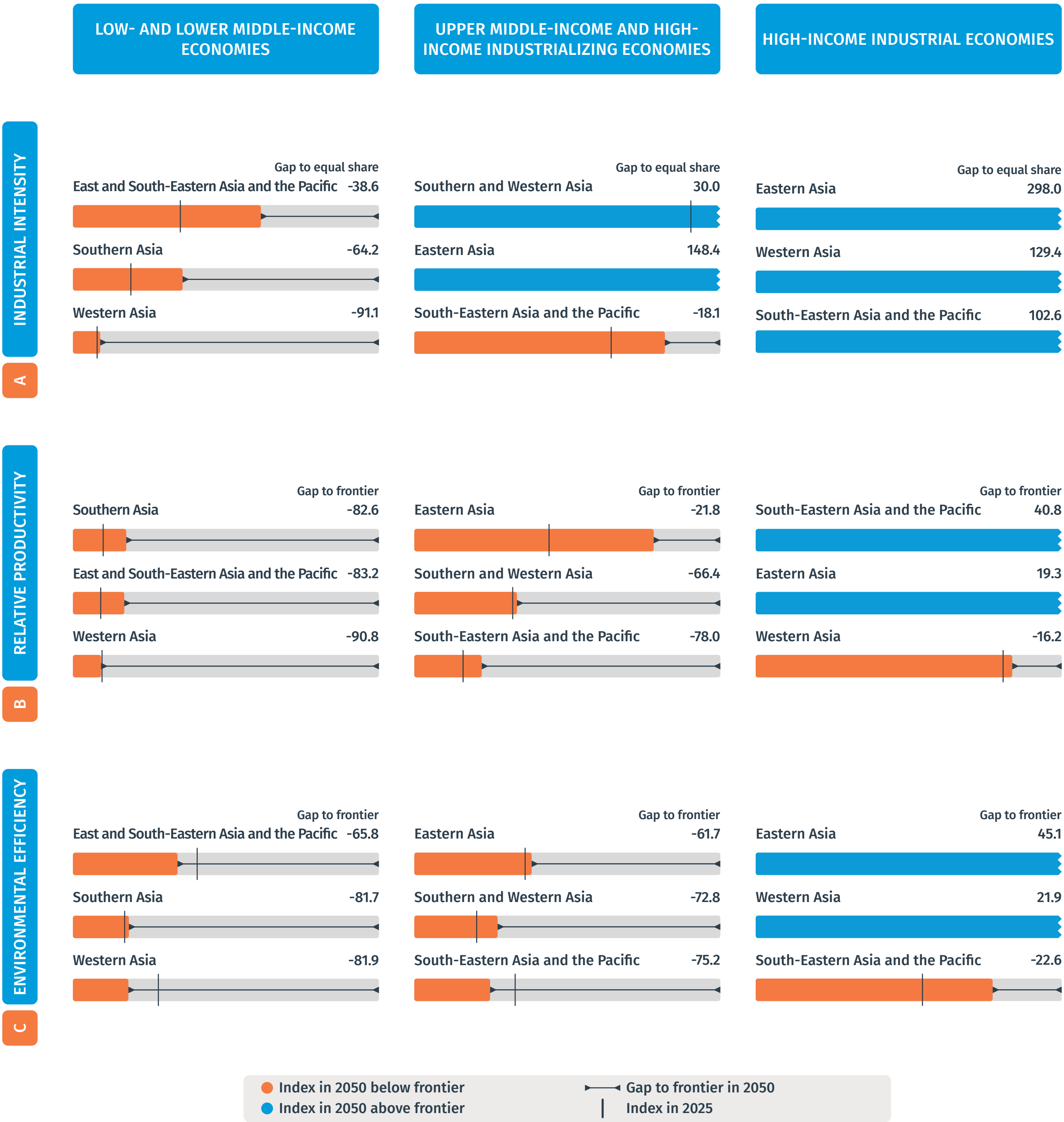
Figure 6.2 **Asia-Pacific: Current and projected distribution of industrial production in the region**



Note: LLMIEs = Low- and lower middle-income economies; UMIEs = Upper middle-income economies; HINGEs = High-income industrializing economies; HIIEs = High-income industrial economies. See Table 6.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, some country groups were merged.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

Figure 6.3 **Asia-Pacific: Industrialization gaps by subregions, current values and projections for 2050**



Note: Bars show projections for 2050 and vertical lines denote 2025 values. Regional averages are weighted by countries' share of manufacturing value added (MVA) in each subregion. The indicators reported in each panel are defined as follows: A) Industrial intensity index = percentage ratio of each subregion's share of global MVA to its share of the world population. A value of 100 indicates equal share. Values below 100 reflect industrial underrepresentation. B) industrial relative productivity index = manufacturing labour productivity (MVA per worker in constant 2017 US dollars) of each subregion relative to high-income industrial economies' average manufacturing labour productivity. A value of 100 indicates that the region stands at the frontier in terms of industrial labour productivity. C) Industrial environmental efficiency index = MVA per unit of CO_2 emissions in constant 2017 US dollars relative to the average value of high-income industrial economies. A value of 100 indicates that the region stands at the frontier in terms of industrial environmental efficiency. See Table 6.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, some country groups were merged.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

A mixed picture emerges for projected industrial environmental efficiency. Generally, low- and lower middle-income economies in the region are expected to experience a decline in their industrial environmental efficiency indices, whereas upper middle- and high-income economies are projected to narrow their gaps in this dimension (Figure 6.3, Panel C). This pattern aligns with traditional structural change, where countries initially move towards more energy-intensive industries before improving these industries' efficiencies. At the same time, however, these projections highlight a missed opportunity for these economies if business continues as usual, as they risk failing to leapfrog towards greener production methods.

The Asia-Pacific region's impressive performance in manufacturing over the past 25 years has not been uniform across all income groups and subregions, and replicating these success stories will require coordinated action. Much of the region's performance has been driven by China, whose manufacturing growth stands out as a global outlier. Beyond China, some income groups and subregions have witnessed strong or moderate growth, while others experienced stagnation or decline. Under the *current path* scenario, most subregions could see their low- and middle-income countries narrowing gaps in industrialization, productivity and emissions. Achieving these projected positive outcomes, and avoiding the negative ones, will require building future-ready industrial ecosystems across the entire region.

6.2 MAIN BOTTLENECKS CONSTRAINING FUTURE INDUSTRIALIZATION

Seven areas of action to prepare for the future. The strengthening of key enablers will be necessary for Asia-Pacific to maintain its lead among developing regions and to expand success stories to more countries. The analysis conducted for IDR 2026 identifies a set of indicators to assess the region's performance in these enablers relative to advanced regions and other developing economies. These indicators are clustered into seven dimensions, namely: (i) institutions; (ii) infrastructure; (iii) labour force; (iv) technology; (v) market structure and integration; (vi) greening, and (vii) finance.[3] For each dimension, two indicators were selected based on their relevance and cross-country availability over the past decade (see Figure 6.4).

6.2.1 Institutions

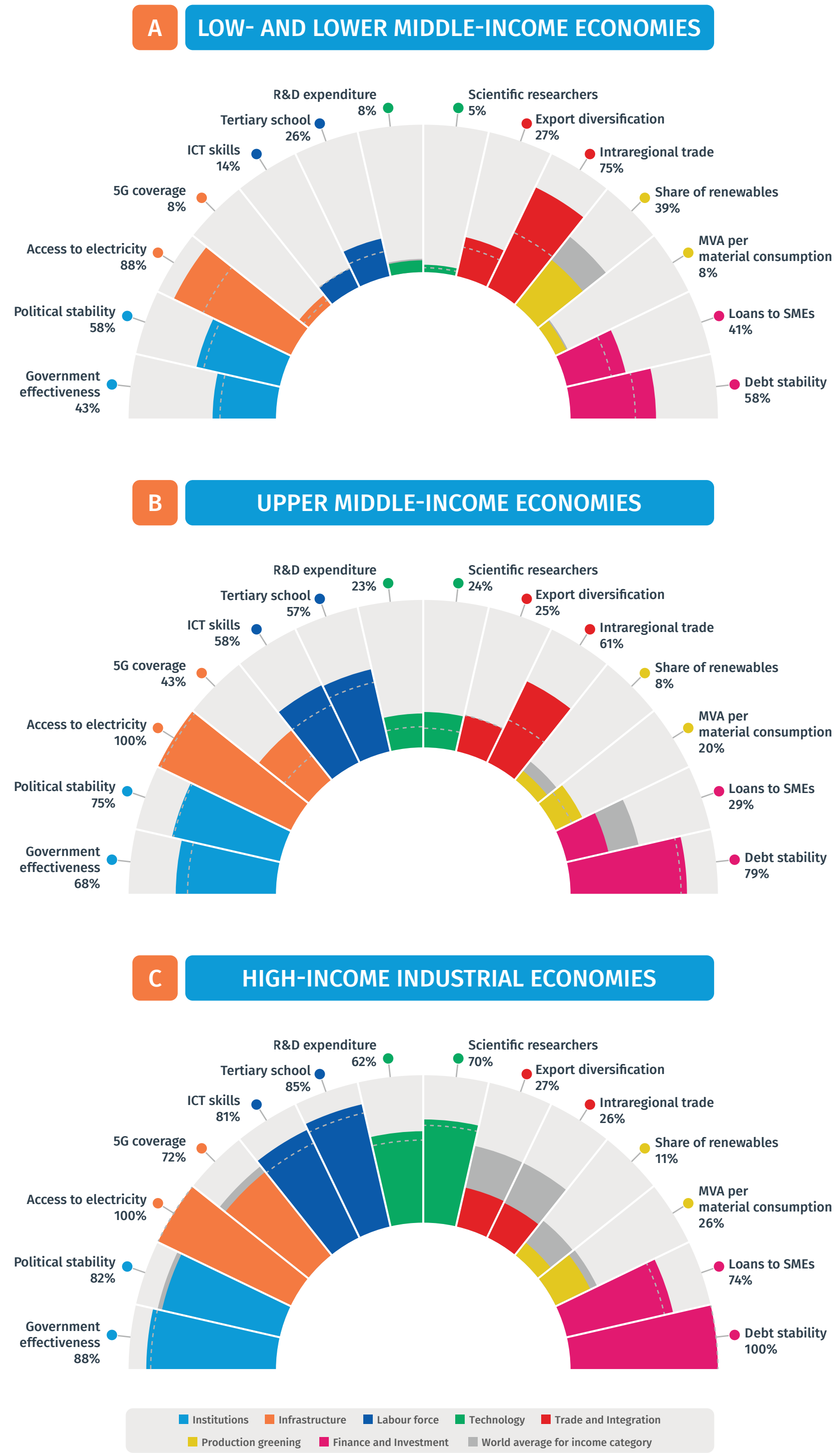
State capacity is relatively strong across the Asia-Pacific region and within income groups. In terms of both political stability and government efficiency, the region outperforms other developing regions (Figure 6.4). Yet, policy inconsistency and weak coordination continue to constrain growth in some countries, and may impede further industrialization, particularly in some South-Eastern and Southern Asian countries. For example, industrial policies that fail to account for green transition objectives may increasingly expose countries to risks associated with emerging global environmental standards, such as carbon border taxes. Additional risks arise from the potential for new or resurgent political conflicts, especially in Western and South-Eastern Asia.

6.2.2 Infrastructure

Infrastructure development in the Asia-Pacific region is comparatively strong relative to other developing regions. Low- and middle-income economies, for instance, outperform their peers in other regions in electricity access. At the same time, however, within-region disparities are substantial. Road and rail density remains low in several economies, contributing to high logistics costs, while port congestion continues to slow the flow of raw materials and finished goods. This unevenness is also mirrored within countries, where infrastructure in many rural or peripheral areas remains sparse and unreliable, raising transaction costs and impeding balanced industrial growth.

Digital divides within countries continue to slow the adoption of emerging technologies. 5G coverage, for instance, is far more prevalent in upper middle- and higher-income economies in the region, with both groups outperforming their peers in other regions. In some economies, uneven access to digital infrastructure exacerbates the digital divide, preventing many businesses and individuals from fully participating in the digital economy and leveraging technological advancements.[4] Poor internet connectivity, coupled with a lack of coordinated national digital strategies, further hampers the diffusion and implementation of new technologies, resulting in a pace of adoption insufficient to drive significant industrial growth.

Figure 6.4 **Industrialization enablers: Asia-Pacific compared to the world frontier and other developing regions**



Note: Indicators are reported as the ratio of regional values to those of the world's best-performing country, defined as the country at the 95th percentile of the global distribution. A value of 100 indicates that the region, on average, is at the frontier for the respective enabler. Values are calculated as simple averages across all countries in the region with available data for each indicator. Country-level data correspond to the average value over the last three years for which data are available (typically, 2021–2023). See Annex A.2 for a detailed descriptions of indicators and data methodology, and Table 6.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, no subregional distinction is made.

Source: UNIDO elaboration based on UNSD (2025a), World Bank (2025a, b and c), Gaulier and Zignago (2010), and UNCTAD (2025a).

6.2.3 Labour force

Education systems in the region exhibit wide disparities: upper- and higher-income economies have very strong systems, while many low- and middle-income economies face significant shortcomings. Across this group, shortages of skilled labour and technical expertise are common, even in economies with a high share of young people. These constraints arise from limited and uneven access to quality education, with notable gaps in vocational training, college education and, in some cases, even secondary education. Horizontal inequalities also play a role – for example, while Southern Asia has made progress in literacy, substantial gender and rural-urban gaps persist.

6.2.4 Technology

Lower- and middle-income economies in the region also face mismatches between the supply and demand for skills, especially in the context of the digital transition. Education and training systems in many countries have been slow to respond to the digital transition, limiting the manufacturing sector's ability to harness the potential of new technologies. Even where tertiary education has expanded, gaps in technical skills persist due to deficiencies in vocational training. Low research and development (R&D) expenditure in most firms further exacerbates the shortage of high-skilled workers. As a result, firms that manage to overcome the costs of adopting emerging technologies often struggle to find the talent required to move towards knowledge-intensive, high value-added manufacturing, constraining prospects for structural transformation in these economies.

6.2.5 Trade and integration

The regional market is an engine of growth, especially for lower-, middle- and upper-middle income economies. Yet in some countries, demand is constrained by small domestic markets and, more generally, by limited integration into GVCs and ongoing geopolitical tensions. In Southern and Western Asia, in particular, the full potential of regional economic integration remains untapped, hampered by geopolitical sensitivities, conflict and inadequate cross-border infrastructure.[5] These barriers limit opportunities for firms to scale up production and engage in broader trade networks.

Local private firms remain underrepresented among high performers in many economies. In South-Eastern Asia, for instance, leading firms are often multinational enterprises (MNEs) and state-owned enterprises (SOEs). Their dominance in value chains reflects the subregion's open industrial model, which heavily relies on incoming foreign direct investment (FDI). These MNEs typically occupy the most productive segments of value chains, leaving lower value-added activities to local firms. In other cases, particularly in Western and Southern Asia, many leading firms are SOEs operating across a wide range of industries, including those typically dominated by private firms elsewhere, such as manufacturing, accommodation and construction.[6]

Competitive pressure from lower-cost imports originating in emerging industrializing economies within the region has intensified in recent years. These imports are increasingly concentrated in neighbouring emerging markets, placing domestic producers in importing markets at a disadvantage compared with foreign competitors that benefit from greater scale, cost efficiency and logistical advantages. This impact is particularly pronounced in industries such as automotive, machinery and transport equipment, electronics, and textiles and apparel. The challenges are especially acute in South-Eastern Asia, where reliance on these trade flows is highest.

6.2.6 Production greening

Despite considerable progress in renewable energy capacity, the Asia-Pacific region remains heavily dependent on fossil fuels. The green transition in manufacturing faces several constraints, including infrastructure bottlenecks, particularly inadequate power grids that limit the integration of renewables, and a substantial financing gap.[7] Without targeted measures to enhance adaptation and resilience, the region's high exposure to climate risks and the associated recovery costs will further strain resources, diverting financial resources away from decarbonization efforts.[8]

Policy uncertainty, misaligned incentives and extensive fossil fuel subsidies discourage low-carbon investment. Without stronger regulatory alignment, continued reliance on high-emission industries will increasingly expose manufacturers to carbon border adjustment measures and erode global competitiveness. The transition is further hampered by institutional capacity gaps, governance challenges, limited access to technology and expertise, as well as financial market barriers, such as insufficient climate-related information disclosure and underdeveloped capital markets in some economies. The commercial viability of green projects is also undermined by high upfront costs, long payback periods, and the concentration of critical mineral supplies essential for clean technologies.[9]

6.2.7 Finance and investment

Small and medium-sized enterprises (SMEs) in the Asia-Pacific region face challenges in accessing finance, especially for long-term investments. This hampers industrial firms' ability to invest in technology, expand capacity and compete internationally. Corporate debt markets, which are essential for funding large infrastructure and industrial projects, remain underdeveloped in many economies, leaving financial systems largely dependent on banks.[10] Smaller firms are often perceived by banks as riskier and lack sufficient collateral, making financing expensive. In South-Eastern Asia, SMEs frequently encounter short repayment terms and stringent documentation requirements, while public financial institutions maintain modest industrial lending portfolios that often focus on working capital rather than long-term investment. In Western Asia, credit access is uneven, impeded by banks' risk aversion, shallow capital markets and underdeveloped financial instruments. In Southern Asia, the region's young demographic could support a dynamic startup ecosystem, yet inadequate financing options and weak corporate governance limit the development of new technologies and knowledge,[11] further deterring investment.

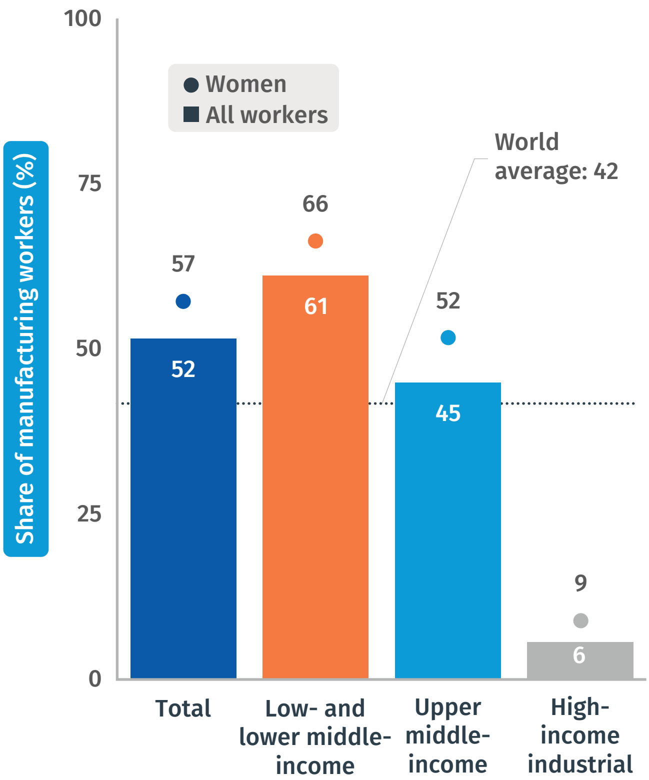
Macroeconomic bottlenecks, ranging from debt burdens and fiscal constraints to weak private investment and exchange rate pressures, pose significant challenges to industrialization. In several Southern Asian economies, high levels of public debt limit governments' ability to mobilize resources, leaving them vulnerable to rising borrowing costs and reduced access to external financing. Fiscal constraints, driven by low revenue mobilization, further restrict public investment in infrastructure and industrial support, undermining the foundations for long-term structural transformation. In Western Asia, several economies have experienced notable real effective exchange rate appreciation in recent years, reducing the competitiveness of manufacturing exports, particularly in price-sensitive industries.

6.2.8 Cross-cutting issues

Informality remains a bottleneck, with substantial variation across income groups. Informality levels range from around 5 per cent in higher-income industrial economies to an average exceeding 60 per cent in low- and middle-income economies (Figure 6.5). The prevalence of informal activity in these economies constrains domestic resource mobilization, productivity growth and business expansion. Recent evidence from India, for instance, suggests that over the past three decades, informality has hampered overall productivity growth in the manufacturing sector.[12]

Across the region, informality tends to exacerbate existing gender imbalances. This is particularly evident in developing economies, where the share of informal employment among women exceeds that of the overall workforce by more than five percentage points. In low- and lower middle-income economies, for instance, an average of 66 per cent of women employed in manufacturing work in the informal sector. Informality, in turn, results in lower wages and poorer working conditions, further widening gender disparities and limiting the capacity of industry to fully contribute to social development.

Figure 6.5 **Informality and gender imbalances in Asia-Pacific's manufacturing sector**



Note: Values represent the share of informal workers in total manufacturing workers by country group and gender. They are calculated as a simple average for all countries in the region with available data and refer to the last three years for which data are available (typically, 2021–2023). See Table 6.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, no subregional distinction is made.

Source: UNIDO elaboration based on ILO (2025).

6.3 SECTORAL OPPORTUNITIES TO SPUR FUTURE INDUSTRIALIZATION

Megatrends are reshaping the global economy and opening new windows of opportunity for industrial development across Asia.[13] Ongoing transitions in digital technology and energy systems are proving especially transformative. The rise of AI and the digitalization of production are driving demand for advanced information and communication technology (ICT) equipment, such as semiconductors and mobile devices, as well as information technology (IT) services, including cloud computing and cybersecurity. The green transition is stimulating investment in critical minerals, renewable energy equipment, low-emission hydrogen and electric mobility, with strong government commitments creating additional momentum.

Other megatrends arising from profound societal shifts are equally important. Demographic changes, including population growth and ageing, are driving demand for e-mobility, pharmaceuticals and healthcare-related industries. At the same time, the reconfiguration of supply chains is creating opportunities for countries to expand into green textiles and clothing, while the transformation in food production systems is opening new avenues for agroprocessing. The in-depth case studies presented in the following subsections illustrate how these trends are translating into tangible sectoral development opportunities across the region (see Table 6.2). Given the heterogeneity of the Asia-Pacific region, unlocking these opportunities will require context-specific industrial strategies tailored to local capabilities, institutional frameworks and development priorities.

6.3.1 Critical minerals processing

The rapid growth of digital and green technologies is fuelling a surge in global demand for critical minerals, creating new opportunities for industrial development and diversification. According to the International Energy Agency (IEA), global demand for critical minerals is expected to double by 2030 under current policies, with stronger policy commitments likely to accelerate this trend.[14] Mineral deposits in several subregions provide a solid foundation for mineral beneficiation strategies. South-Eastern Asia, for example, benefits from Indonesia's large nickel reserves, while Western Asia is endowed with phosphate rock deposits in Saudi Arabia and the Islamic Republic of Iran. Mongolia also presents opportunities with its substantial copper deposits. Beyond natural endowments, the proximity of these countries to major manufacturing hubs, such as China and the European Union (EU), combined with the availability of financial resources, particularly in the Gulf, creates favourable conditions for investment in local mineral refining.

Efforts to localize critical minerals processing are already yielding results. In Indonesia, for instance, an export ban on nickel has stimulated FDI in processing facilities, generating significant diversification and domestic value addition (see Box 6.1). In Western Asia, Saudi Arabia is positioning mining as the "third pillar" of its economic diversification strategy, with beneficiation projects designed to transform raw ores into higher-value products such as aluminium, fertilizers and potentially battery minerals. Saudi Arabia aims to link resource exploration with industrial upgrading, while fostering an ecosystem conducive to foreign investment and technology transfer, transitioning from an extraction-based model to a fully integrated mining and mineral processing hub. Another example is Mongolia. Though still primarily an exporter of raw materials, the country has also initiated small-scale production of value-added goods, such as copper cathodes.[15]

Despite these promising advances, technology gaps, skills shortages and dependence on foreign partners continue to constrain local mineral processing in Asia. With most enterprises owned by foreign investors, the direct economic benefits for host countries remain limited. Skill shortages often require the employment of foreign workers in key operational roles, restricting opportunities for the local workforce. At the same time, the polluting nature of mining exacerbates environmental degradation and deteriorates living conditions, while stricter sustainability standards in developed economies pose challenges for the industry's integration into GVCs. Recent geopolitical tensions have further clouded the outlook, as Asian suppliers of critical minerals navigate competing interests among major global powers.

Targeted interventions are therefore essential for promoting domestic value addition and strengthen regional resilience. Legal frameworks requiring foreign investors to partner with local micro-, small- and medium enterprises (MSMEs) could facilitate knowledge transfer and enhance domestic production capabilities. Improving the efficiency of SOEs and expanding their operational scope would further advance this objective. Regional cooperation frameworks, such as the Association of Southeast Asian Nations (ASEAN) and the South Asian Association for Regional Cooperation (SAARC), should also be reinforced to deepen intra-regional trade and reduce exposure to external shocks. Finally, strong environmental safeguards must be embedded in all mining initiatives to ensure that industrial development is sustainable.

Table 6.2 **Asia-Pacific: Megatrends, drivers and sectoral opportunities for future industrialization**

Main megatrends	Sectoral opportunities	Drivers	Case studies
Energy and the green transition	• Critical minerals processing	• Growing demand for critical minerals from clean-tech industry • Growing demand for critical minerals from the semiconductor industry	**Indonesia**: Critical minerals processing and the electric vehicles industry
	• Renewable energy equipment and hydrogen	• Growing global demand for clean-tech • Geographical positioning close to end-markets	**Oman**: Boosting local capacity in photovoltaic manufacturing to achieve carbon neutrality
	• Electric mobility	• Strong government commitment and incentives for electrification • Growing population and urbanization	**China**: Phased and holistic policy mix for the mobility sector
	• Green textiles and apparel	• Shifting of production away from China • Rising demand for sustainable textiles and apparel	**Sri Lanka**: Building a competitive garment industry
The rise of AI and the digitalization of production	• Semiconductors and ICT equipment	• Growing global demand for high-technology goods, such as smart phones and semiconductors • Strategic position close to manufacturing hubs and strong regional trade agreements	**India**: Accelerating innovation in the communication and electronics industry
	• IT services and digital public infrastructure	• Growing global demand for cloud computing, cybersecurity and software development services, spurred by the rise of AI.	
Population growth and the changing nature of work	• Pharmaceuticals	• Ageing populations and expanding healthcare needs	
The transformation of food production systems	• Agroprocessing	• Growing demand for commodities such as coffee and palm oil	

Source: UNIDO elaboration.

6.3.2 Renewable energy equipment and hydrogen

Global decarbonization efforts continue to create opportunities for the Asia-Pacific region in the production of renewable energy equipment, although manufacturing activity in key value chains remains highly concentrated. East Asian economies, particularly China, continue to play a dominant role in the PV and battery value chains.[16] At the same time, Southern Asia is gradually emerging as a manufacturing hub for wind power, a value chain traditionally dominated by producers in the EU and the United States, with India now reaching an annual manufacturing capacity of 18 gigawatts (GW).[17] Economies in Western Asia, such as the Islamic Republic of Iran and those in the Levant, could leverage their abundant solar and wind resources to enter downstream segments of production. This approach is currently being pursued in Oman, where the 'Manufacturing for Well-being Strategy 2040' aims at attracting foreign investment to develop the domestic photovoltaic (PV) industry (see Box 6.2).

Opportunities are also emerging in less established value chains and nascent technologies, such as hydrogen and carbon capture and storage (CCS). In Western Asia, Saudi Arabia, the United Arab Emirates and Oman are projected to rank among the world's top ten producers of low-emission hydrogen and its derivatives by 2030, benefitting from their proximity to key destination markets and significant investment potential.[18] Low-emission hydrogen is also gaining strategic importance in South-Eastern Asia, with Indonesia, Malaysia and Singapore endorsing the Hydrogen Declaration at COP29, and committing to

Box 6.1 Indonesia: Critical minerals processing and the electric vehicles industry

Indonesia, the world's largest producer of nickel, remained confined to the lower tiers of the global nickel value chain for many years. Over the past decade, however, the country has repositioned itself within the global economy through an assertive industrial policy. A cornerstone of this transformation was the introduction of an export ban on unprocessed nickel ore, which catalysed Indonesia's emergence as a leading producer of midstream and downstream nickel products, particularly stainless steel. This industrial expansion has also contributed to broader structural change, with stainless steel exports now surpassing oil exports in value. Indonesia's transition from a net importer to a net exporter of stainless steel in 2017 marked a milestone. Building on this success, Indonesia has extended its industrial strategy to include electric vehicles (EV) batteries and EV manufacturing, aligning with its 2030 targets for decarbonizing transport.

Indonesia's downstreaming policy implements a mix of instruments designed to attract foreign direct investment (FDI), facilitate technology transfer, and enhance domestic value addition and participation in global value chains (GVCs). The export ban on raw mineral products, including nickel ore, triggered a domestic price drop that attracted substantial foreign investment—primarily from China—into nickel processing. Investment in the basic metals industry grew at an average annual rate of 41.6 per cent, enabling the rapid construction of smelters and the adoption of advanced technologies, such as high-pressure acid leaching (HPAL). This technology has allowed Indonesia to process lower-grade nickel ore into mixed hydroxide precipitate, a critical input for EV batteries.

To ensure meaningful domestic participation in joint ventures with foreign firms, the government's role expanded beyond attracting FDI. It established several SOEs, including the mining holding company ANTAM and the Indonesia Battery Corporation, to secure a central position for domestic firms in strategic partnerships. Furthermore, integrated industrial parks, such as the Indonesia Morowali Industrial Park, were developed to promote vertical and horizontal linkages across the nickel value chain. Indonesia now aims to become a key player in the global EV battery supply chain. One notable measure introduced in April 2023 is a reduction in value-added tax on EV purchases, lowering the rate from 11 per cent to 1 per cent for vehicles with significant local content.

Indonesia's rapid industrial upgrading has not been without challenges. Environmental concerns include high carbon emissions from coal-powered smelters and the risks associated with HPAL waste. Social challenges have also emerged, as job creation within mining communities remains limited. Policy inconsistencies also persist, such as conflicting incentive schemes that favour imported EVs over domestically produced ones, potentially undermining the competitiveness of local manufacturers in the short- to medium-term.

Source: UNIDO elaboration based on a background report produced by Lee et al. (2025).[19]

scale up both production and utilization.[20] Indonesia and Malaysia are also advancing initiatives to expand CCS technology.[21] Regional institutions, such as ASEAN and the Gulf Cooperation Council (GCC), are supporting this transition by harmonizing renewable energy certification schemes and opening opportunities for further development.

Despite numerous initiatives, upgrading in clean-tech value chains remains complex and capital-intensive. Global uncertainty and structural bottlenecks, including weak innovation systems, persistent skills gaps and inadequate infrastructure, continue to hamper progress. Heavy reliance on foreign intellectual property and imported technology limits domestic value capture and increases vulnerability to external shocks. In the case of low-emission hydrogen, technological immaturity raises concerns relating to cost competitiveness and scalability, delaying project implementation. Saudi Arabia's NEOM Green Hydrogen Project remains one of the few initiatives to have reached a final investment decision.[22] Moreover, skills shortages and infrastructure that are ill-suited to new energy systems further constrain development.

To seize these opportunities, Asian countries will need to accelerate innovation while fostering an enabling ecosystem. Increased R&D investment can strengthen technological sovereignty and deepen domestic value chains, while industrial policies should facilitate the commercialization of innovation. Infrastructure upgrades will also be critical: investments should be channelled towards renewable energy infrastructure, retrofitting ports to safely manage large-scale ammonia exports, and expanding desalination capacity to meet the water needs of electrolysis, ensuring that green sector development contributes to a genuinely sustainable transition.

Box 6.2 **Oman: Boosting local capacity in photovoltaic manufacturing to achieve carbon neutrality**

Oman has successfully initiated its entry into the photovoltaic (PV) industry through a combination of public procurement and foreign direct investment (FDI). Despite starting from a limited manufacturing base, the industry is expanding rapidly. By the end of 2024, Oman had 1.7 GW of operational solar capacity and 39.5 GW in announced projects, representing about USD 49 billion in clean energy investments. One of the most advanced initiatives is the United Solar Polysilicon project in the Sohar Freezone, which aims to develop a large-scale polysilicon plant with an annual capacity of 100,000 tonnes using state-of-the-art TOPCon (Tunnel Oxide Passivated Contact) cell technology. Regional demand, driven by Gulf countries' decarbonization efforts, complements the domestic market and provides a secure local offtake base for the future development of solar industry.

Several structural advantages position Oman as a promising hub for PV manufacturing. The country holds substantial reserves of high-quality silica, with the Mahout Silica Sand Project expected to produce 100,000 tonnes of 98 per cent pure silica annually to supply local and regional PV manufacturers. Oman also benefits from exceptional solar and wind resources, providing access to low-cost renewable electricity. Wind turbine manufacturing projects are under development, and wind farms are being explored in Dhofar and Duqm. Its strategic location at the mouth of the Strait of Hormuz, combined with well-developed ports and planned connections to the Gulf Cooperation Council (GCC) railway network, further strengthens its logistics potential.

These enabling factors have been operationalized through the 2019 "Manufacturing for Wellbeing Strategy 2040", subsequently reinforced by Oman's Vision 2040, both of which aim to diversify the economy beyond hydrocarbons. The strategy prioritizes solar power production as a pathway to achieving carbon neutrality. To boost the local processing of silica and manufacturing capacity for glass and other high-value PV components, Oman is partnering with foreign investors through incentives such as tax holidays, 100 per cent foreign ownership, and zero import and re-export tariffs in its special economic zones (notably Duqm and Sohar). These measures have attracted interest from Chinese PV manufacturers exploring relocation opportunities.

However, Oman's PV potential remains largely untapped. The country needs to strengthen backward linkages between foreign firms and domestic industries to ensure effective technology transfer and workforce development. Moreover, global overcapacity, reliance on imported components and geopolitical tensions may pose risks to competitiveness, while the water and energy requirements highlight the importance of sustainable resource management.

Source: UNIDO elaboration based on a background report produced by Boucetta et al. (2025).[23]

6.3.3 Electric mobility

Asia's growing population, combined with strong commitments to decarbonization, positions electric mobility as a promising driver of future industrialization. Developing economies in the region can leverage robust domestic demand, with EV sales experiencing rapid growth. In 2024, passenger EV sales in Asia-Pacific reached nearly 12 million units, representing a 36 per cent increase compared with 2023.[24] Government policies play a crucial role, setting ambitious targets for both public and private fleet electrification. For instance, the Indian government aims to achieve 40 per cent EV adoption for buses, 30 per cent for private cars, 70 per cent for commercial vehicles and 80 per cent for two-wheelers by 2030.[25]

Some Asian countries have already established themselves as global leaders in electric mobility, while others are leveraging their critical mineral endowments, supplier networks and policy frameworks to develop domestic industries. China dominates the industry as the world's largest producer and seller of EVs (see Box 6.3). Other countries in South-Eastern Asia are also building comparative advantages in EVs through natural resources (nickel in Indonesia) and through the use of tariff and non-tariff measures to protect national automotive manufacturers (Viet Nam).[26] In Western Asia, specialization is emerging across the EV value chain, with the United Arab Emirates, Saudi Arabia, Qatar and Oman investing in lithium extraction from seawater, battery production and recycling, as well as establishing initial EV manufacturing facilities.[27]

Box 6.3 China: Phased and holistic policy mix for the mobility sector

China's mobility industry has surged over the past decade, encompassing three key subsectors: (i) EVs, (ii) autonomous driving (AD, or smart driving), and (iii) low-altitude economy (LAE) or urban air mobility. The EV industry served as a steppingstone for the development of the other two subsectors. In 2020, EV penetration in China was only 5 per cent, increasing to over 20 per cent by 2022. Today, the country accounts for more than 70 per cent of global EV production and a similar share of power battery capacity. Growth in the AD subsector has also grown rapidly: in just four years, China has advanced from Level 1 (Driver Assistance) to Level 4 (High Automation) vehicles.[28] The country is now preparing to expand into the LAE subsector, which is increasingly moving towards commercialization, with the market estimated at over RMB 500 billion (approximately USD 70 billion) in 2023 and projected to reach RMB 2 trillion (approximately USD 270 billion to 280 billion) by 2030.

China's leadership in e-mobility was achieved through a comprehensive policy mix, combining both demand-pull and technology-push instruments. The strategy unfolded across three main phases. The first one (2009–2012) focused on initiation and market cultivation. The *"Ten Cities, Thousand Vehicles"* initiative, launched in 2009, created a protected market niche by promoting adoption in 13 cities, prioritizing buses, taxis and official fleets, with subsidies primarily directed towards public service vehicles. The second phase (2013–2020) aimed to stimulate both supply and demand. On the demand side, adoption was supported through purchase tax exemptions, fiscal subsidies and substitution incentives, such as traffic restrictions on internal combustion engine (ICE) vehicles,[29] while investments in charging infrastructure facilitated adoption. On the supply side, the "dual credit" policy required car manufacturers to balance conventional and new energy vehicle production, while industrial funds helped channel private investment.

Finally, the third phase (2021–present) marks a transition towards high-quality production under the New Energy Vehicle Industry Development Plan (2021–2035). Policies now emphasize technological innovation, safety and performance, with subsidies linked to performance indicators such as energy density and driving range, incentivizing quality improvements.

At the same time, however, the industry faces bottlenecks arising from reliance on foreign inputs and the rapid pace of technological change in the industry. Key upstream materials—lithium, cobalt and graphite—remain heavily imported (58 per cent, 65 per cent, and 80 per cent, respectively), and high-end chips for autonomous driving (e.g. SoCs) are also dependent on foreign supply. From a technical point of view, autonomous driving algorithms still encounter challenges in complex urban environments, struggling with extreme weather, mixed traffic and high human-vehicle interaction. In addition, regulatory frameworks are lagging behind,[30] slowing the development of appropriate insurance systems for innovative vehicle types. Furthermore, the current enclave-based approach to data governance, while strengthening security, has created data silos, as mechanisms for cross-regional and cross-entity data sharing remain underdeveloped. China is well-positioned to respond to these challenges, leveraging strong geological partnerships, a dynamic innovation ecosystem, and a flexible institutional framework capable of rapidly adapting to emerging technologies.

Source: UNIDO elaboration based on a background report produced by Lee et al. (2025).[31]

Challenges in the EV industry vary across the region, reflecting differences in development levels and industrialization strategies. China, for instance, faces risks of overcapacity due to the continued expansion of several large car manufacturers.[32] This overcapacity, in turn, makes it more difficult for other countries to develop domestic manufacturing capabilities, as they face overwhelming competition. Market concentration in the value chain's upstream segments, such as raw and refined minerals, also poses significant bottlenecks by creating dependencies. Many Asian producers remain dependent on foreign suppliers for critical components, limiting opportunities for domestic value addition and increasing vulnerability. Similarly, concentrated innovation activity and limited relocation of R&D tasks constrain technology transfer, keeping Asian firms confined to less profitable value chain segments. In addition, insufficient investment in charging infrastructure hampers the growth of domestic EV markets in several economies.

To support domestic EV production, Asian countries should protect their infant industries from excessive import penetration, strengthen charging infrastructure, and leverage regional bodies to foster coordination and strong regional value chains. Resilience, in turn, can be further strengthened by placing greater emphasis on recycling and the local production of inputs. This requires stepping up R&D and innovation in alternative technologies, particularly in battery chemistry, while relying more on domestic resource endowments. Consistency in industrial policy is crucial: experience shows that supply-side efforts to promote battery production from local minerals can be undermined if demand-side policies favour EV imports.[33] National efforts should be complemented by stronger regional coordination to avoid policy fragmentation and unproductive competition. Regional bodies and multilateral frameworks can play a key role in aligning industrial strategies, promoting knowledge exchange, and fostering the development of integrated and resilient value chains across Asia.

6.3.4 Green textiles and apparel

Global and regional shifts are creating new opportunities for countries in the region specializing in textiles and apparel. Rising labour costs in China, coupled with ongoing production decoupling from the United States, may drive the relocation of textile and apparel production to neighbouring countries. At the same time, growing demand for sustainable garments opens new entry points into advanced markets. These global trends are reinforced by the expansion of domestic and regional markets, providing an additional, powerful driver for the regional textile and apparel industry. In Southern Asia, for instance, per capita textile consumption remains just 5.5 kg—well below the global average of 11.2 kg and far behind the 22.5 kg recorded in Northern America—highlighting substantial potential for future demand growth.[34]

Several countries in the region already hold a strong position in the textile and apparel industry and rank among major global players. Southern and South-Eastern Asian countries, such as Sri Lanka (see Box 6.4), have leveraged low labour costs and access to raw materials to develop fully integrated value chains, from cotton cultivation to retail. India ranks second globally in textile exports, while Bangladesh has emerged as the world's second-largest exporter of clothing, followed by Viet Nam (third), Indonesia (sixth) and Cambodia (seventh).[35] Rising incomes, a young population, and the growth of organized retail and e-commerce are expected to boost textile consumption, creating opportunities to expand the industry and generate employment, particularly for women. Preferential tariff schemes under regional agreements, such as the ASEAN Free Trade Area, which also covers the textile and apparel industry, further position these industries for potential expansion.

The ongoing slowdown in international trade, rising protectionism and the dominance of lead firms within domestic value chains may constrain the industry's growth. Higher tariffs on Asian exports, coupled with stringent environmental standards in developed markets, are likely to undermine these countries' competitiveness.[36] Additionally, the region faces a growing mismatch between supply and demand in choice of fibres: while global consumption is shifting towards manmade fibres, driven by sustainability and fairness considerations, Asian producers remain heavily focused on cotton. The prevalence of SMEs supplying foreign lead firms limits opportunities for scaling and upgrading. In some South-Eastern Asian economies, limited technical skills, outdated machinery and low productivity further restrict diversification into higher-value segments, such as technical textiles and advanced fabric production.

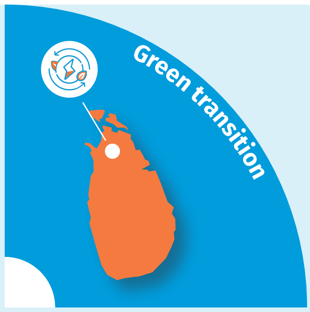
Diversifying export markets and scaling up production capacity are top priorities for the region's textile and apparel industry. Building globally recognized brands and establishing comprehensive marketing networks, including online platforms, would allow textile and garment firms across the region to consolidate their presence in international markets while reaching a broader customer base. At the same time, producers must accelerate the shift towards sustainable practices, such as using organic cotton and dyes, recycled fibres and renewable energy, supported by robust certification schemes to meet rising demand for sustainable fashion. Achieving these objectives will require substantial investment in skills development, design capabilities and innovation. Regional cooperation, through the enforcement of existing trade agreements and the engagement of regional institutions, such as the South Asian Association for Regional Cooperation (SAARC), will be crucial for diversifying export destinations and reducing reliance on advanced economy markets.

6.3.5 Semiconductors and ICT equipment

Rapid technological change is driving an unprecedented surge in global demand for ICT equipment and components, such as smartphones and semiconductors. Smartphones are central to integrated consumer ecosystems, spanning smart homes and vehicles, while semiconductors serve as the backbone of the digital economy. Countries in South-Eastern Asia, benefitting from their strategic location, established upstream manufacturing capabilities, competitive labour costs and participation in regional trade agreements, are well-positioned to absorb a growing share of this demand and advance beyond assembly, testing and packaging. Existing regional trade agreements (e.g. the South Asian Free Trade Area) provide a foundation for harnessing individual countries' strengths to develop integrated and competitive regional value chains.

Regional economies—especially in South and South-East Asia—have successfully integrated into these value chains and are now leveraging their comparative advantages to expand downstream production.

Box 6.4 **Sri Lanka: Building a competitive garment industry**



Sri Lanka's textile and apparel industry has emerged as a dynamic driver of industrial development, representing a notable success story in strategic government – industry collaboration that is capitalizing on global megatrends, including the restructuring of global value chains (GVCs) and the growing emphasis on sustainability. Sri Lanka has carved out a distinctive niche by specializing in high-value apparel, such as women's lingerie and sportswear. Rather than competing on low production costs, the industry has built its competitive advantage on superior product quality and manufacturing capabilities, positioning the country as a high-value sourcing destination in global apparel supply chains. Today, the textile and apparel industry is Sri Lanka's leading export industry, accounting for nearly 40 per cent of total exports.

Industrial policy and government interventions have played a critical role in creating a conducive investment climate and promoting export-oriented industrialization in Sri Lanka. The adoption of market-oriented, liberal economic policies in 1977 promoted export-led growth and private sector participation. Coupled with the Multi-Fibre Arrangement quotas imposed on traditional Asian suppliers, these reforms positioned Sri Lanka as an attractive destination for investors from high-cost developed economies and for "quota-hopping" firms relocating from East Asian newly industrialized countries. Policy initiatives such as the establishment of export processing zones and the "200 Garment Factory Programme" in the early 1990s, further incentivized decentralization and rural industrialization, expanded production capacity and reduced regional economic disparities. Additionally, the government secured preferential market access through the EU and U.S. Generalized System of Preferences schemes, while pursuing free trade agreements with other partners across Asia, including India, Pakistan and Singapore, ensuring the industry's continued integration into global and regional markets.

Another key pillar of industrial policy has been the strengthening of backward linkages and the development of a robust domestic innovation ecosystem. By reducing reliance on imported fabrics and inputs, Sri Lanka has successfully moved up the value chain, improving the sustainability of its export earnings. At the same time, the establishment of national innovation systems has facilitated knowledge spillovers by connecting firms, universities and research institutes, promoting continuous improvement and technological upgrading. Sri Lanka's apparel industry has also gained recognition for its ethical and sustainable practices, adhering to International Labour Organization standards and fostering inclusion and transparency through initiatives such as 'Garments without Guilt' and 'Improving Transparency for Sustainable Business'.

Going forward, Sri Lanka should build on its areas of specialization by developing its own branded products and expanding value chains to lower-cost production locations, such as India and Bangladesh, while leveraging its preferential trade arrangements with India and other South Asian countries.

Source: UNIDO elaboration based on a background report produced by Kumar and Sadana (2025).[37]

India, for example, has capitalized on its large domestic market and skilled workforce to establish itself as a key player in the mobile phone and electronics industry (see Box 6.5), while South-East Asian economies have leveraged their proximity to major East Asian semiconductor centres to gain a foothold in upstream stages of the value chain. Progress is also evident in downstream development; Malaysia has outlined a roadmap to move into high-value segments such as 3D advanced packaging, while Viet Nam is investing in a domestic talent pool of skilled professionals to support the industry's expansion.[38]

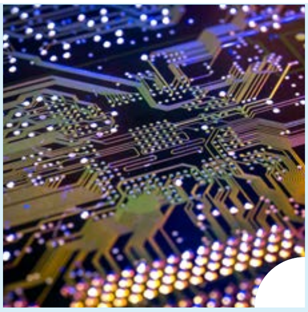
Persistent skill gaps and continued reliance on multinational corporations risk limiting the expansion of domestic capabilities in ICT equipment and components. Many Asian countries remain dependent on foreign firms for technology, infrastructure and capital, constraining the development of local value-added activities. At the same time, skill shortages are exacerbated by low investment in education and brain drain, driven by low wages and limited career opportunities relative to global standards.[39] The skills gap reinforces dependency, as domestic firms often need to source knowledge and expertise from abroad.[40]

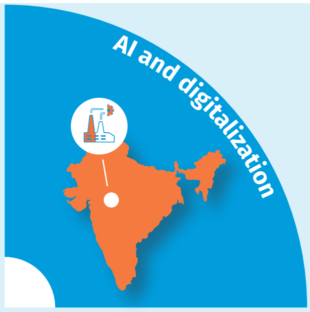
Box 6.5 **India: Accelerating innovation in the communication and electronics industry**

India has developed a robust mobile phone and electronics industry through a strategic mix of government intervention, initially protecting the domestic market and later promoting global expansion. This success was achieved by harnessing global megatrends, including the restructuring of global value chains (GVCs), the digital revolution and the availability of a large, cost-competitive workforce. Rapidly rising domestic demand, fuelled by India's young population, further incentivized both local production and foreign investment. Over the past decade, a combination of these factors and targeted industrial policies has revitalized the industry, enabling India to transition from basic assembly to higher value-added component manufacturing.

In just a few years, India has successfully transformed from a net importer into a major net exporter of mobile handsets. By 2024, the country had become the world's second-largest manufacturer and third-largest exporter of mobile phones, with production expanding more than twentyfold between 2014 and 2024. While nearly 80 per cent of mobile phones sold domestically in 2014 were imported, by 2024, an estimated 99 per cent of devices sold in India were "Made in India." During that same period, employment in the industry grew substantially: direct employment increased eighteen-fold, from 20,000 to 370,000 workers, while indirect employment rose fifteen-fold, from 60,000 to 925,000. Mobile phone exports grew from USD 0.2 billion in 2017 to USD 24.1 billion in 2024, with domestic value addition climbing from 9 per cent in 2019 to 22 per cent in 2022.

The industry's growth was underpinned by a phased national industrial policy strategy that evolved alongside the industry's development. In 2014, India adopted a strategic approach combining market protection with investment attraction under the Make in India programme. By limiting imports through higher tariffs and maintaining selective entry barriers, the government encouraged foreign lead firms to localize production as a prerequisite for accessing





India's growing consumer market. The 2016–17 Phased Manufacturing Programme served as an import-substitution strategy, enhancing domestic production to meet rising mobile phone demand. Building on this foundation, the National Policy for Electronics 2019 and the Production Linked Incentive scheme introduced in 2020 marked a major policy shift, transitioning from a domestic demand-driven model towards an explicitly export-oriented strategy anchored in deeper integration with GVCs.

From the 2020s, India's policy focus shifted towards reducing dependence on foreign inputs and increasing domestic value addition by producing components locally through initiatives such as the 2020 Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors, and the 2025 PLI Electronics Component Manufacturing Scheme. Innovation was further encouraged through the India Electronics Development Fund, which provides risk capital to technology startups, and the Design Linked Incentive Scheme, which offers financial and infrastructural support to strengthen semiconductor design capabilities.

Despite these achievements, India's high dependence on imported components, equipment, technology and skills leaves the country vulnerable to supply chain disruptions and geopolitical risks. Going forward, policy efforts should prioritize the advancement of technology and design capabilities as well as targeted skill development to reduce reliance on imports.

Source: UNIDO elaboration based on a background report produced by Kumar and Sadana (2025).[41]

Building resilient and competitive electronics industries in Asia will require strategic investments in talent, innovation and higher-end operations. A key priority is the development of specialized human capital through the expansion of industry-focused programmes in universities and polytechnics, joint research initiatives between academia and industry, and overseas scholarship schemes with an obligation to return. Strengthening labour protection and welfare is also essential for retaining a skilled workforce. To enhance resilience and reduce external dependence, governments should support the growth of domestic firms by targeting accessible segments of the value chain, such as cleanroom equipment, semiconductor materials and fabless integrated circuit (IC) design. Innovation is equally critical to develop local solutions and increase countries' autonomy; therefore, investing in R&D and innovation infrastructure, such as dedicated innovation districts and research centres, will be indispensable.

6.3.6 IT services and digital public infrastructure

The rapid emergence of AI is accelerating the digital transition across the region, driving growing demand for cloud computing, cybersecurity and software development services. The growth of digital services has a dual impact on future industrialization. On the one hand, it increases demand for hardware, stimulating activity in manufacturing industries that produce server racks, cooling systems for data centres, power distribution units and precision metal components, among other inputs. On the other, the broader diffusion of software, cloud technologies and other digital intangibles plays a crucial role in enhancing productivity across the wider manufacturing sector.[42]

Low labour costs, combined with an increasingly skilled, tech-savvy workforce, provide the region, particularly Southern Asia, with a competitive advantage in IT services and digital public infrastructure. High proficiency in English[43] and a steady supply of computer science and IT graduates proficient in multiple programming languages, further strengthens the talent pool. Investments in data centres and digital infrastructure are attracting foreign tech firms, reinforcing Asia's position in global IT Business Process Management (IT-BPM) and AI-enabled services.

Despite this potential, internet connectivity gaps, unreliable power supply and uneven workforce skills continue to constrain the adoption of AI and advanced digital technologies in many economies across the region. There is also a marked shortage of professionals with expertise in specialized technological fields, such as AI, leaving many firms struggling to fill AI-related roles despite a 60 per cent technology adoption rate among IT-BPM companies.[44] Additionally, growing competition from emerging outsourcing hubs, including South Africa, Colombia, Poland and Egypt, threatens to erode the region's established position in the global IT services market.

To overcome these constraints, governments should implement comprehensive national frameworks for the digital economy, with a focus on skills development, infrastructure enhancement and closing geographical divides. AI and digital skills initiatives should prioritize upskilling and reskilling programmes that align with evolving industry needs. Accelerating the adoption of renewable energy and improving grid reliability will support the expansion of data centres and other digital infrastructure. Policy measures should also include preferential access to government contracts, targeted R&D funding, and support for domestic firms seeking entry into international markets. Addressing urban-rural digital divides through investments in fibre-optic connectivity and 5G networks will further unlock the transformative potential of AI and IT services for industrial development across the region.

6.3.7 Pharmaceuticals

Asia is well-positioned to meet rising global demand for pharmaceuticals, driven by ageing populations and expanding healthcare needs. Growing global and regional demand for affordable medicines presents an opportunity for Asian countries to expand production and strengthen their role in international health supply chains, while enhancing resilience to shocks such as pandemics. India's pharmaceuticals market alone is projected to expand from USD 65 billion in 2024 to USD 450 billion by 2047, highlighting the industry's long-term growth potential.[45]

Several Asian countries already demonstrate significant pharmaceutical production capabilities, providing a foundation for further development. South Asia stands out, with India emerging as a global leader in generics and vaccines, accounting for roughly 20 per cent of global pharmaceutical trade[46] across over-the-counter (OTC) medicines, active pharmaceutical ingredients (APIs), custom manufacturing and biosimilars. Neighbouring Pakistan has developed a large domestic pharmaceutical industry, meeting about 90 per cent of local medicine demand, with exports ranging from USD 400 million to USD 700 million annually.[47] In the Middle East, several countries are treating pharmaceuticals as strategic industries, with Saudi Arabia embedding pharmaceuticals in its Vision 2030 agenda and Jordan positioning itself as a growing export hub.

High dependence on imported APIs and critical raw materials exposes countries in the region to supply chain disruptions and geopolitical risks. Maintaining consistent quality is also a concern, as counterfeit or substandard products can undermine trust in domestic pharmaceutical industries. Moreover, country-specific challenges persist. In Bangladesh, for instance, the impending graduation from least developed country (LDC) status may create difficulties, as the country risks losing exemptions that currently allow local production of certain patented medicines without royalty payments.

Policy actions should prioritize increasing API self-sufficiency and securing the supply of essential raw materials to enhance resilience. Governments need to invest in R&D to promote local product innovation and address artificial bottlenecks created by intellectual property systems. Strengthening regulatory oversight to prevent counterfeit medicines and ensure high-quality production can help domestic firms establish brands in international markets. International institutions can further support these efforts by implementing certification schemes that enhance product reliability.

6.3.8 Agroprocessing

Growing prosperity, urbanization and demographic growth are driving strong incentives for investment in Asia's agroprocessing industry. The region's favourable climatic conditions support specialization across a wide range of agricultural products, creating opportunities for downstream value addition. Palm oil, for example, where Indonesia and Malaysia are global leaders,[48] serves as a critical input not only for the food industry but also for personal care products, household goods and renewable energy through biodiesel. Additional opportunities exist in other subsectors: Viet Nam is emerging as a major player in the coffee value chain, while Pakistan's large milk production provides an opportunity to further develop the dairy industry.[49] At the same time, the region's heavy reliance on food imports highlights the potential to leverage domestic demand to strengthen local production and processing.

Asia benefits from an established agricultural base, the presence of SOEs, and emerging certification systems and infrastructure, collectively positioning the region as a potential future competitor in the agroprocessing industry. Certain niches already demonstrate excellence: Viet Nam's SOEs, which control over 40 per cent of the country's coffee production,[50] have leveraged revenues to fund public services and infrastructure, creating a virtuous cycle that supports diversification into downstream activities such as fertilizers, irrigation, roasting and instant coffee. Malaysia has positioned itself as a regional hub for bio-industrial innovation, building on strong capabilities in palm oil and related industries.

Nevertheless, the region continues to face challenges in capturing value added, reducing post-harvest losses and mitigating environmental impacts. A low level of processing results in significant waste, particularly for fruits and vegetables, and limits value realization in export markets. Key structural bottlenecks include inadequate cold chain infrastructure and logistics, difficulties in complying with stringent food safety standards, challenges in establishing domestic branding and the dominance of lead firms in GVCs. Concentrated ownership among these firms constrains technology transfer and innovation spillovers to domestic companies and smallholders. The prevalence of numerous smallholders further limits economies of scale, while incomplete certification coverage and opaque supply chains hamper access to international markets. Additionally, unsustainable agricultural practices threaten fragile ecosystems, fuelling social resistance and undermining consumer trust.

To unlock the industry's potential, Asian countries should leverage SOEs as instruments of industrial policy and prioritize rigorous food safety and sustainable certification schemes. Continued investment in cold chain infrastructure and greater alignment with international food safety standards will be crucial for strengthening competitiveness and restoring consumer confidence. Modernizing land traceability systems through digital mapping and satellite imaging can further increase transparency and prevent "greenwashing." To ensure inclusive growth, governments should also expand land titling programmes and support cooperative models that empower smallholders, enabling them to scale production, improve productivity and capture greater value within the industry.

ENDNOTES

[1] Weighted average excluding China.
[2] Projections presented in this chapter are based on the *current path* scenario of the IFs model. For a detailed explanation of this scenario, refer to Annex A.1.
[3] This section builds on the background notes of Boucetta (2025); Kumar and Sadana (2025); Lee (2025) produced for the IDR 2026.
[4] Gusarova et al. (2023).
[5] UN.ESCAP (2017).
[6] Gatti et al. (2024); Islam et al. (2022).
[7] Kamiya (2025).
[8] ADB (2024).
[9] Ibid.
[10] Kumar and Sadana (2025).
[11] Estrada et al. (2010).
[12] Djidonou and Foster-McGregor (2022).
[13] This section builds on the background notes of Boucetta et al. (2025), Kumar et al. (2025) and Lee et al. (2025) produced for the IDR 2026.
[14] IEA (2024e).
[15] Namkhaijantsan and Naranbaatar (2025).
[16] IEA (2024c).
[17] Government of India - Press Information Bureau (2025).
[18] IEA (2023b).
[19] The data reported in this box is taken from: Abdullah et al. (2025).
[20] ASEAN Centre for Energy (2025); (2024).
[21] Ibid.
[22] Dokso (2024).
[23] The data reported in this box is taken from: GEM (2025); Oman News Agency (2025); United Solar Polysilicon (FZC) SPC (2025).
[24] IEA (2025b).
[25] Trivedi et al. (2025).
[26] Kohpaiboon and Lee (2024).
[27] IEA (2025c).
[28] Note that the international classification standards for autonomous driving define six levels (L0-L5), from driver assistance (L0) to full automation (L5).
[29] See Altenburg et al. (2022).
[30] See Bartneck (2022).
[31] The data reported in this box is taken from: Government of China (2024); IEA (2025c); Wang and Witlox (2025).
[32] Kong et al. (2020).
[33] Huda et al. (2025).
[34] Kumar et al. (2025), background material to the IDR 2026.
[35] WTO (2023).
[36] UNIDO and WIFO (2025).
[37] The data reported in this box is taken from: CBSL (2024).
[38] Singh (2025).
[39] MIDA (2024).
[40] Phartiyal et al. (2025).
[41] The data reported in this box is taken from: Veeramani et al. (2025).
[42] ABI Research (2025).
[43] iSupport Worldwide (2025).
[44] Balasolla (2024).
[45] IBEF (2024).
[46] Ibid.
[47] UNIDO (2025g).
[48] OECD and FAO (2023).
[49] USDA (2024).
[50] Kamwilu et al. (2021).

CHAPTER 7 EASTERN EUROPE AND CENTRAL ASIA: CHALLENGES AND OPPORTUNITIES FOR FUTURE INDUSTRIALIZATION

Eastern Europe and Central Asia's manufacturing sector has experienced sustained industrial growth over the past 25 years. While continued progress in industrial development, competitiveness and environmental performance is expected across most country groups in the region, the pace and extent of growth will depend on how effectively persistent bottlenecks are addressed. Key challenges include insufficient policy coordination, over-reliance on external funding, inadequate infrastructure that limits innovation and industrial upgrading, and fragmented or underperforming national innovation systems. Demographic shifts further weaken the region's productive base, while many firms locked into lower-value activities face heightened risks from artificial intelligence (AI)-driven automation and evolving dynamics in global value chains. Furthermore, chronic underinvestment in research and development constrains domestic capability development, and limited access to green finance slows the energy transition.

Most countries in the region already possess substantial production capabilities, valuable natural resources and established economic ties, providing a solid foundation to harness the megatrends shaping future industrial development. This chapter highlights promising sectoral opportunities to transform this potential into reality. By prioritizing industries such as clean energy technologies, critical minerals processing, electric mobility, green construction, digital manufacturing and AI-driven industrial applications, as well as the industrial bioeconomy, the region can diversify production, enhance competitiveness, upgrade capabilities and strengthen its position in international markets.

Tatiana Molcean

"Investing in infrastructure, advancing digitalization and fostering innovation are powerful catalysts for sustainable economic growth and industrial development across Eastern Europe and Central Asia. Strengthening connectivity and technological capacity enables countries to expand industrial output, diversify their economies and enhance resilience to global shifts. At the same time, addressing structural challenges, such as demographic change and the transition to sustainable energy, will be crucial to unlocking the subregion's full economic potential. Regionally coordinated efforts can support leveraging these drivers to attract investment, enhance competitiveness and accelerate sustainable development, thereby laying the foundation for long-term prosperity and deeper integration into regional and global value chains."

United Nations Under-Secretary-General and Executive Secretary of the UN Economic Commission for Europe (UNECE)

7.1 RECENT AND FUTURE INDUSTRIAL DYNAMICS

As a region, Eastern Europe and Central Asia has demonstrated consistent relative growth in manufacturing over the last 25 years. During this period, manufacturing value added (MVA) per capita in the region increased at an average annual rate of 3.7 per cent, outperforming the developing country average (1.9 per cent over the same period).[1] The region, however, comprises diverse groups of countries, each with distinct characteristics in terms of recent dynamics, challenges and future prospects. To account for these subregional differences, this section clusters countries according to their level of development and geographical location within the region (see Table 7.1).

Rapid industrialization has been observed across all income groups in the region. Strong and sustained MVA per capita growth during the first quarter of the century was evident in all income segments, from lower middle-income economies of Central Asia to high-income industrial powerhouses in Central Eastern Europe (Figure 7.1). This pattern contrasts with that of other regions, where higher-income economies typically grow at slower rates than lower-income ones. Among upper middle-income economies in the region, Central Asia and the South Caucasus have demonstrated the greatest dynamism, whereas North-Eastern Europe has been the leading performer among high-income countries.

High-income industrial economies dominate the region's industrial landscape but are projected to lose some ground by 2050. Currently, the region's MVA is primarily concentrated in the most advanced countries, with the high-income industrial economies of Central and South-Eastern Europe accounting for over 80 per cent (Figure 7.2). Projections under the *current path* scenario indicate that this share will decline by 2050, creating new opportunities for the region's developing economies.[2] The strongest gains are expected among the upper middle-income economies of Central Asia and the South Caucasus. In resource-rich economies such as Kazakhstan and Turkmenistan, abundant natural endowments are expected to spur growth in manufacturing and processing industries, supported by rising global demand for both traditional and critical resources.

Developing countries in the region are projected to move closer to their expected representation in global manufacturing relative to their size. The industrial intensity index, measured as the ratio between a country's share of global MVA and its share of global population, is expected to rise across most country groups in the region (Figure 7.3, Panel A). Among upper middle-income economies, those in Central Asia and the South Caucasus are projected to achieve the greatest gains and expected to surpass parity by 2050. Despite this progress, significant gaps remain, especially among Central Asia's lower middle-income and Central Eastern Europe's upper middle-income economies.

Across the region, countries will move closer to the technological frontier, although significant gaps will persist. Catch-up dynamics in manufacturing productivity are expected to remain positive overall, though the pace of progress will vary across regions (Figure 7.3, Panel B). Central Asia's lower middle-income economies are on track to narrow their productivity gaps to levels approaching those of more advanced economies in the region. Even greater gains are anticipated for upper middle-income economies in Central Asia and the South Caucasus, where relative productivity is projected to jump from 40 per cent to 70 per cent by 2050.

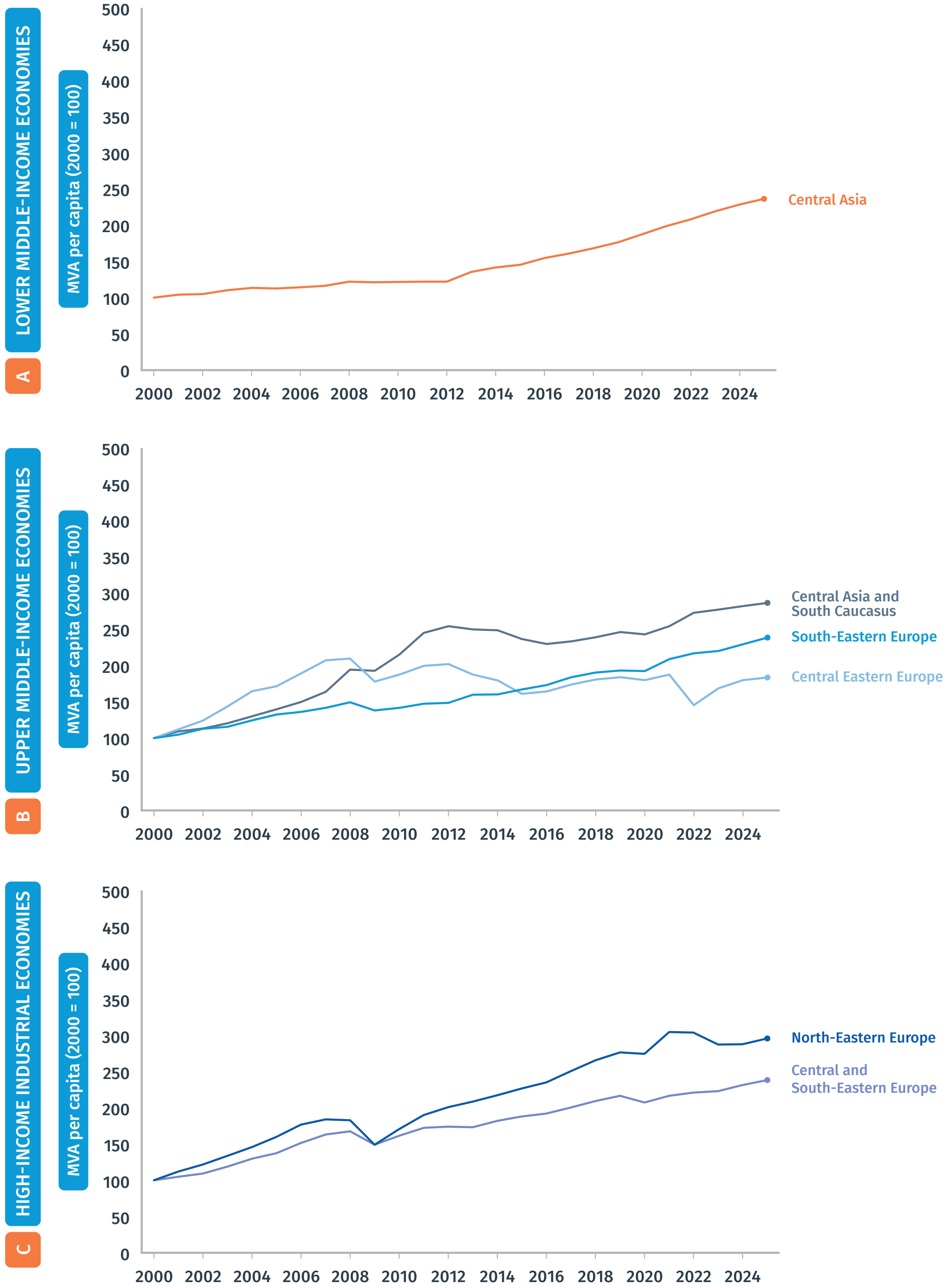
Table 7.1 **Eastern Europe and Central Asia: List of economies by geographical area and stage of industrial development**

Lower middle-income economies (LMIEs)			
Central Asia	Kyrgyzstan	Tajikistan	Uzbekistan
Upper middle-income (UMIEs)			
Central Asia[a]	Azerbaijan	Ukraine	North Macedonia
Kazakhstan	Georgia	**South-Eastern Europe**	Serbia
Turkmenistan	**Central Eastern Europe**	Albania	
South Caucasus	Belarus	Bosnia and Herzegovina	
Armenia	Republic of Moldova	Montenegro	
High-income industrial economies (HIIEs)			
Central Eastern Europe	Poland	**South-Eastern Europe[b]**	Estonia
Bulgaria	Romania	Croatia	Latvia
Czechia	Russian Federation	Slovenia	Lithuania
Hungary	Slovakia	**North-Eastern Europe**	

Note: In the analysis of this chapter, country groups with a small sample size (fewer than three economies) or small population share (less than 2 per cent of the regional population) are merged with neighbouring groups at a similar stage of industrial development to limit outlier effects from low representation and/or inconsistencies in country-level data. a) Presented together with the South Caucasus due to small sample size; b) Presented together with Central Eastern Europe due to small sample size and population share.

Source: UNIDO elaboration based on UNIDO country classification (see Annex A.3).

Figure 7.1 **Eastern Europe: Industrial dynamics in the first quarter of the 21st century**



Note: Regional averages calculated using population weights. Values indexed to 2000 (2000 = 100). See Table 7.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, some country groups were merged.

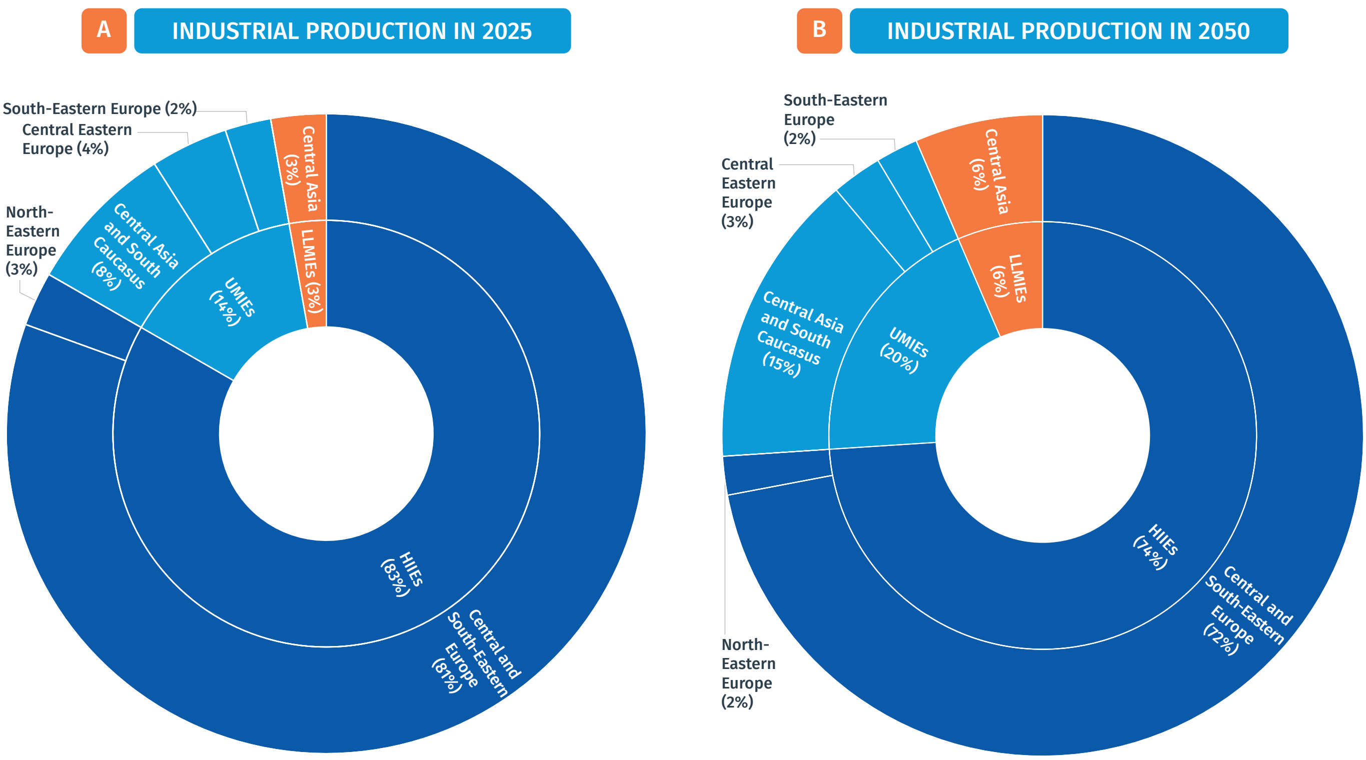
Source: UNIDO elaboration based on UNIDO (2025f).

This dynamism is partly driven by the group's tremendous potential in processing natural resources and energy products, amid a global environment characterized by rising energy demand (see Chapter 2). In these industries, the region is leveraging its state-owned enterprises (SOEs) to move up global value chains (GVCs) beyond commodity exports while meeting domestic demand.[3] Growing household consumption—supported by remittances and higher wages—together with fiscal expansion tied to energy transition and infrastructure investments, is expected to create a stable anchor market for continued growth and industrialization in coming years.[4] Important catch-up is also expected among upper middle-income economies in South-Eastern Europe, which are projected to reduce their productivity gap by more than 10 percentage points over the next 25 years.

Some progress in industrial environmental efficiency is also expected across the region, although the pace remains insufficient to meet the urgency of the climate emergency. Environmental efficiency gains. are expected to vary across subregions (Figure 7.3, Panel C). While this trend applies to most subregions and income groups, improvements will be most pronounced among the upper middle-income economies of South-Eastern Europe, which are expected to surpass the relative environmental efficiency of some of the region's high-income industrial economies. Countries in North-Eastern Europe are projected to be among the strongest performers, with projected efficiency levels by 2050 nearly four times higher than those of other high-income economies worldwide.

Realizing the region's positive industrial outlook for 2050 will hinge on effectively addressing bottlenecks, particularly in lower-performing subregions. Overall, the region exhibits relatively strong baseline values and notable improvements across indicators of industrial performance. Unlike in other parts of the world, high-income industrial economies in the region showed sustained growth between 2000 and 2025, accounting for the majority of the region's MVA by 2025. Under the *current path* scenario, their dominance is expected to recede slightly, while gaps in industrialization, productivity and emissions performance are projected to narrow across subregions. To build on these favourable trends and unlock the region's full industrial potential, countries will need to address a series of bottlenecks to support an industrial trajectory capable of achieving sustainable prosperity.

Figure 7.2 **Eastern Europe and Central Asia: Current and projected distribution of industrial production in the region**



Note: LMIEs = Lower middle-income economies; UMIEs = Upper middle-income economies; HIIEs = High-income industrial economies. See Table 7.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, some country groups were merged.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

Figure 7.3 **Eastern Europe and Central Asia: Industrialization gaps by subregions, current values and projections for 2050**

Note: Bars show projections for 2050 and vertical lines denote 2025 values. Regional averages are weighted by countries' share of manufacturing value added (MVA) in each subregion. The indicators reported in each panel are defined as follows: a) Industrial intensity index = percentage ratio of each subregion's share of global MVA to its share of the world population. A value of 100 indicates equal share. Values below 100 reflect industrial underrepresentation. b) Industrial relative productivity index = manufacturing labour productivity (MVA per worker in constant 2017 US dollars) of each subregion relative to high-income industrial economies' average manufacturing labour productivity. A value of 100 indicates that the region stands at the frontier in terms of industrial labour productivity. c) Industrial environmental efficiency index (MVA) per unit of CO_2 emissions in constant 2017 US dollars relative to the average value of high-income industrial economies. A value of 100 indicates that the region stands at the frontier in terms of industrial environmental efficiency. See Table 7.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, some country groups were merged.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

7.2 MAIN BOTTLENECKS CONSTRAINING FUTURE INDUSTRIALIZATION

Seven areas of action to prepare Eastern Europe and Central Asia's industrial sector for the future.[5] Leveraging the region's existing industrial base to advance future industrialization will require overcoming bottlenecks across a range of enablers, the foundational building blocks that translate industrial ambitions into tangible outcomes. The analysis presented in this report identifies a set of indicators to assess Eastern Europe and Central Asia's performance in these enablers, benchmarked against the world's top performing economies. These indicators are grouped into seven dimensions, namely: (i) institutions; (ii) infrastructure; (iii) labour force; (iv) technology; (v) trade and integration; (vi) production greening, and (vii) finance. For each dimension, two indicators were selected based on their analytical relevance and the availability of cross-country data over the past decade (see Figure 7.4). A particularly critical challenge for the region relates to its current trade model, which has been showing signs of exhaustion.

7.2.1 Institutions

Weak coordination across key policy domains, such as skills development, infrastructure, finance, innovation and energy, often results in missed synergies and inefficient resource allocation. Public interventions are frequently reactive, fragmented or shaped by external compliance pressures rather than coherent national development strategies. Policy implementation often relies on simpler instruments, such as import and export restrictions and quotas, rather than more sophisticated tools such as trade financing mechanisms and incentives to localize value addition.[6] A lack of transparency and weak governance standards continue to undermine effective policy implementation, eroding accountability and negatively impacting the overall investment climate.[7]

Past institutional integration with the European Union (EU), while beneficial and, in some cases, essential, may represent barriers to industrial deepening. Overreliance on EU or multilateral funding has, at times, contributed to institutional inertia and dependence on policy models not fully aligned with local capabilities or industrial structures. In certain cases, the absence of competitive pressure and substantial external assistance may have inadvertently slowed domestic transformation.[8] At the same time, current policy debates and recent EU legislation, particularly in areas related to strategic autonomy, industrial policy and climate regulation, introduce additional compliance requirements alongside new funding streams, which may significantly impact countries in Central Eastern Europe, South-Eastern Europe and North-Eastern Europe.[9]

7.2.2 Infrastructure

Eastern Europe and Central Asia continue to face persistent infrastructure bottlenecks that constrain innovation and industrial upgrading, particularly in transport, energy and digital systems. Chronic underinvestment in high-tech infrastructure remains a structural challenge across the region, especially in South-Eastern Europe and the South Caucasus.[10] While interest in automation and digital tools is growing, scaling these innovations will remain limited without targeted investments in digital infrastructure, supported by workforce development and coherent policy frameworks. Renewable energy infrastructure, which is essential for decarbonization and resilience, also remains underdeveloped, particularly in Central Asia, where abundant fossil fuel resources continue to slow the energy transition.[11]

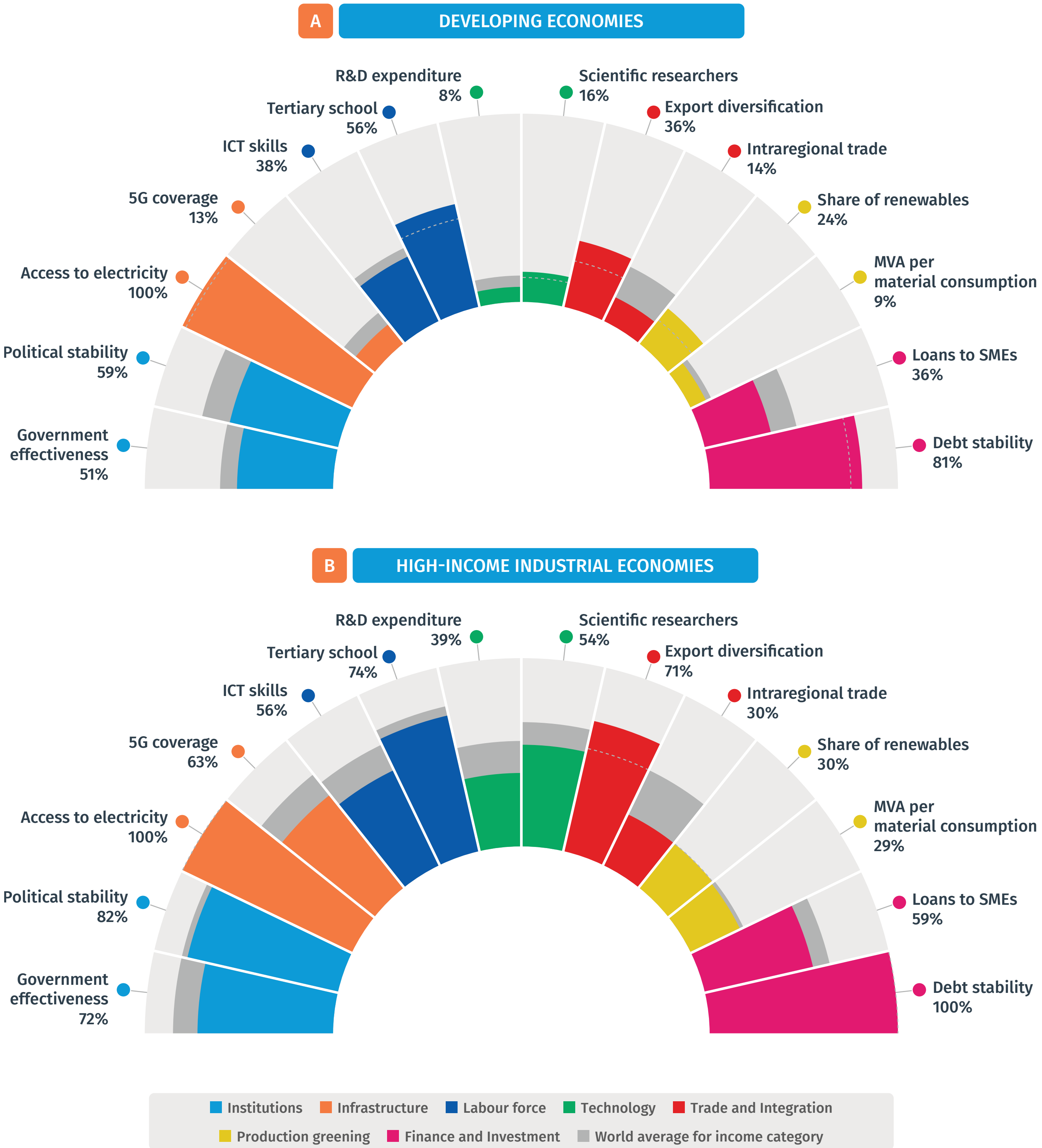
7.2.3 Labour force

Technological advances and demographic transitions are exerting increasing pressure on the region's skill base. Shrinking populations, ageing workforces and continued emigration are eroding the region's productive capacity. Skills mismatches and ageing labour forces in Central Eastern Europe, combined with emigration and the underutilization of youth in South-Eastern Europe, the South Caucasus and Central Asia have created substantial capability gaps. While labour markets are increasingly being shaped by the digital transition, education and training systems remain entrenched in outdated industrial models. Lifelong learning systems are underdeveloped, and technical, vocational education and training (TVET) systems are often too rigid or underfunded to keep pace with evolving industrial trends, limiting equitable access to reskilling and upskilling opportunities. This mismatch reflects both chronic underinvestment and poor cross-ministerial coordination.

7.2.4 Technologies

The fragmentation of national innovation systems remains a challenge to industrial transformation in the region.[12] Chronic underinvestment in high-tech infrastructure and domestic innovation systems, combined with rapid technological advances in automation, robotics and AI, has exposed profound gaps across three critical areas: (i) productive capabilities, (ii) innovation ecosystems, and (iii) institutional readiness.[13]

Figure 7.4 **Industrialization enablers: Eastern Europe and Central Asia compared to the world frontier and other regions**



Note: Indicators are reported as the ratio of regional values to those of the world's best-performing country, defined as the country at the 95th percentile of the global distribution. A value of 100 indicates that the region, on average, is at the frontier for the respective enabler. Values are calculated as simple averages across all countries in the region with available data for each indicator. Country-level data correspond to the average value over the last three years for which data are available (typically, 2021–2023). See Annex A.2 for a detailed description of indicators and data methodology, and Table 7.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, no subregional distinction is made, and all middle-income economies are clustered into a single category.

Source: UNIDO elaboration based on data from UNSD (2025a), World Bank (2025a, b and c), Gaulier and Zignago (2010), UNCTAD (2025a) and UNEP IRP (2025).

Although some progress has been made, especially among EU Member States, systemic weaknesses persist in finance and investment, institutional capacity, workforce skills, technology infrastructure and coordination. Low levels of technology absorption among firms further undermine innovation ecosystems and constrain competitiveness across the region, a challenge that is particularly pronounced in Central Asia.[14] Across all subregions, innovation continues to heavily rely on learning-by-doing and informal networks rather than structured, science-based innovation systems.[15] Compounding these issues, national innovation strategies have often prioritized production expansion and technology imports over the development of endogenous capabilities that support strategic autonomy and resilience.

7.2.5 Trade and integration

The regional trade model is showing signs of exhaustion. In Eastern Europe, integration into GVCs has been a cornerstone of industrial growth since the 1990s, particularly in industries such as automotive, machinery and electronics. Anchored in geographic proximity to key EU markets, low labour costs and foreign direct investment (FDI), this model enabled rapid export expansion and the modernization of production systems. However, its capacity to deliver sustained productivity gains is now diminishing due to limited progress along GVCs.[16] Economies in the region remain concentrated in lower value-added segments, such as assembly, with weak horizontal and vertical linkages between firms. Expanding into higher value-added functions such as R&D, branding and systems integration, remains an urgent priority.[17]

Shifting global dynamics, including technological disruption, automation, geopolitical fragmentation and supply chain reconfiguration, pose challenges to the region's position in GVCs. While proximity to EU markets and accumulated industrial experience remain important assets, dependence on narrowly defined, low value-added roles, particularly in industries vulnerable to automation or environmental regulation, limits adaptability. Restructuring of GVCs, such as trends towards reshoring or friendshoring, threatens existing positions, while exposure to global demand volatility in small, undiversified economies adds further vulnerability. Eastern European and Central Asian economies stand at the crossroads of global economic decoupling, facing both opportunities to capture shifting demand and risks related to sanctions or reliance on a limited number of trade partners.[18]

7.2.6 Greening of production

Limited access and availability of green finance constrains the region's energy transition, while rising capital requirements for clean technology and digital investments place additional strain on existing financial systems. The industrial future of Eastern Europe and Central Asia hinges on reconciling growth with environmental sustainability. Yet the region's energy- and resource-intensive production models create structural disadvantages. EU Member States can leverage instruments such as the Cohesion Funds, RePowerEU and other instruments, but only if credible project pipelines, competent implementation bodies and co-financing capacity are in place. For non-EU countries, the challenge is even greater: fiscal space is limited, domestic capital markets are shallow and external financing is often conditional. Mobilizing domestic resources and developing blended finance mechanisms will therefore be essential.

To capitalize on the green transition, especially within agri-food systems, Eastern Europe and Central Asia must prioritize modern and flexible energy and transport infrastructure, affordable access to renewables and a predictable regulatory environment. The EU's growing demand for clean technologies presents opportunities for the region to supply intermediate goods and components.[19] At the same time, climate change and shifting global food markets are reshaping agri-food systems, requiring strategic upgrades to both physical and digital infrastructure. However, underdeveloped agri-food value chains, particularly in post-harvest segments such as processing, logistics, packaging and branding, risk locking the region into low-margin, climate-vulnerable export models. To reposition itself and leverage its natural endowments, the region must invest in physical, digital and green infrastructure, including irrigation systems, rural logistics, cold chains, rural broadband, data platforms and renewable energy.[20]

7.2.7 Finance and investment

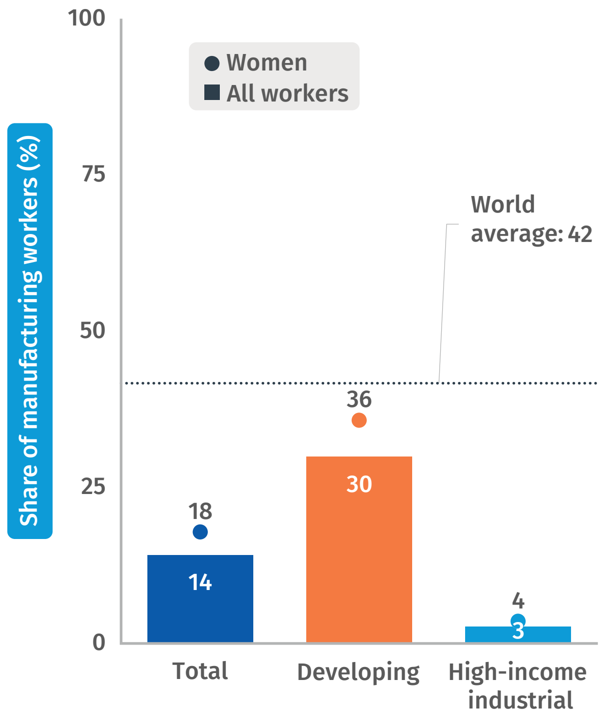
Chronic underinvestment in R&D continues to constrain the development of domestic capabilities across the region. Small and medium-sized enterprises (SMEs) struggle to access innovation finance, while mechanisms for technology transfer and commercialization are often weak or absent.[21] Collaboration between public research institutions and industry remains weak, and the persistent disconnect between academic research and business challenges undermines the potential for innovation-driven growth.[22] Funding for research remains unevenly allocated across and within subregions. Public research funding is particularly low in South-Eastern Europe and the South Caucasus, and innovation policies are often externally driven or inconsistently applied.[23] They tend to be donor-dependent and characterized by inefficient institutions, exacerbating fragmentation and uneven implementation. Even in Central Eastern Europe, where EU accession has increased funding and improved infrastructure, domestic firms' innovation performance remains modest, limiting spillovers to the broader domestic economy.[24] Access to finance remains a significant bottleneck in Central Asia, where remittance inflows continue to serve as a primary source of funding.[25]

7.2.8 Cross-cutting issues

Informality in manufacturing tends to be lower in Eastern Europe and Central Asia than in other global regions. The region's higher-income industrial economies report low informality rates. Even the region's developing economies, where about 30 per cent of manufacturing workers are informally employed, informality rates remain well below the global average for developing countries (Figure 7.5).

While informality levels in Eastern Europe and Central Asia are lower than in many other regions, they are disproportionately higher for women than for men. In the region's developing economies, the share of informal employment among women is over 6 percentage points higher than for the total workforce. Given that informal employment is associated with lower wages and poorer working conditions, addressing these gender disparities in informal employment is a priority for promoting inclusive manufacturing growth across the region.

Figure 7.5 **Informality and gender gaps in Eastern Europe and Central Asia's manufacturing sector**



Note: Values represent the share of informal workers in total manufacturing workers by country group and gender. They are calculated as a simple average for all countries in the region with available data and refer to the last three years for which data are available (typically, 2021–2023). See Table 7.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, no subregional distinction is made.

Source: UNIDO elaboration based on ILO (2025).

7.3 SECTORAL OPPORTUNITIES TO SPUR FUTURE INDUSTRIALIZATION

As in all other global regions, the future of industrial development in Eastern Europe and Central Asia will be shaped by the megatrends discussed in Part A.[26] From the green transition and digitalization to demographic shifts and the transformation of food production systems, these forces are redefining demand patterns, regulatory environments and the geography of GVCs. For countries in the region, they present both challenges and opportunities to diversify production, upgrade capabilities and strengthen their positions in international markets.

The megatrends translate into concrete drivers of change that can open new pathways to industrialization. Countries in the region are not passive bystanders of global shifts: they already possess production capabilities, natural endowments and integration links that can be leveraged to initiate or sustain structural transformation. The case studies presented in this section illustrate how firms and governments can act now to secure a stronger foothold in emerging industries (Table 7.2). Success will depend less on frontier innovation and more on the ability to excel in applied engineering, modular manufacturing and system-level deployment – areas where the region can cultivate competitive advantages and accelerate industrial upgrading.

7.3.1 Critical minerals processing

The global shift towards clean energy and digitalization is driving a surge in demand for critical minerals such as lithium, cobalt, nickel, graphite and rare earth elements.[27] Their scarcity and strategic importance have prompted global actors to diversify supply sources, opening opportunities for local downstream processing. Nascent initiatives are emerging in Central Asia, where countries have initiated bilateral dialogues with advanced partners to attract FDI in the industry — for example, through the C5+1 Critical Minerals Dialogue with the United States and strategic mineral partnerships with the EU.[28] Megatrends are also creating new opportunities for Eastern European countries to integrate into minerals-related GVCs. Countries such as Ukraine, which has substantial reserves of lithium, titanium and graphite, can leverage their mineral endowments, while those without significant deposits can still create value through processing. Poland, for instance, has built on its metallurgical heritage to develop niche capabilities in copper processing, tailings recovery and urban mining. Early-stage recycling and secondary metallurgy initiatives, though still nascent, also show promising potential.[29]

Further processing of critical minerals in the region requires addressing coordination failures across industrial ecosystems and institutions. While several countries possess reserves, resource-led industrialization faces significant barriers in the absence of robust governance frameworks, community engagement and environmental safeguards. In South-Eastern Europe, for instance, projects are often deterred by underdeveloped regulatory systems, political volatility and limited stakeholder engagement. In the South Caucasus, mining remains small in scale, poorly integrated into value chains, and disconnected from downstream processing functions.

Similar barriers constrain the development of downstream capabilities. While some initiatives are emerging across the region, such as Poland's early-stage battery recycling and Slovakia's pilot e-waste recovery projects, these efforts remain fragmented, project-based and often lack commercial viability. A more significant limitation lies in weak regulatory capacity. Across much of the region, mining legislation is outdated, licensing procedures are opaque, and enforcement of environmental standards is inconsistent.[30] These challenges are further compounded by the absence of strong mechanisms for meaningful community engagement.

Moving forward, national critical minerals strategies should be aligned with both national and regional contexts, with investments targeting downstream infrastructure and recycling. In resource-rich countries, priority should be given to developing infrastructure for mineral extraction and processing within the framework of a broader industrial strategy. Establishing open-access geological data systems, harmonizing technical and environmental, social and governance (ESG) standards, and aligning with the EU Critical Raw Materials Act can help reduce market uncertainty and attract responsible investment. Ultimately, the region's success in the critical minerals economy will depend less on geological endowments and more on institutional quality, strategic coherence, and the ability to integrate resource strategies with downstream industrial ecosystems.

7.3.2 Renewable energy equipment and electric mobility

The region is well positioned to tap into the growing global demand for green technologies, with distinct industrial capabilities present across all subregions. Central and North-Eastern Europe have developed niches critical to the green transition, including smart grids, power electronics and applied engineering. For instance, Czechia and Slovakia are advancing initiatives in smart grid modernization, power electronics and low-emission hydrogen, which are attracting increased inflows of FDI.[31] In addition, advanced digital infrastructure in parts of the region, most notably in North-Eastern European countries, provides a foundation for energy system digitalization and serves as a strategic entry point into cleantech value chains.[32]

Central Eastern Europe is also emerging as a leader in battery manufacturing and related activities, a promising opportunity for growth as global demand for electric vehicles (EVs) continues to accelerate. The region hosts large-scale original equipment manufacturer (OEM) plants and supplier networks, with Poland serving as the regional frontrunner (see Box 7.1).[33] This provides a strong foundation to expand into next-generation semiconductors, EV component production and recycling.[34] Adjacent niches, such as battery casings, thermal management systems and battery management software present additional opportunities for countries with established initial capabilities, such as, for example, Romania and Slovakia.

Table 7.2 **Eastern Europe and Central Asia: Megatrends, drivers and sectoral opportunities for future industrialization**

Main megatrends	Sectoral opportunities	Drivers	Case studies
Energy and the green transition	• Critical minerals processing	• Demand for inputs for EVs, renewable energy equipment and expansion of the grid (e.g. processed lithium, copper, nickel) • EU legislation incentivizing local minerals processing • Demand for inputs for semiconductors and advanced electronics (e.g. processed graphite, titanium, etc.)	
	• Renewable energy equipment and electric mobility	• Global and regional demand for clean technology products, equipment and components, including EVs • Existing production capabilities in battery manufacturing and related activities, as well as in automotive • Deep integration in EU automotive supply chains	**Poland**: Fostering clean energy industrialization through battery valleys
	• Green construction and low-carbon building materials	• EU regulations are influencing demand patterns, incentivizing demand for sustainable construction	**Slovenia**: Upgrading in the wood-based construction industry
The rise of AI and the digitalization of production	• Digital manufacturing and AI-driven industrial applications	• Emerging demand niches in business-to-business (B2B) markets • Push from lead firms to digitalize operations	**Croatia**: Emerging ecosystem for digital manufacturing
Population growth and the changing nature of work	• Petrochemicals and pharmaceuticals	• Ageing populations and growing demand for medical products • Existing pharmaceutical clusters	
The transformation of food production systems	• Agroprocessing and bio-economy	• Growing demand for (sustainable) agroprocessed products • Natural endowments (biodiversity, agricultural tradition)	**Georgia**: Emergence of a high-value agroprocessing industry

Source: UNIDO elaboration.

There is also potential for clean energy technologies in South-Eastern Europe, the South Caucasus and Central Asia, although progress remains at an early stage. Countries in the Western Balkans have opportunities in hydro, solar and wind energy and could participate in downstream manufacturing segments.[35] Looking ahead, realistic prospects for this subregion include scaling the production of grid infrastructure components, localized assembly of control systems and retrofitting supply chains for public buildings. In Central Asia, strong governmental commitments to the energy transition,[36] coupled with regional cooperation to develop a green energy corridor linking the region to European markets,[37] are generating domestic demand that can anchor emerging industries. Central Asian countries can also leverage their critical minerals endowments to pursue beneficiation strategies.[38]

Despite recent progress, countries across the region continue to face significant structural constraints. Some of these bottlenecks stem from coordination failures. Even when positive initiatives exist, industrial spillovers remain modest, as pilot projects are often disconnected from broader market deployment. In addition, progress in reforming permitting procedures and upgrading skills has also been slow. Other bottlenecks are rooted in legacy capabilities and infrastructure. In the e-mobility industry, in particular, a key vulnerability is suppliers' limited ability to pivot towards EV technologies.[39] This is compounded by insufficient capacity for high-value components production, underdeveloped R&D and gaps in digital infrastructure. Without early adaptation, factory closures and job losses could disproportionately affect regions heavily reliant on automotive manufacturing. At the same time, persistent shortages in key EV components indicate that alternative industrialization pathways remain feasible for latecomers.[40]

Box 7.1 **Poland: Fostering clean energy industrialization through battery valleys**

Poland is rapidly emerging as a global leader in clean energy industrialization, ranking as the world's second-largest producer of lithium-ion batteries globally, surpassed only by China. In 2023, exports of lithium-ion batteries and related components were approximately EUR 12 billion. The country has attracted multiple gigafactories and suppliers spanning the entire value chain, including the world's largest lithium-ion battery factory, with a planned capacity of 90 gigawatt per hour (GWh) by 2025. Poland's ecosystem also includes active upstream, midstream and downstream firms, including Europe's largest recyclers. The development of this ecosystem has created thousands of jobs across engineering, logistics, maintenance and R&D.

Poland's success builds on a strong industrial heritage, a strategic location near major European supply networks, and access to a skilled engineering and scientific workforce. Effective public-private coordination has further accelerated investment through special economic zones (SEZs), targeted tax incentives and EU co-financing instruments. Well-developed infrastructure, including the Port of Gdansk, intermodal transport hubs and proximity to German automotive value chains, enhances the country's integration into European supply networks. The rapid expansion of the European EV market, coupled with EU regulatory pressure to increase local content, has fuelled demand for batteries, creating both export opportunities and regional demand from major car manufacturers.

Poland's policy mix promotes a place-based approach to industrial development, exemplified by the battery

valleys, which are built on multi-actor partnerships between universities, municipalities, development agencies and anchor firms to foster resilient industrial ecosystems. The strategy is closely aligned with EU demand patterns and decarbonization objectives, as outlined in the Energy Policy of Poland until 2040 (PEP2040). Additional support for the battery industry is provided by EU frameworks, notably the Important Projects of Common European Interest (IPCEI) on batteries and complementary schemes (including investment incentives and storage-related assistance). Critically, the battery valleys are supported by large-scale, long-term financing that integrate FDI, EU funds, national co-financing and municipal infrastructure investment.

Despite significant progress in downstream assembly and recycling capacity, several challenges threaten the industry's long-term sustainability. A major vulnerability lies in its dependence on imported critical raw materials, as domestic upstream capacity and access to resources remain limited, exposing the industry to geopolitical risks and supply chain disruptions. Furthermore, intellectual property creation continues to be concentrated in foreign firms.

Source: UNIDO elaboration based on a background report produced by Stojčić et al. (2025).[41]

Strengthening the clean energy industry in Eastern Europe and Central Asia will require coordinated public-private R&D partnerships, the promotion of local demand, and targeted investment in system-integration skills. Institutional reforms in regulation, certification and inter-ministerial coordination are essential to unlock financing from the EU and international financial institutions (IFI) and to fast-track technology deployment. Developing joint technology roadmaps with OEMs and R&D institutions can identify realistic avenues for specialization, while strategic use of public procurement can further boost domestic demand. Effective reskilling will require hands-on training, modular curricula and competency-based certification schemes, particularly for emerging jobs in the e-mobility industry.

7.3.3 Green construction and low-carbon building materials

The shift towards sustainable construction presents both a climate imperative and an opportunity for industrial upgrading in the region. The construction industry accounts for over one-third of global energy-related carbon emissions.[42] In Eastern Europe and Central Asia, an ageing building stock, combined with infrastructure investment, can create new demand for low-carbon construction and renovation solutions. For instance, major infrastructure initiatives in Kazakhstan have driven strong growth in the construction industry, which expanded by 18.4 per cent year-on-year in the first half of 2025, driving demand for innovative materials.[43] New EU regulatory frameworks, including the European Green Deal, the Energy Performance of Buildings Directive, the Renovation Wave and Green Public Procurement rules, further reinforce incentives for innovation and industrial upgrading.

Eastern European countries are already emerging as leaders in specific niches. Poland, Czechia and Slovenia are investing in prefabrication and advancing the decarbonization of traditional materials industries.[44] Slovenia, in particular, has positioned itself as a regional frontrunner in engineered wood and cross-laminated timber (CLT), offering scalable alternatives to conventional high-carbon inputs (see Box 7.2).[45] Estonia offers another example, integrating Building Information Modelling (BIM), e-permitting systems and modular timber construction, demonstrating a digitally enabled and climate-conscious approach to urban development. Additional opportunities exist for latecomer regions, such as Central Asia, particularly in recycling scrap materials as inputs for the construction industry.[46]

Progress remains uneven, with persistent gaps in skills, materials and institutional capacity constraining the industry's ability to scale. These challenges differ across subregions. In North-Eastern European countries, shortages of certified installers, energy auditors and engineers continue to slow the deployment of low-carbon technologies. In South-Eastern Europe and the South Caucasus, dependence on imported materials continues to hamper progress. Meanwhile, limited institutional capacity presents a major bottleneck, as under-resourced local administrations struggle to enforce standards and to align evolving procurement practices with sustainability goals.

Scaling up green construction requires coordinated action across procurement, skills development and domestic industrial capabilities. On the demand side, public procurement should shift from cost-based to performance-based criteria, supported by standardized templates, auditing and capacity development initiatives. On the supply side, targeted investments are needed to strengthen skills along the sustainable construction value chain. Expanding domestic production of low-carbon materials and prefabricated systems can further reduce import dependence. Complementing these measures, national certification schemes aligned with international standards can build market trust and open opportunities for exports.

7.3.4 Digital manufacturing and AI-driven industrial applications

While the adoption of advanced digital production technologies in Eastern Europe and Central Asia remains concentrated in a few industries, it is increasingly recognized as a driver of productivity, competitiveness and future industrialization. In Central Eastern Europe, digital upgrading has been most pronounced in the automotive and electronics industries. Firms in Poland, Czechia, Slovakia and Hungary have leveraged their linkages to multinational enterprises (MNEs) within EU supply chains to accelerate digitalization. Outside these supply chains, adoption remains highly uneven, with domestic SMEs facing limited access to finance, infrastructure and skilled labour.[47]

The scaling up of digital manufacturing can be supported by emerging innovation hubs and strong digital governance frameworks. Economies in North-Eastern Europe are leveraging their capabilities in digital public infrastructure, e-governance and cybersecurity to pilot AI applications in manufacturing.[48] Yet, diffusion beyond urban centres remains limited, with only 4 per cent of firms in the region reportedly integrating AI as of 2024.[49] The digitalization landscape is even more challenging in South-Eastern Europe and the South Caucasus, where industrial systems remain fragmented and dominated by micro, small- and medium-sized enterprises (MSMEs) with low digital adoption rates.[50] Even against this backdrop, Croatia is emerging as a regional hub for digital manufacturing (see Box 7.3).

Common bottlenecks across Eastern Europe and Central Asia include underdeveloped broadband infrastructure, skills shortages and uneven digital adoption, especially among SMEs.[51] These challenges are especially pronounced in South-Eastern Europe and the South Caucasus, where innovation ecosystems and intermediary support structures are weaker. Across the region, heavy reliance on FDI to drive production and innovation poses risks to the development of domestic industrial and technological capabilities.[52] Finally, regional disparities persist, with peripheral areas continuing to lag behind urban centres in digitalization.

Targeted public support is essential to accelerate digital adoption in manufacturing across the region. Public policy instruments such as digital transformation grants, innovation vouchers and infrastructure co-financing can help lower adoption barriers for SMEs.[53] European Digital Innovation Hubs offer a valuable platform for training and piloting new technologies, which could have significant impact if effectively integrated into local industrial ecosystems, especially in South-Eastern Europe and the South Caucasus. Workforce development, including vocational retraining and micro-credential programmes in AI and robotics, is critical to addressing demographic pressures and out-migration.[54]

7.3.5 Petrochemicals and pharmaceuticals

The global megatrends outlined in Part A of this report present opportunities for diversification within both the petrochemical and pharmaceutical industries. In the South Caucasus, Azerbaijan has begun

Box 7.2 **Slovenia: Upgrading in the wood-based construction industry**

With nearly 60 per cent forest cover and a centuries-long tradition of sustainable forest management, Slovenia is strategically repositioning its wood-based construction industry. Building on its legacy in sawn timber and biomass production, the industry has increasingly pivoted towards engineered wood products such as cross-laminated timber, glulam, prefabricated housing units, smart furniture and advanced bio-based materials such as nanocellulose applications. This transformation integrates ecological sustainability with digitalization and design excellence, drawing on Slovenia's strong design heritage and innovation-driven industrial base. The industry's modernization has already yielded tangible benefits, from sustained employment, rural development to carbon emissions reduction.

Slovenia's competitive advantage lies in the synergy between its natural endowments, industrial legacy and public-private partnerships (PPPs). At the centre of the industry's transformation stands the Wood Industry Cluster (*Lesarski grozd*), a multi-stakeholder platform established in 1999 that brings together SMEs, R&D institutions and policymakers. Such a cluster-based governance model facilitates resource pooling, knowledge transfer, coordinated innovation and internationalization. Research and design institutes provide cutting-edge expertise in engineered wood, nanocellulose and timber design. The cluster model has helped create jobs in less urbanized areas, contributing to sustained employment in rural communities.

Regulatory frameworks have created a strong momentum for the industry. Slovenia's government has promoted the forest-wood value chain as a key pillar

of its circular economy strategy. The increased use of timber in construction aligns both with national and EU-level goals on climate neutrality by substituting carbon-intensive materials such as concrete and steel, and encouraging the use of locally sourced wood. This policy orientation is reinforced by concrete measures: public procurement rules now require that at least 30 per cent of materials used in new public buildings are wood or wood-based products. In addition, green public procurement (GPP) criteria further stimulate low-carbon construction by mandating environmental performance standards for building materials, including wood, in public tenders.

Challenges persist, particularly due to the prevalence of SMEs, which constrains the industry's capacity to scale operations, internationalize and independently undertake advanced R&D. Persistent skills shortages further limit growth, as the industry struggles to attract workers with the digital and design competencies increasingly critical for its technological advancement. Yet, Slovenia's experience demonstrates that coordinated institutional support, especially through cluster mechanisms that enable small firms to pool resources and access training, can successfully transform a traditional resource-based industry into a competitive green industry.

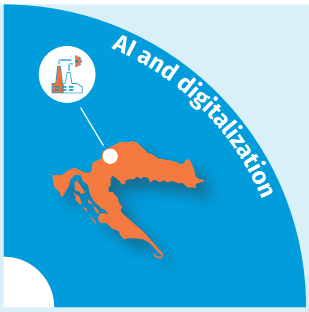
Source: UNIDO elaboration based on a background report produced by Stojčić et al. (2025).[55]

leveraging its oil and gas reserves to expand downstream into petrochemicals. Rather than relying solely on crude exports, the country is increasing the production of polymers, base chemicals and other industrial intermediates. The national oil company is also investing in refining capacity, marking a gradual shift from energy extraction towards manufacturing. A similar, albeit more moderate, trajectory is observed in Turkmenistan, where oil and gas reserves have supported the development of chemical refining and driven notable growth in polypropylene production.[56]

As populations in high-income economies age, the pharmaceutical industry offers a high-value opportunity for industrial upgrading across parts of Central Eastern Europe and North-Eastern Europe. Countries such as Poland, Czechia, Lithuania, Slovenia and Estonia already host basic pharmaceutical production and have attracted FDI in generic drug manufacturing, making this one of the few industries where functional specialization extends beyond assembly. Poland and Czechia are emerging as regional hubs for biosimilar development and clinical trials.

Several countries in the region are moving into higher-value niches within biotechnology. Lithuania has integrated biotechnology into its national innovation strategy, fostering clusters in precision medicine and therapeutic platform development. Estonia is investing in bioinformatics and digital health, leveraging its digital infrastructure to support personalized medicine and pharma-adjacent services. However, biotechnology remains both capital- and knowledge-intensive, with high entry barriers. Scaling up in this industry requires sustained investment in research infrastructure, cross-sectoral collaboration, regulatory flexibility and effective strategies for talent retention.

Box 7.3 **Croatia: An emerging ecosystem for digital manufacturing**



Croatia is emerging as a regional leader in digital manufacturing and AI-driven innovation. As a small, service-oriented economy, Croatia's innovation system has historically been characterized by low R&D intensity and weak public-private linkages. Over the past decade, the country has nurtured several globally competitive firms specializing in advanced digital applications across industries such as electric drivetrains and battery systems, cloud communications, AI-powered robotics, drones and farm management software. While the ecosystem is still consolidating, early results are promising. Domestically, these developments have fostered skilled employment opportunities in engineering, software development and applied data science. In 2023, Croatia's information technology (IT) industry generated over USD 4.4 billion in revenue, achieving an annual growth of 12.5 per cent.

Firms within this emerging ecosystem share a founder-led, export-driven approach. They navigate domestic constraints, such as a small local market and limited public R&D expenditure, by targeting global B2B markets from inception. Instead of relying on traditional manufacturing clusters, these firms focus on delivering technological value within specialized GVC niches. They have concentrated their expertise in software-hardware integration, operating through platform-based business models, and embedding advanced technologies such as AI and machine learning.

Public support has played a catalytic role, even if initially reactive. EU accession provided regulatory certainty and alignment with policy frameworks that reward digital innovation. EU funds and Horizon Europe grants have been instrumental in de-risking R&D activities and financing infrastructure. Strategic national initiatives, such as the National Recovery and Resilience Plan and the Digital Croatia 2032 Strategy, prioritize AI, advanced manufacturing and data infrastructure, including 5G and cloud services, while the Smart Specialisation Strategy promotes digital hubs and applied research centres. Complementing these efforts, national programmes implemented by the Croatian Agency for SMEs, Innovations and Investments (HAMAG-BICRO) provide grants and loans to incentivize early-stage investment and technology validation.

Challenges remain, limiting a broader systemic impact. Innovation is concentrated in a small number of firms and urban centres (such as Zagreb), resulting in limited regional and sectoral diffusion of capabilities. Additional constraints include weak university-industry linkages and persistent shortages of high-skilled labour, which is further compounded by brain drain. Yet, Croatia's experience illustrates that even in small markets with structural constraints, globally competitive firms can emerge when entrepreneurial initiative, international networks and targeted public support converge.

Source: UNIDO elaboration based on a background report produced by Stojčić et al. (2025).[57]

EU programmes such as Horizon Europe and the Health Emergency Preparedness and Response Authority (HERA) provide important entry points for fostering PPPs, while national governments can stimulate domestic demand through strategic procurement and incentives for clinical infrastructure. Regional integration through joint testing platforms or harmonized regulatory pathways, could help smaller countries compete effectively in biopharmaceutical niches. While the pharmaceutical industry may not generate large-scale employment, it can contribute to strengthening domestic knowledge-intensive industrial ecosystems and the diversification of the region's industrial base beyond traditional manufacturing. In the petrochemical industry, successful diversification increasingly depends on aligning with global sustainability standards and responding to demands from downstream users. These include emissions transparency, traceability and reduced life-cycle impacts.

7.3.6 Agroprocessing and bioeconomy

Rising demand for low-impact food products and clean energy presents significant opportunities to harness the agricultural potential of Eastern Europe and Central Asia, a region endowed with fertile soils and rich biodiversity.[58] Ukraine, a major grain exporter, has potential to expand into biomass energy and biofuels, while Hungary, Slovakia and Poland are developing capabilities in bioplastics and biorefining. However, these countries largely focus on biomass production, while value added creation remains concentrated in Western Europe.[59] In North-Eastern Europe, digital innovations in agriculture and forestry, ranging from precision farming to circular agro-value chains, are gaining traction, though often at a limited scale. The South Caucasus shows promise in sustainable horticulture, agro-tourism and natural bioproducts, such as cosmetics, yet activities remain fragmented and constrained by limited certification and market access.[60] Georgia is beginning to address these challenges by leveraging trade agreements with the EU (see Box 7.4). In Central Asia, the extensive livestock industry offers opportunities to develop bioenergy and products based on animal waste, contributing to both value addition and energy resilience.[61]

Progress in the bioeconomy and agro-industry remains constrained by weak policy coordination, infrastructure gaps and limited access to certification and finance. In many countries, governance of the bioeconomy is fragmented across sectors and policy areas. SMEs in the industry face challenges in securing certification, green finance and innovation support, while innovation ecosystems outside larger states remain underdeveloped. In South-Eastern Europe and Central Asia, critical gaps persist in cold storage, agro-logistics and certification systems, limiting the growth of organic farming, traditional food branding and biomass energy production. In addition, linkages between producers and processors are weak.

Unlocking the bioeconomic potential requires coordinated investments in rural infrastructure, such as cold chains, smart logistics and waste valorisation, alongside targeted support for sustainable farm management and bio-entrepreneurship. Certification schemes, green labelling and local innovation platforms can strengthen market access and incentivize high standards. EU Member States, for example, can leverage instruments such as the Common Agricultural Policy, Horizon Europe, and Cohesion Policy, while non-EU countries can benefit from regional harmonization and targeted support. Ultimately, the bioeconomy provides a strategic pathway to link environmental sustainability, rural revitalization and selective industrial upgrading, provided initiatives are grounded in local territorial realities and supported by investment in government capabilities.

Box 7.4 **Georgia: The emergence of a high-value agroprocessing industry**

Georgia's agroprocessing industry is positioning itself for long-term competitiveness. Agriculture accounts for approximately 7 per cent of GDP and employs nearly 40 per cent of the workforce. Linkages with manufacturing are deepening as the industry increasingly caters to EU and international demand for premium wines, organic products and branded food items. In recent years, the focus has shifted from raw commodity exports to higher value-added processing, supported by investments in technology adoption, certification schemes and marketing.

Regional integration and strategic industrial policy have further expanded opportunities. The EU's Deep and Comprehensive Free Trade Area has increased market access while requiring compliance with stringent EU quality, safety and traceability standards. Agroprocessing is a central pillar of Georgia's Agriculture and Rural Development Strategy 2021–2027, which prioritizes competitiveness, export growth and climate resilience.

Public policy and donor engagement are accelerating technology adoption. The European Neighbourhood Programme for Agriculture and Rural Development, USAID and other international partners have financed upgrading in bottling, storage and marketing for the wine industry, as well as advanced machinery for hazelnut processing. These interventions have helped Georgia become the world's sixth-largest hazelnut exporter, supplying major multinational confectionery companies. Wine remains the country's flagship export, accounting for approximately one-fourth of total agricultural export value in 2024, with domestic institutions such as the National Wine Agency actively supporting branding, certification and international promotion.

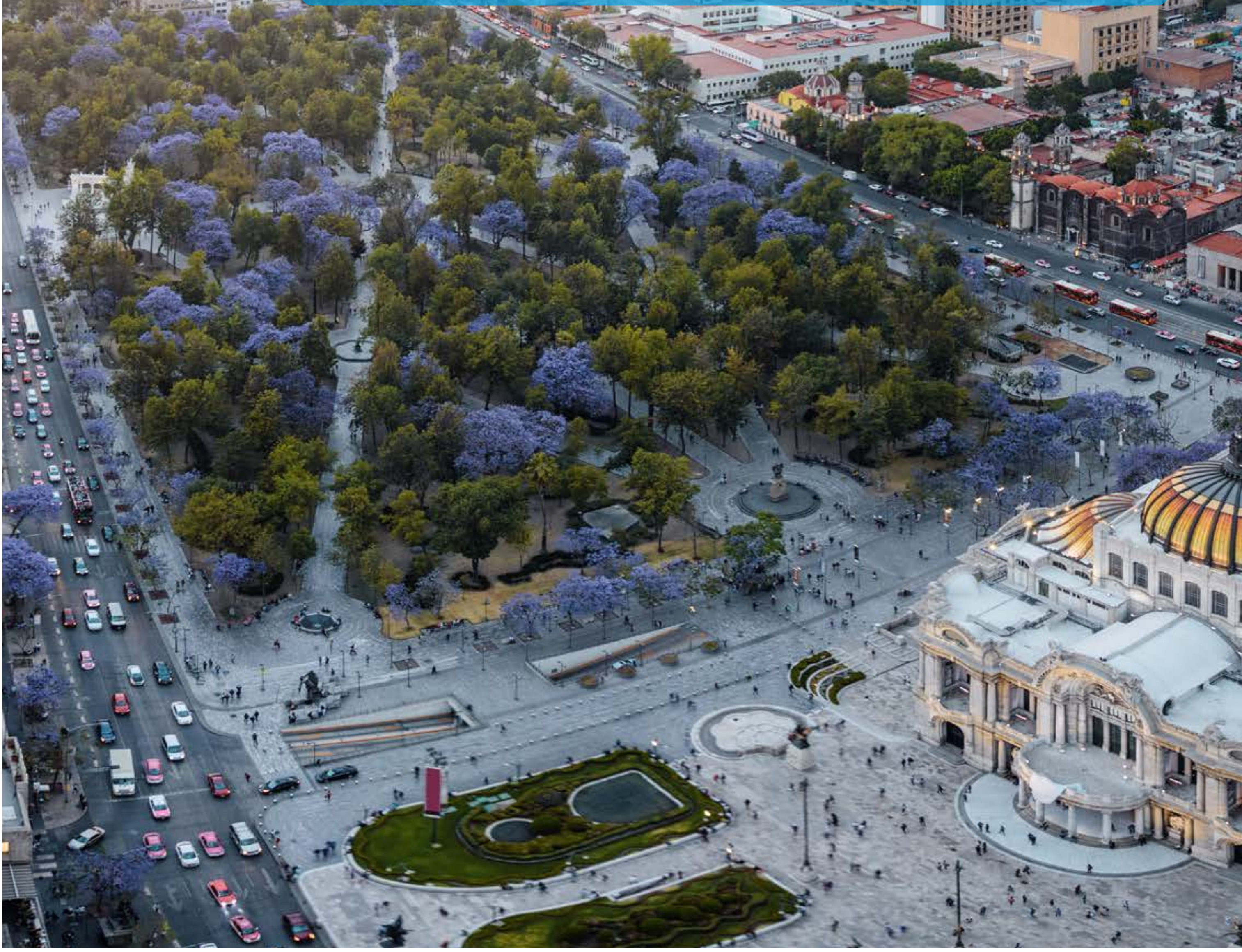
Upgrading is gradually taking place across multiple export niches. Wine producers have obtained EU certifications and modernized production processes, while hazelnut processors now perform shelling, roasting and packaging domestically. Traceability systems within the hazelnut value chain are also improving. Diversification is advancing with the emergence of SMEs in industries such as juices, teas, honey and dried fruits. The development of cooperatives, processing clusters and rural tourism initiatives is further strengthening rural employment and skills.

Source: UNIDO elaboration based on a background report produced by Stojčić et al. (2025).[62]

ENDNOTES

[1] Weighted average excluding China.
[2] Projections presented in this chapter are based on the *current path* scenario of the IFs model. For a detailed explanation of this scenario, refer to Annex A.1.
[3] DeRemer et al. (2025).
[4] EBRD (2025).
[5] This section builds on the background report produced by Stojčić et al. (2025) for the IDR 2026. It also benefited from the insights provided by the following experts during a regional Expert Group Meeting organized at the University of Dubrovnik on June 24, 2025: Marta Götz, Azimzhan Khitakhunov, Antoneta Manova, Ibrahim Niftiyev, Slavko Rakic, Andrea Szalavetz, Marta Ulbrych, Jelena Vasic, Nina Vujanovic, Yana Zabanova, Zuzana Zavarska..
[6] EBRD (2024).
[7] Ibid.
[8] Götz et al. (2024).
[9] Hrubý (2024).
[10] EIB (2025).
[11] EBRD (2024).
[12] EIB (2025).
[13] Črešnar et al. (2023).
[14] UNECE (2023a).
[15] Radosevic (2017); EIB (2025).
[16] EIB (2025).
[17] Hrubý (2024).
[18] EBRD (2025).
[19] Draghi (2024).
[20] Bański and Kamińska (2022).
[21] Radosevic (2022).
[22] Stojčić (2021).
[23] Radosevic (2017); Shkolnykova et al. (2024); Stojčić (2021).
[24] Stojcic et al. (2025); EIB (2025).
[25] EBRD (2025).
[26] This section builds on the same sources reported in endnote 5.
[27] IEA (2021).
[28] U.S. Department of State (2024).
[29] Digital innovation can create opportunities to integrate into value chains in the critical minerals industry even in countries with limited extractive potential. For example, Estonia has leveraged blockchain technology in its mining cadastres and licensing systems. See Martinovic et al. (2017).
[30] OECD (2024).
[31] CzechInvest (2010); Mladineo et al. (2024).
[32] Estonia's pilot programmes in decentralized energy markets are among the most advanced in Europe. See Invest in Estonia (2025).
[33] Publications Office of the European Union (2025).
[34] Hoarau and Lorang (2022).
[35] IRENA (2020).
[36] Kazakhstan aims to obtain 50 per cent of its total electricity generation from alternative sources by 2050; Tajikistan aims at 100 per cent by 2032. UNECE (2023b) and EBRD (2024)
[37] Ministry of Energy (2025).
[38] Slovenia and Croatia demonstrate promising prospects in mobility software, vehicle testing and integrated transport infrastructure, though efforts remain fragmented.
[39] CLEPA (2021).
[40] Cresti et al. (2025).
[41] The data reported in this box are taken from: OEC (2025).
[42] UN Environment Programme and Yale Center for Ecosystems in Architecture (2023).
[43] EBRD (2025).
[44] MIT (2025).
[45] Schau et al. (2023).
[46] World Bank (2024).
[47] Stojcic and Chidlow (2024).
[48] Examples include programmes such as Tehnopol and AI & Robotics, both of which have been introduced in Estonia.
[49] European Commission (2024b).
[50] OECD (2022); Tintor et al. (2023).
[51] Brunori et al. (2023); Zolkover et al. (2022).
[52] Szalavetz (2020).
[53] OECD (2021).
[54] Cedefop (2020).
[55] The data reported in this box are taken from: MKGP (2025).
[56] EBRD (2024).
[57] The data reported in this box are taken from: HGK (2024).
[58] Garazha et al. (2023); Kacprzak and Ferri (2025).
[59] European Commission et al. (2024).
[60] Capannelli (2019); Ursu et al. (2023).
[61] FAO (2023).
[62] The data reported in this box are taken from: UNSD (2025b); MEPA (2019); Tsintsadze (2018); Geostat (2025).

CHAPTER 8 LATIN AMERICA AND THE CARIBBEAN: CHALLENGES AND OPPORTUNITIES FOR FUTURE INDUSTRIALIZATION



Over the past quarter century, premature deindustrialization has left Latin America and the Caribbean's manufacturing sector lagging behind global peers. Manufacturing value added growth has consistently remained below the developing country average. While industrial development is projected to advance in some income groups and subregions, others risk falling further behind, with emissions rising across much of the region. Reversing this trajectory and unlocking the region's industrial potential will require concerted efforts to address long-standing structural bottlenecks: the lack of coherent growth models, underinvestment in both basic and green infrastructure, limited spending on research and development spending, weak intra-regional trade and low skill levels continue to constrain industrial and technological upgrading, hampering the region's ability to accelerate sustainable industrial development.

Global megatrends, while presenting significant challenges, are also emerging as key drivers of industrial transformation across the region, opening new windows of opportunity for both producers and policymakers. This chapter highlights a set of strategic industries that can leverage these megatrends, including lithium processing, renewable energy equipment, bioeconomy, food processing, automotive, semiconductors and pharmaceuticals. Prioritizing these industries provides clear pathways to diversify production, upgrade technological capabilities and strengthen integration into global value chains.

José Manuel Salazar-Xirinachs

"Latin America and the Caribbean needs a profound productive transformation across industry, services and agriculture to escape the low-capacity-to-grow trap. This transformation will not occur spontaneously. It will require countries and their regions to scale up productive development policies, guided by a renewed vision and mindset focused on, among other elements, advancing strategic agendas in key driving sectors, supported by multi-stakeholder and multi-level governance mechanisms – particularly through cluster initiatives or other forms of productive coordination. The new geoeconomics of competition in specific technologies and industries, and the new ways countries relate to each other, makes this approach imperative to grow and prosper under the new realities of the world economy."

Executive Secretary of the UN Economic Commission for Latin America and the Caribbean (ECLAC)

8.1 RECENT AND FUTURE INDUSTRIAL DYNAMICS

Manufacturing growth in Latin America and the Caribbean (LAC) has struggled to gain momentum. Over the past 25 years, the region's average per capita manufacturing value added (MVA) has declined, an alarming sign of premature deindustrialization, with current levels standing about 8 per cent below those of the year 2000.[1] This overall negative trend, however, masks significant variations across the region. The analysis in this section captures these subregional differences by grouping countries according to income level and (where data are available) their geographical proximity (see Table 8.1). This analysis sets the stage for the following sections, which provide a detailed discussion of the key challenges and sectoral opportunities shaping LAC's industrial future.

All subregions and income groups have experienced, at best, sluggish MVA growth, with lower middle-income economies performing relatively better. This group achieved higher MVA growth rates than the regional average, yet continues to trail behind other developing regions (Figure 8.1). In contrast, upper middle-income economies in South and Central America have recorded nearly zero-net growth since the turn of the century, despite a period of moderate growth between 2013 and 2018. Only in the Caribbean did upper middle- and high-income industrializing economies manage to outperform the regional average. Overall, manufacturing dynamics in the region reflect Latin America's typical "stop-and-go" growth pattern, partly fuelled by the commodity super-cycle.

Across the region, manufacturing activity remains concentrated in upper middle-income economies, a pattern that is likely to persist through 2050 under current conditions. South American economies, such as Brazil, account for a large share of regional manufacturing output, followed by Central American countries (Figure 8.2). Projections under the *current path* scenario indicate little change in the distribution of industrial production within LAC by 2050, with marginal growth in South America offset by a slight contraction in Central America.[2] While some emerging economies, such as Mexico and Costa Rica, are deepening their integration into Northern American and global value chains (GVCs), the overall regional industrial structure remains largely unchanged, reflecting limited diversification.

When looking beyond absolute output levels, the LAC region remains underrepresented in global manufacturing relative to its population. The industrial intensity index (the ratio of a country's share in global MVA to its share in global population) highlights significant gaps. Upper middle-income and high-income industrializing economies in the Caribbean (and to a lesser extent in South America) are projected to narrow the industrial intensity gap by 2050, though they still fall short of achieving parity (Figure 8.3, Panel A). High-income industrial economies, by contrast, already exceed the equal-proportion benchmark but are projected to experience a decline in this indicator. Low- and lower middle-income economies face a far more challenging scenario, with substantial baseline gaps and limited projected improvement across all subregions. The persistence of these disparities reflects the structural challenges discussed later in this chapter, particularly the lack of coherent industrial strategies, weak technological capabilities and limited regional integration.

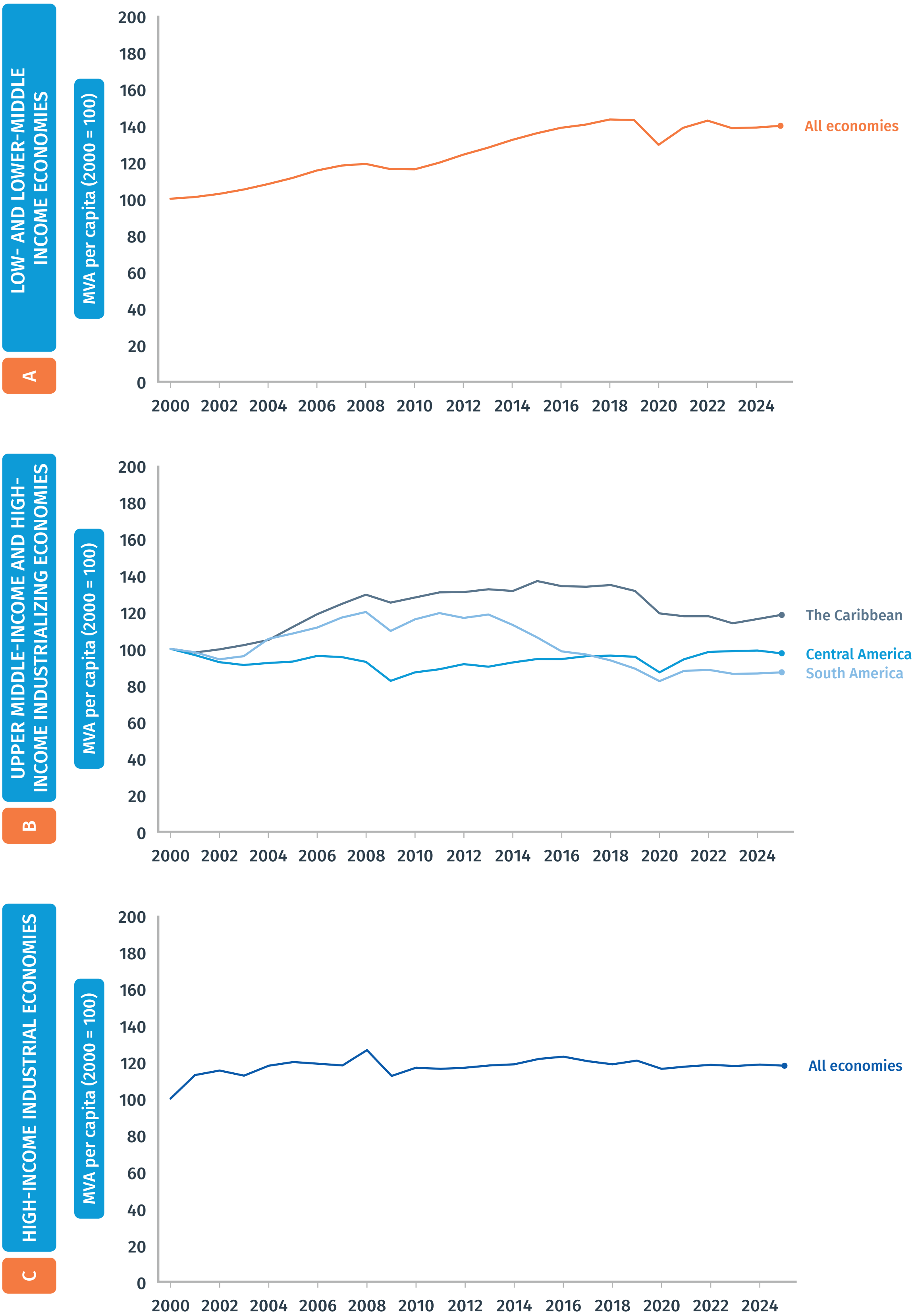
Table 8.1 **LAC: List of economies by geographical area and stage of industrial development**

Low- and lower middle-income economies (LLMIEs)			
Caribbean[a]	**Central America[a]**	Nicaragua	Bolivia (Plurinational State)
Haiti	Honduras	**South America[a]**	
Upper middle-income and high-income industrializing economies (UMIEs and HINGEs)			
Caribbean	Dominica	Turks and Caicos Islands	Brazil
Anguilla	Dominican Republic	**Central America**	Colombia
Antigua and Barbuda	Grenada	Belize	Ecuador
Aruba	Jamaica	Costa Rica	Guyana
Bahamas	Montserrat	El Salvador	Paraguay
Barbados	Saint Kitts and Nevis	Guatemala	Peru
British Virgin Islands	Saint Lucia	Mexico	Suriname
Cayman Islands	Sint Maarten (Dutch part)	Panama	Venezuela
Cuba	St. Vincent	**South America**	
Curaçao	Trinidad and Tobago	Argentina	
High-income industrial economies (HIIEs)			
Caribbean[b]	**South America[b]**	Uruguay	
Puerto Rico	Chile		

Note: In the analysis of this chapter, country groups with a small sample size (fewer than three economies) or small population share (less than 2 per cent of the regional population) are merged with neighbouring groups at a similar stage of industrial development to limit outlier effects from low representation and/or inconsistencies in country-level data. a) presented together as All economies due to small sample size; b) presented together as All economies due to small sample size.

Source*:* UNIDO elaboration based on UNIDO country classification (see Annex A.3).

Figure 8.1 **Latin America and the Caribbean: Industrial dynamics in the first quarter of the 21st century**



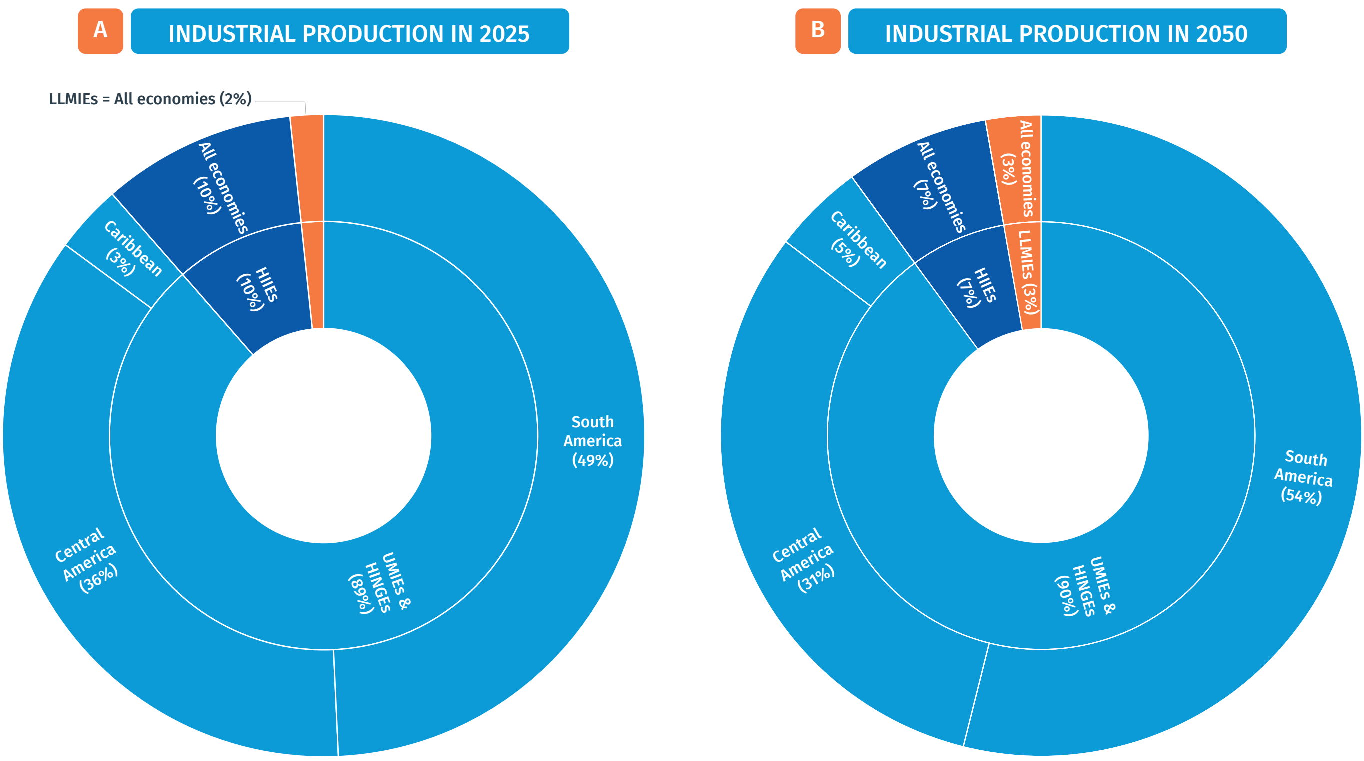
Note: Regional averages calculated using population weights. Values indexed to 2000 (2000 = 100). MVA = Manufacturing value added. See Table 8.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, some country groups were merged.

Source: UNIDO elaboration based on UNIDO (2025f).

Across the region, productivity performance correlates with income levels, with countries within the same income group, regardless of subregion, exhibiting similar gaps. Relative productivity catch-up dynamics differ across income groups (Figure 8.3, Panel B). Low- and lower middle-income economies across the region start from substantial baseline gaps and are projected to improve only marginally. Upper middle-income and high-income industrializing economies, on the other hand, while starting from intermediate productivity levels, also show only marginal gains. By 2050, productivity in South and Central America is expected to reach just over one-quarter of the average for high-income industrial economies, while the Caribbean performs slightly better, yet still remains more than halfway below the global frontier. This sluggish pace of productivity reflects the persistence of the region's industrial dualism, where a few large, globally competitive firms coexist alongside a vast number of low-productivity SMEs, a pattern further explored in Section 8.1.4.

Environmental efficiency is heterogenous across the region, with gaps projected to widen by 2050 (Figure 8.3, Panel C). Even upper middle-income economies in Central America, the group of countries currently leading the region in environmental performance, are expected to fall further behind the global frontier by 2050 (Figure 8.3, Panel C). This deterioration reflects a structural constraint in the region's ability to decouple growth from emissions. Projections indicate that moderate growth in manufacturing output by 2050 will be accompanied by disproportionately higher emissions, suggesting that production gains will continue to rely on fossil fuel-based energy and low-efficiency processes rather than on technological upgrading or the expansion of renewable energy. This trend is particularly concerning given LAC's vulnerability to climate change and its reliance on resource-intensive industries, and can be traced to structural bottlenecks analysed later in this chapter: weak renewable energy infrastructure, insufficient investment and low technological absorption.

Figure 8.2 **Latin America and the Caribbean: Current and projected distribution of industrial production in the region**



Note: LLMIEs = Low- and lower middle-income economies; UMIEs = Upper middle-income economies; HINGEs = High-income industrializing economies; HIIEs = High-income industrial economies. See Table 8.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, some country groups were merged.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

Figure 8.3 **Latin America and the Caribbean: Industrialization gaps by subregions, current values and projections for 2050**

Note: Bars show projections for 2050 and vertical lines denote 2025 values. Regional averages are weighted by countries' share of manufacturing value added (MVA) in each subregion. The indicators reported in each panel are defined as follows: A) Industrial intensity index = percentage ratio of each subregion's share of global MVA to its share of the world population. A value of 100 indicates equal share. Values below 100 reflect industrial underrepresentation. B) Industrial relative productivity index = manufacturing labour productivity (MVA per worker in constant 2017 US dollars) of each subregion relative to high-income industrial economies' average manufacturing labour productivity. A value of 100 indicates that the region stands at the frontier in terms of industrial labour productivity. C) Industrial environmental efficiency index = MVA per unit of CO_2 emissions in constant 2017 US dollars relative to the average value of high-income industrial economies. A value of 100 indicates that the region stands at the frontier in terms of industrial environmental efficiency. See Table 8.1 for the list of economies included in each group. To limit outlier effects from low representation and/or inconsistencies in country-level data, some country groups were merged.

Source: UNIDO elaboration based on Denver University's Pardee Institute for International Futures (IFs) model.

Putting the region back on track and reversing decades of stagnation in industrialization will require decisive action. While important industrialization gaps are expected to narrow or close for specific country income groups and subregions, many others are likely to stagnate and, especially in the case of emissions, even widen. These trends reflect a series of structural bottlenecks that must be addressed to place the region on a more sustainable and prosperous trajectory, while capitalizing on emerging sectoral opportunities. As discussed in the following sections, targeted policy interventions are needed to rebuild institutional capacity, strengthen infrastructure, close skills and technology gaps, and promote competitive, greener industrial ecosystems. At the same time, the region can leverage its natural endowments and seize emerging global trends, such as the energy transition, nearshoring and digitalization, to develop new industrial sectors.

8.2 MAIN BOTTLENECKS CONSTRAINING FUTURE INDUSTRIALIZATION

Seven areas of action to prepare for the future. Reversing the losses caused by premature deindustrialization in LAC requires addressing bottlenecks across multiple enablers. The analysis conducted for this report identifies a set of indicators to assess the region's performance relative to both advanced economies and other developing regions. These indicators are clustered into seven dimensions, namely: (i) institutions; (ii) infrastructure; (iii) labour force; (iv) technology; (v) trade and integration; (vi) production greening, and (vii) finance.[3] For each dimension, two indicators were selected based on their relevance and availability across countries over the past decade (see Figure 8.4).

8.2.1 Institutions

With government capacity and political stability generally slightly below the global average, the region has historically struggled to design and sustain coherent industrial policies. Countries have faced challenges in establishing a shared vision for industrialization and its role relative to natural resources and services.[4] Frequent political shifts have disrupted previously established policy frameworks that link industrial, trade and technology strategies.[5] Conflicting rules of law and excessive red tape have further undermined implementation.[6] Although recent years have seen progress in democratic consolidation and strengthened state capacities compared to other developing economies, many countries in the region continue to face social upheaval due to persistently high levels of violence, poverty and inequality.

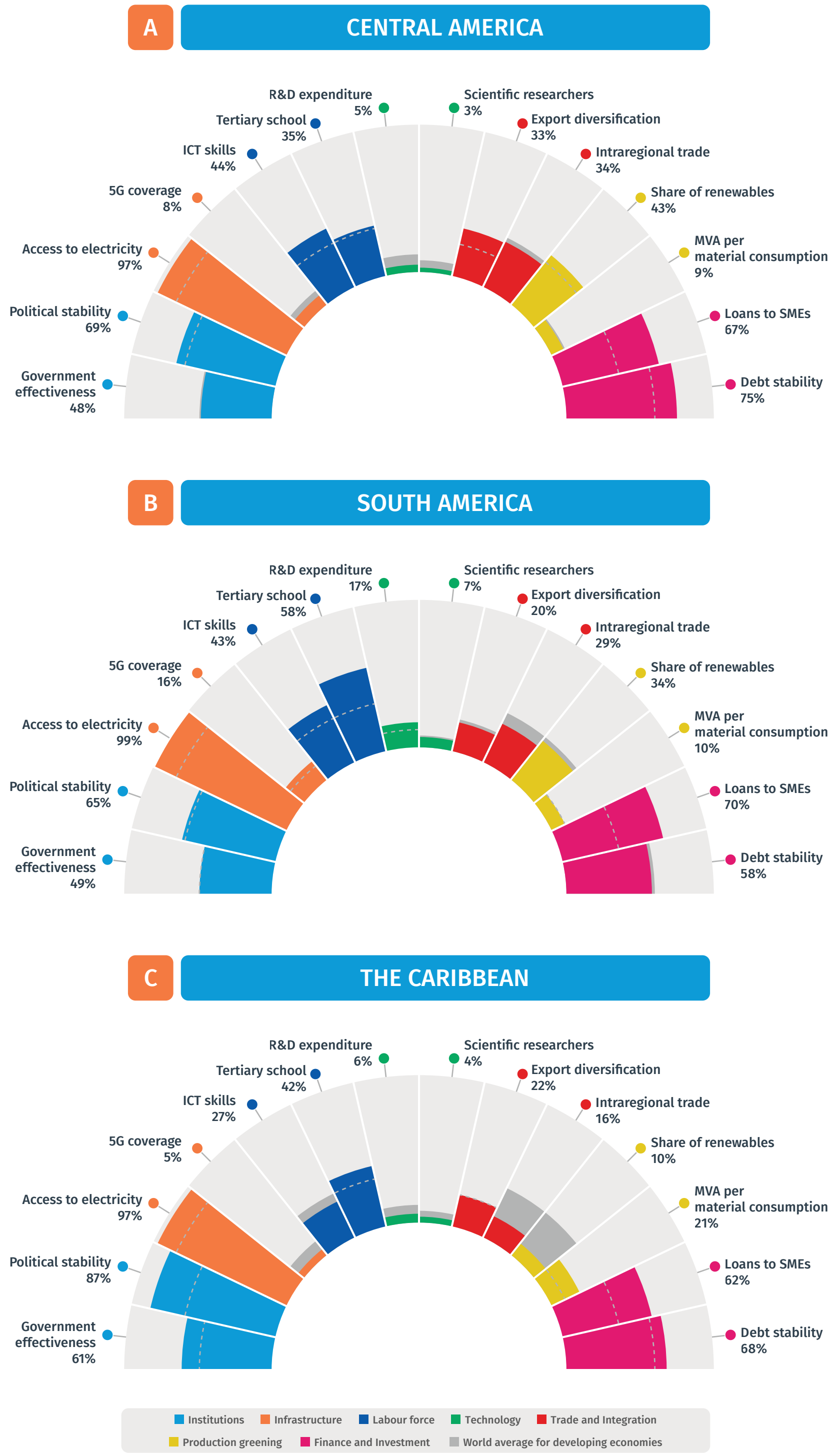
The region faces intensifying geopolitical pressures while also possessing unique advantages as a neutral and resource-rich partner. LAC is characterized by competing foreign relations,[7] whose large-scale investments have expanded trade but also raised concerns about dependence. Unresolved tensions with United States policy, particularly regarding sanctions, trade uncertainty and drug and crime prevention, pose risks to key production chains in Central America, with potential ripple effects across Caribbean and South American industries. At the same time, the region's neutrality in many international conflicts and its role as a reliable supplier of food, energy and minerals provide it with a unique geopolitical position, making it an attractive partner for both established and emerging powers.

8.2.2 Infrastructure

The region continues to lag behind in infrastructure investment, which increases the cost and reduces the efficiency of economic activities, including both international and intraregional trade. Investment in transport and logistics networks remains below global averages. While internet penetration in the region has increased throughout the 2010s, progress in affordability, reliability and speed has been more limited.[8] Deployment of 5G infrastructure remains low (Figure 8.4). Significant disparities persist between formal and informal sectors, urban and rural areas and across demographic groups.

Gaps in renewable energy generation infrastructure are particularly concerning given the region's abundant land, natural resources and favourable climate for large-scale renewable deployment. While these gaps exist across all subregions, they are particularly pronounced in South America and the Caribbean (Figure 8.4). Financial constraints and dependence on technology from the Global North are further delaying the green transition. Adaptation infrastructure is also insufficient, raising concerns in a region highly exposed to environmental degradation and climate risks. Severe deforestation in the Amazon exemplifies these challenges, while many countries in LAC remain susceptible to wider climate impacts, including natural disasters.

Figure 8.4 **Industrialization enablers: LAC compared to the world frontier and other regions**



Note: Indicators are reported as the ratio of regional values to those of the world's best-performing country, defined as the country at the 95th percentile of the global distribution. A value of 100 indicates that the region, on average, is at the frontier for the respective enabler. Values are calculated as simple averages across all countries in the region with available data for each indicator. Country-level data correspond to the average over the last three years for which data are available (typically, 2021–2023). See Annex A.2 for a detailed description of indicators and data methodology and Table 8.1 for the list of economies included in each group. Due to the relative homogeneity of the region in terms of income categories (over 80 per cent of the countries are upper middle-income economies or high-income industrializing economies), the figure presents averages by subregion without distinguishing by development stages.

Source: UNIDO elaboration based on data from UNSD (2025a), World Bank (2025a, b and c), Gaulier and Zignago (2010), UNCTAD (2025a) and UNEP IRP (2025).

8.2.3 Labour force

Historical shortcomings in education systems have contributed to low skill levels and limited labour productivity, especially in the context of the digital transition. In 2023, output per worker in the region reached only 37 per cent of the OECD average and 27 per cent of the United States' level, a gap that has widened over the years, with relative productivity reaching 46 per cent and 36 per cent, respectively, in 1990.[9] Low productivity disproportionately affects SMEs and informal economic activities, and is attributable to low and unequal skill levels. The region faces persistent challenges in its education systems, characterized by poor quality, unequal access and low levels of science, technology, engineering and mathematics (STEM) training.[10] These skill gaps are compounded by an ageing population and the phasing out of the demographic dividend, highlighting the need to strengthen technical and vocational education and training (TVET).

8.2.4 Technology

Countries in the region continue to face a persistent technological lag. Nearly all countries in the region invest less than 1 per cent of GDP in R&D, constraining innovation, scientific output and technological development (Figure 8.6). Local firms often lack both the capacity and the incentives to innovate, while weak university-industry linkages further severely limit the commercialization of innovation and research. This technological gap prevents industries from moving up the value chain and competing globally in advanced industries.[11] The regional landscape remains dominated by micro and small firms with limited resources to invest in R&D or adopt new technologies. Access to financing for tech startups and innovative projects is limited, and venture capital ecosystems are still underdeveloped.[12]

8.2.5 Trade and integration

LAC's exports remain heavily concentrated in the primary sector. South American countries are highly dependent on commodity exports, leaving them vulnerable to international price fluctuations.[13] As discussed in Section 8.1, even industrialized countries in the region have experienced premature deindustrialization over the past two decades. Countries have historically relied on external markets for machinery, inputs, technology and capital, yet foreign direct investment (FDI) frequently targets extractive industries rather than manufacturing, reinforcing existing specialization patterns.[14] Significant disparities in the level of capabilities and performance prevail in all economic activities, including manufacturing.

Institutional gaps and a lack of trade complementarity have severely constrained the potential for intra-regional trade in the region. LAC is fragmented across multiple overlapping economic blocs, each with differing goals and regulations. This "spaghetti bowl" of agreements creates confusion and hampers trade integration.[15] Non-tariff barriers, including customs inefficiencies, licensing requirements and inconsistent standards, further restrict cross-border trade. Furthermore, LAC's national production systems lack complementarity, limiting opportunities to develop more advanced production chains and to foster intra-regional trade based on complementary industries and supply chains.[16]

Low regional integration is compounded by weak domestic demand, a consequence of inequality levels among the world's highest. Economic dualism contributes significantly to one of the world's most unequal income distributions. Even in countries where a growing middle class and urbanization could stimulate demand for higher-value goods, structural weaknesses in logistics, digital infrastructure and education limit the region's ability to respond with innovation and productivity.

Global uncertainty further limits global demand. In Central America and the Caribbean, manufacturing in recent years has been heavily oriented towards exports to high-income Northern American markets, creating strong dependence on the economic conditions and foreign policy of these destination markets. While the reconfiguration of GVCs presents new challenges, efforts to capitalize on nearshoring trends and strengthen regional integration remain uneven.[17]

8.2.6 Finance and investment

The outlook for finance and investment in the region is stronger than in many other developing regions, yet high borrowing costs and institutional weaknesses persist. SMEs continue to face barriers to credit, including stringent collateral requirements, limited credit histories and a lack of tailored financial products. Many countries rely heavily on bank-based financing, where the dominance of a few large banks, low financial inclusion, and shallow credit penetration further restrict access to capital. Institutional investors, such as pension funds and insurance companies with long-term horizons, remain underdeveloped compared with advanced economies, limiting market depth and liquidity. At the same time, however, the region benefits from a dynamic network of national and regional development banks that are increasingly capable of catalysing private sector investment in the region.[18]

Domestic and global macroeconomic headwinds further constrain capital inflows and limit investment opportunities in the region. Macroeconomic volatility,[19] currency fluctuations, inflationary pressures, inconsistent fiscal policies[20] and high debt burdens[21] deter investment and restrict access to affordable credit. At the same time, shifts in international finance exacerbate the region's vulnerabilities. Rising global interest rates and heightened investor risk aversion redirect capital towards more stable, developed markets, intensifying competition for investment.

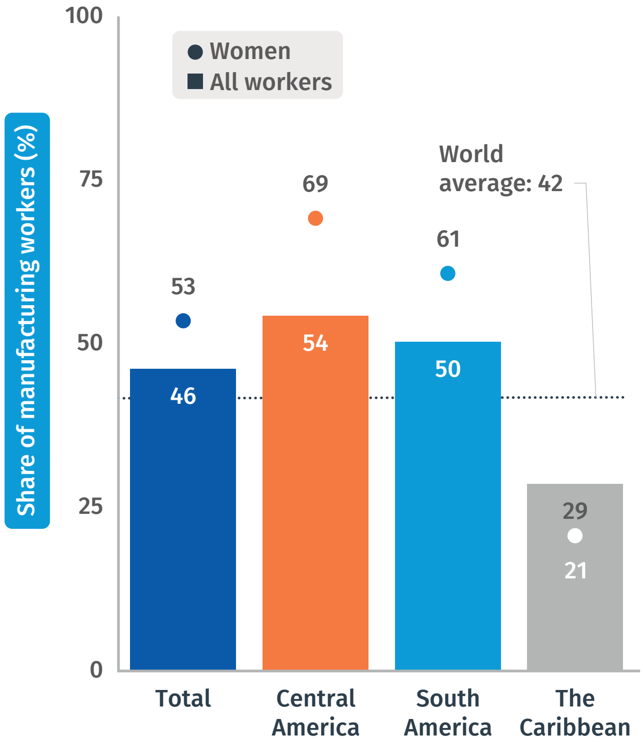
8.2.7 Cross-cutting issues

Dualism influences industrial structures across the region. The typical pattern features islands of progress, i.e. a small number of globally competitive large firms that coexist alongside a large number of low-productivity SMEs, which account for the vast majority of employment but remain marginalized in terms of value added, productivity and investment in innovation.[22] Much of this duality reflects the formality divide: large informal sectors contribute to job creation, but also reinforce structural bottlenecks, including inequality, low productivity activities and employment without social protection.[23]

The prevalence of informal activities across the region represents a major bottleneck, limiting the potential for future industrialization. In LAC's manufacturing sectors, 46 per cent of workers are currently engaged in informal employment, slightly above the global average for developing economies (Figure 8.5). Informality is more prevalent in Central America compared with the other two subregions. Recent evidence suggests that, after a decade of improvement in the early 2000s, informal employment began rising again around 2015, a trend that was further accelerated by the COVID-19 pandemic, which disproportionately impacted younger workers.[24]

Disparities between formal and informal employment are further exacerbated by pronounced gender imbalances in manufacturing activities, negatively affecting women's income opportunities, job security and access to social protection. Across the three subregions, women are more likely than men to work in informal manufacturing. In Central America, nearly 70 per cent of female manufacturing workers are employed informally, compared with 54 per cent of the overall workforce. The gap is similarly high in South America, followed by the Caribbean, where, despite generally lower informality rates, there is still a disproportionate representation of women in informal manufacturing employment.

Figure 8.5 **Informality and gender imbalances in LAC's manufacturing sector**



Note: Values represent the share of informal workers in total manufacturing workers by country group and gender. They are calculated as a simple average across all countries in the region with available data and refer to the last three years for which data are available (typically, 2021–2023). See Table 8.1 for the list of economies included in each group. Due to the relative homogeneity of the region in terms of income categories (over 80 per cent of the countries are upper middle-income economies or high-income industrializing), the figure presents averages by subregion without distinguishing by development stages.

Source: UNIDO elaboration based on ILO data.

8.3 SECTORAL OPPORTUNITIES TO SPUR FUTURE INDUSTRIALIZATION

The megatrends are creating new sectoral opportunities for the region, providing a potential pathway to revitalize industrial ecosystems and drive future industrial development. As observed in other regions, the megatrends discussed in Part A of this report can serve as a tangible catalyst for industrial transformation, offering distinct pathways for countries to diversify their production base, upgrade technological capabilities and deepen integration into GVCs.

Changes in global demand and the creation of new markets. The green transition, for instance, is driving global demand for EV batteries, creating opportunities for mid- and downstream processing in countries with abundant lithium and other critical mineral reserves. Similarly, the shift towards clean energy sources can stimulate the development of clean-tech manufacturing and biomass processing in countries with existing industrial capabilities in related industries. At the same time, demographic and societal shifts, such as ageing populations, are generating rising demand for pharmaceuticals, a need that the region can meet by building on its established pharmaceutical clusters.

Shifts in global production with regional implications. Other megatrends are creating opportunities linked to the reconfiguration of GVCs. As friendshoring accelerates, the region can position itself as a competitive location for the production of cars, automotive parts and semiconductors, as exemplified by Costa Rica's semiconductor industry (see Box 8.3). At the same time, the transformation of food systems opens prospects for developing healthier and more sustainable food processing industries, as illustrated by recent innovations in Chile (see Box 8.4).

The region exhibits significant heterogeneity in industrial structures and readiness to capitalize on emerging megatrends. South America generally benefits from abundant critical resources—both mineral and agricultural—and possesses more diversified, technologically advanced industrial bases, positioning it relatively well to benefit from the green and digital transitions. Mexico and parts of Central America are closely integrated into Northern American value chains, particularly in automotive and electronics, making them attractive destinations for reshoring investments. In contrast, the Caribbean and smaller Central American economies face substantial structural constraints, including limited market size, weak industrial capabilities, and vulnerability to climate change. Nonetheless, some of these economies hold potential in renewable energy production and in industries driven by demographic dynamics, such as pharmaceuticals. These subregional differences highlight that the opportunities created by global megatrends are unevenly distributed across the continent, with middle-income countries better positioned to benefit, while low-income countries may still seize the opportunity to leapfrog through targeted industrial policies and strategic planning.

8.3.1 Critical minerals processing

Rising global demand for critical minerals and rare earths is creating industrial development opportunities for resource-endowed countries, especially in South America. Lithium, in particular, is expected to become increasingly critical, with demand projected to rise sixfold by 2050 to around 1.5 million tonnes, roughly 85 per cent of which will be used in the electric vehicle (EV) industry.[25] Other critical minerals, such as copper and rare earths, are also expected to see growing demand to sustain the production of digital and green technologies. At the same time, advanced economies are pursuing strategic autonomy by diversifying their suppliers, strengthening the bargaining position of mineral-rich countries. Moreover, the ongoing reconfiguration of trade away from major refining hubs is creating new opportunities for downstream industrial diversification.

The region is well positioned to seize this window of opportunity, as Argentina, Bolivia and Chile—the so-called 'Lithium Triangle'—hold more than half of global lithium reserves. A key advantage lies in the prevalence of brine deposits, which are both cheaper and more environmentally efficient to extract than the hard-rock deposits found in Australia and China. While initiatives to expand materials processing and downstream production remain at an early stage, they are beginning to take shape. In Chile, for example, the government has strengthened control over the lithium industry by retaining majority stakes in strategic projects, often through state-owned enterprises (SOE) such as Codelco, and by renegotiating contracts with large firms to increase state participation and reserve quotas for domestic processing.[26] These measures are expected to ensure that a greater share of lithium is processed domestically, while facilitating experimentation with more sustainable extraction technologies, such as direct lithium extraction. Bolivia is pursuing a similar strategy, with its SOE, Yacimientos de Litio Boliviano, signing partnership agreements with major lithium processing firms worth over USD 1 billion, subject to approval by the Congress.[27]

Table 8.2 **LAC: Megatrends, drivers and sectoral opportunities for future industrialization**

Main megatrend	Sectoral opportunities	Drivers	Case studies
Energy and the green transition	• Critical minerals processing	• Global demand for EV batteries • Abundant reserves of critical minerals (lithium, copper)	
	• Renewable energy equipment	• Global and regional demand for renewable energy equipment • Pre-existing industrial capabilities in related industries (e.g. aerospace in Brazil)	
	• Bioeconomy	• Growing regional and global demand for biofuels, biochemicals and biomaterials • Strong agricultural sector	**Brazil:** Driving the green industrial transition with biomass
The reconfiguration of global supply chains	• Automotive industry and electric mobility	• Emerging demand for EVs • Well-developed regional value chains	**Mexico:** Automotive industry as a core component of Factory America
The rise of AI and the digitalization of production	• Semiconductors	• Geopolitical risks and friendshoring • Growing global demand for semiconductors	**Costa Rica:** Leveraging global investments to build a robust semiconductor industry
Population growth and the changing nature of work	• Pharmaceuticals and biopharmacauticals	• Ageing populations and growing demand for medical products • Existing pharmaceutical clusters	
The transformation of food production systems	• Agroprocessing	• Growing regional and global demand for healthy food • Strong agricultural sector	**Chile:** Regulation and digital technologies as a pivot for the agroprocessing industry

Historically, the region has been confined to the role of an upstream supplier of raw materials within GVCs, constrained by limited technological upgrading, heavy reliance on external markets and weak institutional governance. Investment in technology remains marginal, leaving most countries dependent on exporting lithium carbonate or hydroxide with minimal downstream integration. Despite strong international demand providing leverage for lithium exporters, the global concentration of refined materials and battery production in China, the United States and the European Union (EU) means that South American countries must negotiate with a small group of powerful downstream actors that set the technical and economic standards for the rest of the chain.[28] Mining companies also face challenges in governance, social legitimacy and environmental sustainability. Lithium extraction is highly water-intensive, raising environmental concerns and complicating efforts to meet the growing demand for certified sustainable production, while generating only limited new employment opportunities. Price volatility represents another major challenge: lithium prices soared above USD 80,000 per tonne in 2022 before plunging to below USD 10,000 in 2023, complicating long-term investment planning.[29] Moreover, the industry faces mounting pressure from emerging alternative technologies, such as sodium-ion batteries, and the discovery of new deposits, which could disrupt future demand.

To achieve industrialization based on critical materials, South America aims to leverage its vast reserves to develop local downstream production while facilitating technology transfer. This can be pursued through joint ventures between SOEs and global leaders, conditional on local production commitments and knowledge sharing. Strengthening institutional capabilities will be essential to implement such agreements effectively and to upgrade productive structures. Regional cooperation could further enhance scale and political leverage, reinforcing the region's bargaining position vis-à-vis lead firms. At the same time, mitigating the environmental impacts of extraction and ensuring meaningful community participation in policymaking will be critical for legitimacy, reducing implementation costs and promoting sustainable and inclusive development. These efforts must be framed within a long-term, forward-looking industrial policy that prioritizes steady, sustained gains over immediate, one-time rents.

8.3.2 Renewable energy equipment

Investment in renewable energy equipment manufacturing is gradually gaining traction in the LAC region, driven by rising local and global demand. Over the past two decades, FDI in renewables has totalled approximately USD 170 billion, with Brazil, Chile and Mexico consistently capturing the largest shares. While solar PV and wind power have historically accounted for the bulk of this investment, hydrogen has emerged as an increasingly important priority since 2022.[30] The availability of geothermal and wind resources in the Caribbean, notably in Dominica, highlights the region's potential to pursue import substitution and develop downstream production capabilities.[31]

Among emerging clean-tech manufacturing clusters, wind power shows particularly strong potential, driven in part by the region's abundant wind resources.[32] The region's strategic positioning and supportive industrial policies also play an important role. Mexico leverages its geographic proximity to export wind subcomponents to the United States, while Brazil, supported by public financing from institutions such as the Brazilian Development Bank (BNDES), has achieved about 80 per cent national content in turbine production, fostering local supplier development and strengthening domestic industrial capabilities. Brazil's mature aerospace industry creates synergies for further domestic upgrading: both aerospace and wind manufacturing require advanced engineering, rigorous safety standards and long component lifespans, facilitating knowledge transfer and innovation in turbine design and production.[33]

In other clean-tech niches, regional capabilities remain nascent. In solar PV, both Mexico and Brazil host panel assembly plants, yet high dependence on imported raw materials and upstream components highlights untapped potential to expand local production along the value chain. In energy storage, despite the region's abundant lithium reserves, Mexico remains among the few countries to have started investing in battery assembly.[34] Hydrogen-related manufacturing has also lagged behind project deployment. Despite the region's potential as a hub for low-emissions hydrogen production, only a limited number of manufacturing plants for electrolysers and other hydrogen technologies have been announced to date.[35]

Major bottlenecks continue to constrain progress. Despite growing interest, LAC accounts for only 5 per cent of privately financed global investment in clean energy, limited by high interest rates and limited long-term financing, and mounting public debt servicing costs.[36] Weak regional integration further fragments markets, impeding the development of large-scale supply chains for solar, wind and storage technologies. Consequently, local manufacturers face intense competition from well-established global producers in China, Europe and the United States, which benefit from economies of scale, advanced technologies and dense industrial ecosystems.

To address these constraints, policymakers should prioritize measures to strengthen domestic manufacturing capacity and enhance regional integration. This includes fostering technology transfer and R&D

collaboration in wind and solar industries, leveraging synergies with established industries such as aerospace in Brazil and automotive in Mexico. Expanding access to long-term finance and reducing investment risks through public-private partnerships (PPPs) and regional development banks can further support the attraction of new capital.

8.3.3 Bioeconomy

Urbanization and rising demand for energy, chemicals and sustainable materials are creating new opportunities for biomass-based value chains. Global demand reinforces these prospects: biofuel consumption is projected to exceed 200 billion litres within the next four years and could double by 2028, driven by decarbonization goals.[37] Bioplastics, while currently only representing 1 per cent of the global plastics market, are expected to grow at an annual rate of 8 per cent, outpacing fossil-based plastics.[38] Other innovative market segments, including sustainable aviation fuels, biochemicals and specialty chemicals derived from biomass, remain less mature but have future growth potential, with estimates suggesting that up to two-thirds of chemicals could be replaced by bio-based alternatives.[39] Abundant agricultural resources position the region, especially South America and the Caribbean, to become a major supplier of biomass. LAC has already demonstrated capabilities in scale-intensive segments such as ethanol and pulp and paper, with Brazil emerging as a global leader (see Box 8.1).

Box 8.1 **Brazil: Driving the green industrial transition with biomass**

The green transition presents opportunities for the development of biomass-based industries. Given stringent decarbonization targets, global demand for biofuels is projected to more than double by 2050, driven primarily by emissions reduction targets in the transport industry. The scale of this opportunity can be gauged by looking at biofuel production for aviation; currently, it remains below 10 million litres per year, yet estimates suggest that production may have to be scaled to 100 billion litres annually by 2050 to meet decarbonization targets.

In this context, Latin America is well positioned to benefit from the global shift towards bio-based products. Across the region, bio-based products already account for over 17 per cent of GDP. Biomass, including agricultural crops, forestry residues and organic waste, serves as the essential feedstock for producing a wide range of bio-based goods such as bioethanol, biodiesel, bioplastics and biochemicals. The region is also a globally competitive exporter: bio-based products represent 28 per cent of total exports, well above the global average of 17 per cent. Bioeconomy-related exports, a broader category of products ranging from minimally processed goods, such as ground coffee and fresh fruits, to processed goods using or derived from biological materials, including wooden furniture and glycerol extracted from natural oils and fats, account for over 44 per cent of the region's total exports. This share is expected to increase further as countries implement ambitious national bioeconomy strategies. Brazil possesses a unique competitive advantage to become a global leader in the bioeconomy.

A distinctive feature of Brazil's economy is its diverse biomass base, encompassing a variety of biomass value chains with distinct structures. Some, such as soybeans, sugarcane and planted forests, present greater potential for industrialization and product diversification. For instance, Suzano, a leading Brazilian pulp and paper company, is investing in research and development for biorefineries to develop new products from residues and by-products, such as pulp-based textiles derived from wood processing. In contrast, smaller and more fragmented chains, such as açaí, remain less industrialized and offer limited potential for diversification. Although açaí represents a strategic Amazonian resource, its value chain remains largely focused on pulp extraction, leaving substantial residues underutilized due to the industry's limited technological capabilities to convert them into higher-value products.

Public policy has increasingly supported the industry's development in recent years. For example, BPAISS and PADIQ, two programmes launched jointly by Brazil's innovation agency FINEP and the National Development Bank (BNDES), focused on developing bioproducts, although both were eventually discontinued. More recently, the bioeconomy, decarbonization and the green transition have become central pillars of Brazil's 2024–2026 Action Plan for Neoindustrialization, led by the Ministry of Development, Industry, Trade and Services. In 2024, the government also launched the National Bioeconomy Strategy, aiming to promote sustainable development by fostering innovation, research and technological development, and integrating traditional and scientific knowledge to generate high value-added products.

Source: UNIDO elaboration based on a background report produced by Ferraz et al. (2025).[40]

Biomass production can deliver positive economic, social and environmental outcomes, depending on a country's position within the value chain. Brazil's ethanol programme has reduced oil dependency, created jobs, spurred rural development, and positioned the country as a global leader in renewable fuels. The pulp and paper industry, based on planted forests, generates substantial export revenues and is closely integrated into GVCs. By contrast, other biodiversity-based biomass chains such as cocoa and açaí, though smaller on an economic scale, deliver important social and environmental benefits. In the Caribbean, the valorization of sargassum presents emerging opportunities across multiple bio-based value chains,[41] including biochar, biogas, compost and fertilizer production.[42] These opportunities are particularly promising due to their low technological requirements and capacity to absorb large volumes of biomass while generating economic and environmental benefits.[43] Environmental outcomes are mixed, however: biofuels reduce emissions, but large-scale monocultures raise concerns about deforestation, biodiversity loss and land-use change.

Despite these opportunities, the biomass industry faces several bottlenecks that need to be addressed. Policy and governance gaps limit sectoral development, as governments often struggle to establish long-term and coordinated mechanisms that bring together ministries, development agencies and other stakeholders. At the same time, large-scale monocultures can result in deforestation and other adverse environmental impacts. Biodiversity-based value chains face unique challenges, notably difficulties in improving product quality and ensuring equitable benefit-sharing with local communities. Unstable raw material supply further complicates investment planning, as in the case of sargassum, where coastal blooms in the Caribbean are affected by ocean currents, nutrient levels and temperature fluctuations.[44]

Unlocking the potential of biomass in Latin America requires product differentiation, enhanced value chain efficiency, and the adoption of sustainable practices to strengthen the industry's legitimacy. Public and private actors must develop strategies that maximize the use of biomass while expanding value chains beyond fuels to include chemicals, polymers, nutraceuticals and bioplastics. Effective coordination among ministries and funding agencies is essential to sustain innovation and create an enabling environment for growth. This should be complemented by increased investment in R&D and systematic data collection to track industry development. Finally, strengthening fragmented and poorly integrated biodiversity-based value chains—such as those of babassu, açaí, macaúba, licuri and cocoa—through financing cooperatives and micro-biorefineries and robust certification schemes can further facilitate access to global markets.

8.3.4 Automotive industry and electric mobility

Global shifts towards low-carbon mobility present significant opportunities for Latin America's automotive industry. Transport is the region's largest source of energy-related emissions, positioning the automotive industry as a key lever for both decarbonization and industrial upgrading.[45] Further, the global transition to electric mobility is reshaping demand, supply chains and technological innovation, creating new opportunities in batteries, electronics and software integration. Trade disputes and subsidy regimes in the United States, the EU and China are influencing the competitive landscape, but also open strategic opportunities for Latin American producers to strengthen their presence in emerging markets.

The e-mobility transition is particularly relevant for established automotive hubs in Central and South America, where integration into GVCs is complemented by the development of innovative mobility solutions. Mexico's automotive industry is deeply embedded in the tri-national chain under the North American Free Trade Agreement (NAFTA), now the United States-Mexico-Canada Agreement (USMCA), specializing in labour-intensive assembly and auto parts production. Brazil, in turn, leverages complementary capabilities in advanced mobility technologies through Embraer, which is applying its aeronautics expertise to expand into urban air mobility solutions.

The transition to EVs presents an opportunity to align industrial capabilities with sustainability and technological innovation. In Brazil, Embraer's diversification into electric vertical take-off and landing (eVTOL) aircraft exemplifies the country's capacity to expand into new technological frontiers. Beyond manufacturing, through its subsidiary Eve Air Mobility, the company is developing a comprehensive urban air mobility ecosystem that includes infrastructure, training, certification and service platforms, positioning Brazil as a leading innovator in sustainable mobility.

A key priority for advancing electric mobility in the region is the development of domestic capabilities. Across the region, the main challenge lies in ensuring that the shift towards EVs and new mobility systems strengthens local supply chains and technological capacity, rather than increasing dependency on external markets and foreign technologies. Transitioning from internal combustion engines to EVs requires substantial investments in infrastructure, technological capabilities and supplier development, yet weak domestic linkages continue to limit spillovers to the wider economy.

Capturing these opportunities requires sustained industrial policies, deeper integration of local suppliers and coordinated investment in innovation and infrastructure. Original equipment manufacturers (OEMs) operating in the country can be incentivized to transfer knowledge and technology by linking benefits to verifiable outcomes and fostering technical and R&D partnerships with public institutions, such as through supplier development programmes. At the same time, local suppliers should be strengthened, for instance by improving access to blended finance for high-tech production lines. In Mexico, initiatives such as the IMMEX programme, the 2025 Plan Mexico, and targeted supplier development schemes support SME upgrading and integration into EV production, while PPPs are advancing new EV projects and digital transformation (see Box 8.2). In Brazil, long-term support from development banks, research agencies and innovation ecosystems has been instrumental to Embraer's expansion into eVTOLs and urban air mobility.

8.3.5 Semiconductors

Rising demand driven by the digital transition, combined with the Global North's ongoing friend- and reshoring strategies, positions Central America as a potentially attractive destination for chip production. The semiconductor industry exemplifies how industrial policy can serve as a lever for strategic autonomy: the U.S. Chips and Science Act explicitly aims to reduce dependence on Asian manufacturing while promoting 'nearshoring' to countries such as Mexico and Costa Rica. By allocating USD 500 million to support regional partnerships, the Act creates a strategic window for LAC countries to integrate into the semiconductor value chain, particularly in assembly, testing and packaging (ATP) activities.

Box 8.2 **Mexico: Automotive industry as a core component of Factory America**

Owing to its participation in the North American Free Trade Agreement (NAFTA, now USMCA), Mexico has developed a robust automotive industry deeply integrated into the Northern American market. The country has evolved from hosting basic automotive maquiladora—manufacturing plants that import duty-free inputs for processing or assembly for export—into establishing a sophisticated industrial base embedded in complex transnational production networks. Between 1999 and 2023, vehicle production nearly tripled, reaching 4 million units. By 2024, Mexico ranked as the world's fourth largest auto parts manufacturer, sixth largest heavy truck producer, and seventh largest passenger vehicle producer. The industry directly employs over one million workers, paying wages 40 per cent above the manufacturing average, and generates an estimated 3.5 million indirect jobs. Foreign direct investment in the industry increased from USD 2 billion in 2006 to USD 7.7 billion in 2023.

Mexico's progress in the automotive industry has been supported by a national strategy focused on integrating into global value chains. The Manufacturing, Maquiladora and Export Services Industry programme, launched in 2006, facilitated the internationalization of manufacturing by allowing the temporary import of intermediate goods without payment of import duties or value-added tax, thereby reducing production costs. More recently, the Nearshoring Decree of 2023 introduced fiscal incentives, such as accelerated depreciation of new assets and additional deductions for workforce training, to attract firms' relocating operations to Mexico. In January 2025, under the framework of Plan Mexico, the National Auto Parts Industry Association and the International Finance Corporation of the World

Bank launched a supplier development programme. This initiative aims to strengthen supply chains and integrate small and medium enterprises into the automotive ecosystem by reducing dependence on external inputs, enhancing operational efficiency, attracting foreign investment and fostering innovation, advanced technologies and technical training.

Despite its success, uncertainty clouds the outlook for Mexico's automotive industry. Domestic integration is still limited, with local inputs accounting for only 38 per cent of total inputs, leaving production heavily dependent on Northern American economies. The industry also faces reconversion challenges linked to the transition to e-mobility, where automakers from other regions, especially Asia, have gained a competitive edge through earlier strategic investments. While megatrends may introduce some uncertainties, Mexico is poised to play an increasingly central role within the integrated Northern American industrial ecosystem, serving as both a primary destination for nearshoring initiatives and consolidating its position in the regional market. Strengthening bilateral and regional trade agreements, such as the Economic Complementarity Agreement No. 55, governing automotive trade with Brazil, will help reinforce this role.

Source: UNIDO elaboration based on a background report produced by Ferraz et al. (2025).[46]

In addition to its strategic geographic position, the region can leverage existing capabilities in related industries, such as electronics and automotive, as well as a substantial pool of skilled labour. In Mexico, maquiladora plants in Baja California and Chihuahua assemble televisions, computers and other consumer electronics, providing a foundation of skilled labour and export infrastructure. Costa Rica has capitalized on political stability and early investments in human capital to attract electronic firms (see Box 8.3.). The presence of maquiladora factories in electronics can also serve as a foundation for upgrading in other, less-industrialized countries, such as Honduras.[47] This established industrial base positions Central America to enter specialized niches in ATP and, in the longer term, wafer fabrication.

The path towards semiconductor specialization remains challenging: extreme global concentration, technological uncertainty and limited financial resources present significant obstacles. The international market is dominated by the United States in design and intellectual property, and by Taiwan, Province of China, the Republic of Korea and China in fabrication, making it difficult for LAC countries to compete with these well-established industrial ecosystems. Even with the Chips and Science Act promoting regionalization, projections indicate that Central America may account for no more than 1 per cent of global ATP capacity by 2032.[48] Additionally, the industry's susceptibility to cyclical booms and shortages also necessitates sustained investment and liquidity to weather temporary downturns. Aligning industrial strategies too closely with United States policy also risks confining LAC countries to low value-added ATP functions, limiting opportunities for broader technological upgrading.

Box 8.3 **Costa Rica: Leveraging global investments to build a robust semiconductor industry**

Since the early 1990s, Costa Rica has developed a competitive semiconductor industry. In the early 2000s, Intel's investment in the country, which was initially six times larger than the country's total annual foreign direct investment (FDI) at the time, generated substantial export revenues and created thousands of high-quality jobs. The 2014 relocation of Intel's assembly operations to Asia marked a turning point in Costa Rica's trajectory: while the company moved its production offshore, it retained its local engineering, research and development (R&D) and design capacities. This shift signalled a broader transition from tangible, production-based activities towards a growing specialization in intangible, knowledge-intensive services, with manufacturing providing the foundational base for the industry's development. This transformation is also evident in trade patterns, as exports gradually shifted from electronics to knowledge-intensive business services. Today, Costa Rica hosts a mature semiconductor ecosystem comprising over a dozen firms with more than 25 years of experience, generating around 5,000 direct jobs. This network is supported by over 600 domestic suppliers and a skilled workforce engaged across R&D, design, verification, assembly and testing.

Costa Rica's achievements in the semiconductor industry reflect a long-term national strategy primarily driven by the Costa Rican Investment Promotion Agency (CINDE). The country initially attracted FDI in low-complexity textile maquiladora companies before expanding into electrical and, later, electronic products. Over time, the country has reinforced its position through targeted policy instruments, notably free trade zones, which offer tax and customs incentives in exchange for investment, employment and value-added commitments. These zones have been instrumental in cultivating a skilled pool of young professionals in high-tech industries. In 2024, the government launched the "Roadmap to Strengthen the Semiconductor Ecosystem", structured around four pillars: (i) talent development, (ii) modernization of incentives, (iii) investment attraction, and (iv) regulatory improvement. Costa Rica's strategy also aligns with opportunities arising from the U.S. Chips and Science Act, particularly the International Technology Security and Innovation Fund. For example, in February 2024, Arizona State University was awarded USD 13.8 million to collaborate with Costa Rica and five other partner countries to assess semiconductor capabilities and develop local curricula to train workers for the industry.

Despite Costa Rica's long-term achievements and strong potential in the semiconductor industry, it remains vulnerable due to its heavy reliance on a single lead firm. In July 2025, Intel announced the relocation of parts of its production from Costa Rica to Malaysia and Viet Nam, raising concerns about future developments. However, the country can leverage its strategic location, solid infrastructure, skilled workforce and ongoing trends in GVC reconfiguration to continue diversifying its export basket into higher value-added products.

Source: UNIDO elaboration based on a background report produced by Ferraz et al. (2025).[49]

To address these challenges, countries should focus on attracting foreign firms while strengthening intersectoral linkages between semiconductor production and related industries. Mexico and Costa Rica, in particular, can position themselves as reliable partners, serving both as suppliers to fIrms in the United States and Europe and as hosts for leading Asian producers. Fiscal incentives for foreign investors should be conditional on achieving verifiable milestones and delivering sustainable outcomes. At the same time, strategies should prioritize specialization in semiconductor applications for the automotive and medical device industries, where the region already possesses strong industrial capabilities. Complementary measures, such as developing specialized training programmes, establishing research centres and investing in infrastructure, will be essential to support this transition and enhance long-term competitiveness.

8.3.6 Pharmaceuticals and biopharmaceuticals

Ageing populations in both LAC and globally are driving growth in the region's pharmaceutical market, with projected market value rising from USD 127 billion in 2024 to over USD 234 billion by 2033. Generics account for the bulk of consumption, while biosimilars represent the fastest-growing segment.[50]

LAC possesses a broad base of pharmaceutical and biopharmaceutical capabilities distributed across the region. Costa Rica leads in scientific capacity, clinical research infrastructure and investment attractiveness, supported by national bioeconomy strategies that reinforce its role as a regional innovation hub. Argentina is emerging as a competitive producer of generics and biosimilars,[51] while Cuba stands out for its fully integrated, vertically organized pharmaceutical industry.[52] Brazil hosts a consolidated network of public laboratories and large domestic pharmaceutical groups, enabling effective public-private cooperation in R&D collaborations. Colombia has prioritized the industry through its ongoing industrial strategy (Plan de Reindustrialización). Chile excels in clinical trial intensity, while Mexico has made notable advancements in science infrastructure and regulatory standards.

Despite these strengths, the region faces significant challenges, including limited market access, regulatory uncertainty, reliance on imports and underdeveloped financing frameworks. Production capacity also varies considerably across countries: Mexico and Uruguay reportedly meet 46 per cent and 42 per cent of domestic demand for medicines, respectively; Brazil and Argentina supply around 35 per cent, while Chile and Peru cover only 15 per cent and 12 per cent of national consumption, respectively.[53]

Coordinated industrial policies that integrate investment incentives, regulatory modernization and human capital development can strengthen industrial capabilities in the pharmaceutical and life sciences industries. Costa Rica's experience illustrates how free trade zone incentives, streamlined pharmaceutical registration and robust education systems can attract global manufacturers and build local innovation ecosystems. Implementing similar measures across the region could expand domestic production and reduce reliance on imports. At the same time, aligning industrial strategies with public health objectives and consolidating research, production and commercialization under a central coordinating structure—as exemplified by Cuba's state-led biotechnology organization BioCubaFarma—can strengthen industrial development while ensuring that pharmaceutical innovation translates into equitable health outcomes. Developing regional supply chains, promoting technology transfer and fostering partnerships with global OEMs would further position the region as a competitive hub for pharmaceuticals, biotechnology and medical devices.

8.3.7 Agroprocessing

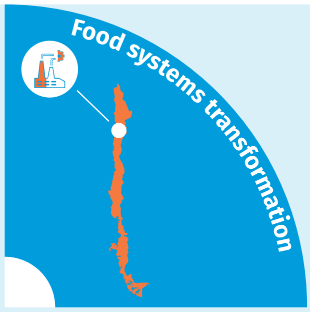
For LAC, with its strong agricultural base, the agroprocessing industry represents a 'low-hanging fruit' for future industrialization. Rising populations, urbanization and a growing middle class are fuelling domestic demand for more processed foods. Currently, processed products account for around one-quarter of caloric intake in countries such as Mexico, Brazil, Chile and Colombia[54] – still well below the levels observed in advanced economies. At the same time, growing awareness of food-related health issues, including obesity and diabetes, together with a shift towards more sustainable consumption patterns, is driving demand for healthier, plant-based and clean-label alternatives, opening new opportunities for innovative firms. Digital technologies can further accelerate this transformation, for example by using AI to accelerate ingredient innovation.

Beyond its strong agricultural base, LAC has also emerged as a global innovator in food processing, driven in part by recently implemented stringent regulations. The industry is characterized by a dual structure: long-established multinationals exist alongside robust domestic champions such as Bimbo in Mexico, Nutresa in Colombia, and JBS and Marfrig in Brazil. These regional players have consolidated a strong presence across the region and are increasingly expanding internationally. Regulatory measures, such as mandatory labelling requirements and taxes on sugary drinks and ultra-processed foods, have further incentivized firms to innovate their product portfolios. Brazil's NOVA classification system, which categorizes the degree of food processing, has redefined dietary guidelines and influenced consumer preferences. This regulatory and industrial environment has also fostered the growth of startups, some evolving into unicorns. In Chile and Brazil, for example companies such as NotCo and Fazenda are leveraging AI to develop alternative proteins and clean-label formulations, successfully entering the North American market and partnering with major food retailers (see Box 8.4). Similarly, Colombia's *Plan de Reindustrialización* promotes digital farming and ecological restoration as pathways towards sustainable industrialization and food sovereignty.

Despite a strong domestic base and innovative capacity, the industry remains vulnerable to external pressures due to input dependency and the dominance of large firms. In several countries, key inputs, particularly cereals and oilseeds, are heavily imported, exposing the industry to global commodity price volatility and trade disruptions.[55] Large domestic and multinational corporations, which often do not prioritize healthier or more sustainable food processing, exert significant influence on governance through lobbying, thereby weakening policy action. Moreover, digital innovation within food systems remains limited. Public investment is low, and multinationals frequently retain their R&D functions in their home countries, constraining local technological upgrading.

Governments can implement forward-looking industrial strategies to develop upstream segments of the value chain, reduce dependency, incentivize innovation and strengthen sectoral regulation. Robust regulatory frameworks that encourage major players to pursue innovative solutions, coupled with an enabling innovation ecosystem that fosters collaboration among domestic champions, startups and research institutions, can enhance the industry's performance and establish the foundations for future sustainable industrialization.

Box 8.4 Chile: Regulation and digital technologies as a pivot for the food-processing industry

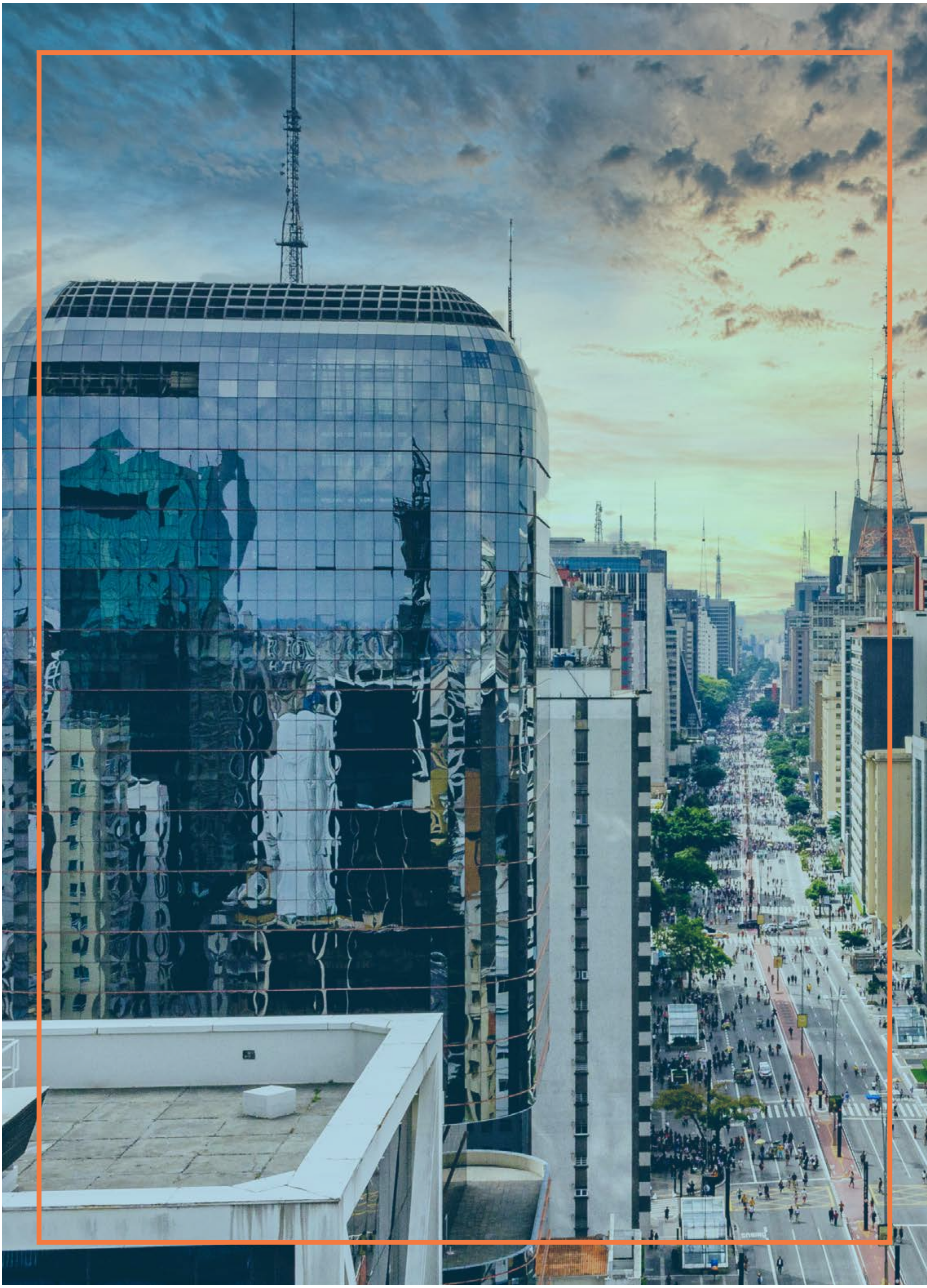


Chile has emerged as a regional leader in innovative food processing, particularly in healthier, clean-label and alternative protein products. The country has consolidated its role as a key player in the global food industry, with the industry ranking second only to mining in terms of contribution to national GDP and exports. The food industry accounts for approximately 18 per cent of gross domestic product, 25 per cent of exports, 20 per cent of domestic sales, 23 per cent of agroprocessing, and 31 per cent of registered companies, highlighting its strategic importance for Chile's industrial development. Within this context, Chile hosts Latin America's first food-processing unicorns, such as NotCo and DE3PBIO, alongside a dynamic ecosystem of startups that harness AI and digital technologies to develop novel ingredients, functional foods and alternative proteins. Many of these firms have successfully expanded beyond domestic markets into other Latin American countries and Northern America, increasingly supporting global consumer packaged goods companies in reformulating products to meet stricter health regulations.

This transformation has been driven by a combination of regulatory measures and innovation policies. In Chile, efforts to address the rise of non-communicable diseases included the introduction of a nutrient profiling system to classify unhealthy foods, front-of-package warning labels, and restrictions on the consumption and marketing of unhealthy foods for children. Early adoption of these measures created strong market incentives for product reformulation and innovation. Complementing this regulatory push, Chile has promoted innovation through initiatives such as the Start-Up Chile accelerator and the Transforma Alimentos programme, both under the supervision of the Chilean Economic Development Agency (CORFO). These coordinated efforts provided equity-free funding, one-year visas, grants, accommodation and access to innovation facilities, helping domestic and international entrepreneurs transform ideas into viable businesses. Notably, Start-Up Chile extended beyond agroprocessing, reducing the influence of established interest groups and fostering a more open innovation ecosystem, while Transforma Alimentos channelled increased efforts in the industry.

Despite the programme's success in fostering innovation, several challenges threaten its long-term impact. While it has attracted a wide range of startups, its relatively modest funding is better suited for short-term, software-oriented ventures. To support more durable food-tech startups, future efforts should prioritize longer-term investment and the development of advanced equipment, such as fermentation tools, bioreactors and digital food printers, areas in which Latin America remains underdeveloped.

Source: UNIDO elaboration based on a background report produced by Ferraz et al. (2025).[56]



ENDNOTES

[1] Average MVA per capita in LAC currently stands at USD 1,200 (at constant 2017 prices) against USD 1,300 in 2000.

[2] Projections presented in this chapter are based on the *current path* scenario of the IFs model. For a detailed explanation of this scenario, refer to Annex A.1.

[3] Analyses of bottlenecks in LAC are primarily based on the background note prepared by partners, which draws on specialized literature on industrialization in the region, notably Ferraz et al. (2025).

[4] Khan and Blankenburg (2009).

[5] Peres and Primi (2024).

[6] OECD et al. (2021); (2018).

[7] OECD et al. (2023); Santiso (2007).

[8] ECLAC (2024); Ferraz et al. (2023).

[9] CAF (2023); OECD (2019); OECD et al. (2024).

[10] Arias Ortiz et al. (2023); OECD et al. (2019).

[11] ECLAC (2022).

[12] ECLAC (2024a).

[13] ECLAC (2023a); OECD et al. (2023).

[14] ECLAC (2024b).

[15] OECD et al. (2021).

[16] Baumann (2010).

[17] Ayres et al. (2025); ECLAC (2025a).

[18] OECD et al. (2024).

[19] CAF (2024).

[20] Galindo and Izquierdo (2024).

[21] ECLAC (2025b).

[22] ECLAC (2024a).

[23] ILO (2024).

[24] Abramo (2022).

[25] IEA (2025d).

[26] Government of Chile (2023).

[27] MHE (2024a); (2024b); Obaya (2025).

[28] Bridge and Faigen (2022).

[29] ECLAC (2023b).

[30] ECLAC (2023c).

[31] OECD and IDB (2024).

[32] Brazil, for example, has expanded its electricity generation capacity from 73 GW in 2000 to 206 GW in 2022, with wind power accounting for 24 GW of installed capacity, making Brazil the world's seventh-largest wind energy producer. Argentina possesses the fourth-largest offshore wind potential in the world, and the highest onshore wind potential in the region, with Patagonia ranking among the world's windiest places. See OECD (2025d).

[33] Inter-sectoral linkages extend beyond Brazil. In Argentina, for example the first plant for manufacturing wind turbine components was recently inaugurated, the result of an agreement between a global wind power supplier, Nordex Group, and Argentina's FAdeA, a firm originally engaged in the aviation industry.

[34] Parés Olguín and Busch (2024).

[35] IEA (2023c).

[36] IEA (2025e).

[37] IEA (2023d).

[38] Nova Institute (2023).

[39] Golden and Handfield (2014).

[40] This case study was developed based on a background note produced by Bomtempo et al. (2025), building on consultations with the following experts: Luiz Augusto Horta, Bruno Nunes, Christian Blanco and Juan Martinez. The data reported in this box are taken from ECLAC (2024a).

[41] This is particularly important for the Caribbean, where, since 2011, large influxes of sargassum along coastlines have severely affected public health, disrupted economic activities, such as fishing and tourism, and damaged coastal ecosystems, see IDB (2025).

[42] Since 2011, several funding initiatives have been launched to develop sustainable solutions to the sargassum problem, including support from Horizon Europe (2025), as well as from the Inter-American Development Bank (IDB) (2025) and the Government of Japan, implemented through the United Nations Development Programme ((UNDP) (2025b)).

[43] See Bennett et al. (2025).

[44] Jouanno et al. (2025).

[45] See Messina et al. (2022).

[46] This case study was developed based on a background note produced by Garrido (2025a), building on consultations with the following experts: Ramón Padilla, Carlos Rozo and Ricardo Monge. The data reported in this box are taken from OICA (2025).

[47] Editor Latam (2024).

[48] Varadarajan et al. (2024, p. 21).

[49] This case study was developed based on a background note produced by Garrido (2025b), building on consultations with the following experts: Ramón Padilla, Carlos Rozo and Ricardo Monge.

[50] Market Data Forecast (2025).

[51] Papini and Morinigo (2020).

[52] Vargas et al. (2022).

[53] Ibid.

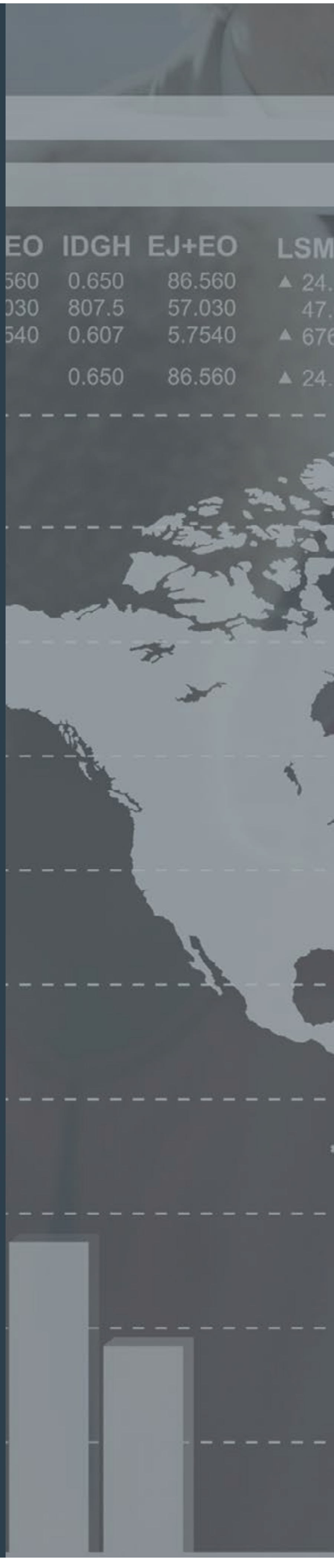
[54] Martins et al. (2013); Cediel et al. (2018).

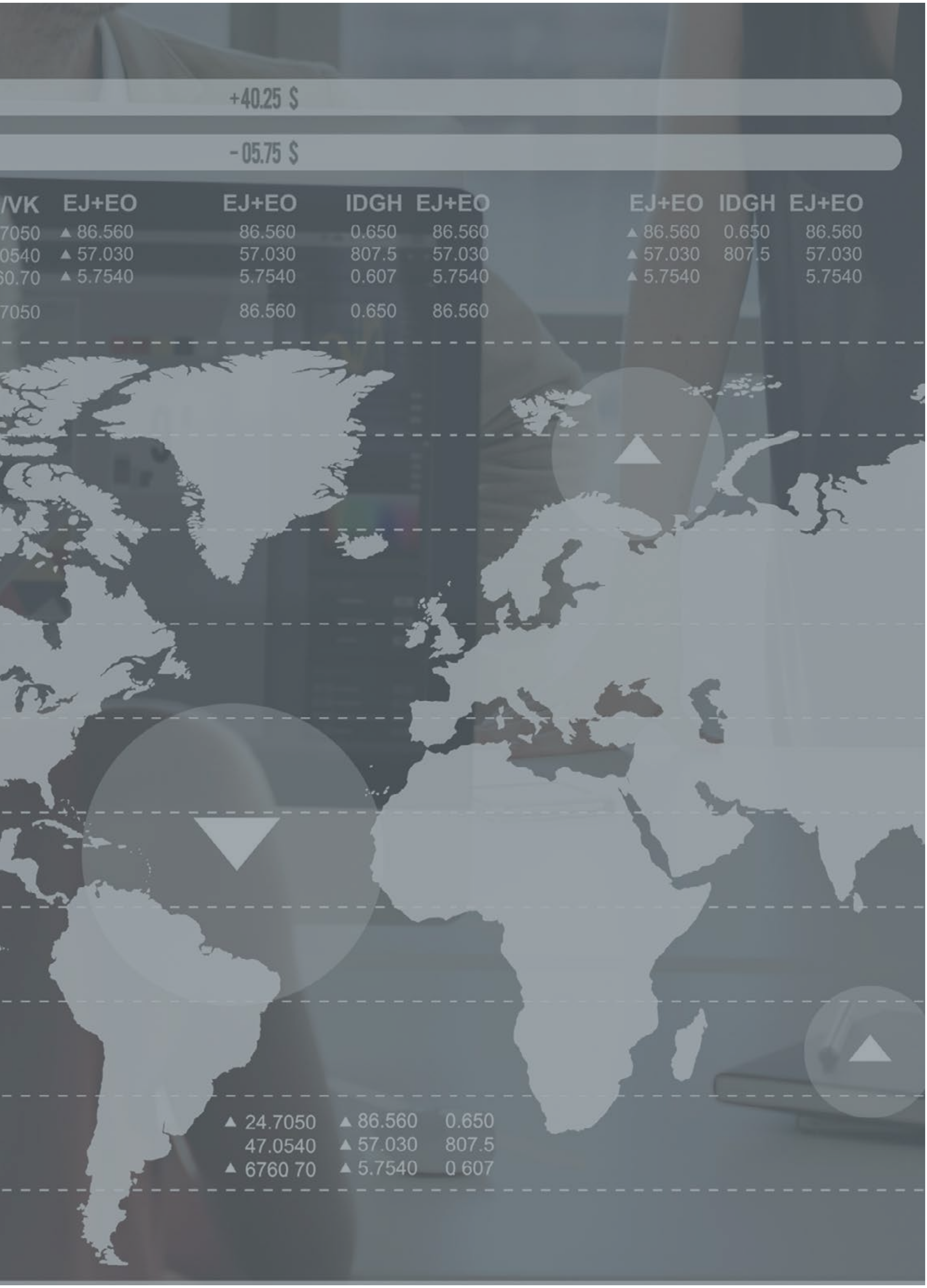
[55] Sandström et al. (2024).

[56] This case study was developed based on a background note produced by Wilkinson (2025), building on consultations with the following experts: Ruth Rama, Eduardo Trigo, Michelle Chauvet and Walter Belik. The data reported in this box are taken from InvestChile (2021).

PART C

Annexes and references





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ANNEXES

A.1 PROJECTIONS TO 2050 UNDER DIFFERENT SCENARIOS

A.1.1 International Futures Model

The projections to 2050 included in the report are based on the International Futures (IFs) model developed by the Frederick S. Pardee Institute for International Futures at the University of Denver. IFs is a globally recognized integrated assessment tool designed to support long-term development forecasts under different interventions. It is a dynamic model that interconnects more than 1,000 variables across key development systems, including demographics, education, the economy, the environment, energy, agriculture, and technology. The model allows us to examine the current trajectory of major global systems and develop alternative scenarios under "if-then" statements about the future. For a detailed overview of the IFs model structure and assumptions, see Hughes (2019) and Pardee's wiki platform.

In the IDR 2026, projections were generated using version 8.53 of the IFs model. The model was customized to reflect UNIDO's classification of the manufacturing sector and data on manufacturing value-added, consistent with the UNIDO Statistics Data Portal. Countries were aggregated according to the regional and development-level classification applied throughout the report (see Annex A.3 for details on country groupings).

A.1.2 Variables

For each country group, the following variables were projected from the base year (2020) to 2050**:**

- Economy-wide CO_2 emissions
- Economy-wide employment
- Global average temperature
- Gross Domestic Product (GDP), in constant 2021 USD
- Manufacturing CO_2 emissions
- Manufacturing employment
- Manufacturing value added (MVA), in constant 2021 USD
- Population
- Population living in extreme poverty (under the international poverty line of USD 3.00 per day)
- Population living in poverty (under the international poverty line of USD 8.30 per day)
- Undernourished population

A.1.3 Scenarios

Variables were projected under a *current path scenario*, along with two alternative scenarios that simulate a series of interventions across all developing countries yet to industrialize. In the two alternative scenarios, interventions were applied to economies that are not classified as high-income industrial economies (HIIEs) and have a MVA share of less than 25 per cent of GDP in 2025. This set of criteria targets countries that both need and have the potential for further industrialization. See Table A.1 for the complete list of economies included in the intervention group.

1. The *current path scenario*, also referred to as the *baseline* or *business-as-usual*, is IFs' base case scenario. It represents the most likely trajectory of development if historical patterns continue without major policy shifts or external shocks. This scenario is not a simple extrapolation of past trends, but the result of dynamic interactions across IFs' development systems. It incorporates the gradual unfolding of major megatrends, such as demographic transition, climate change and technological diffusion, and assumes no coordinated global effort or breakthrough innovation that would alter the trajectory. It thus provides a benchmark to assess what the future might look like in the absence of deliberate course corrections.

2. The *industrialization push scenario* is the first alternative scenario and explores what would happen if developing countries pursue ambitious policies to accelerate industrial development. It models a set of interventions designed to increase investment in manufacturing, expand productive capacity, improve enabling infrastructure and institutions and mobilize innovation and skills development. This scenario corresponds to a significant industrial strategy push and is aligned with the enabling conditions and policy priorities discussed in Chapter 3. See Table A.2 for the complete list of interventions simulated in this scenario, including IFs' parametrization and magnitude.

3. The *clean energy and just industrialization push* builds on the assumption that rapid industrialization must also be aligned with climate goals and equitable development. It includes all interventions from the *industrialization push* but adds an explicit focus on environmental sustainability and social inclusion through targeted actions to reduce emissions, promote energy transition and ensure social welfare. See Table A.3 for the details of additional interventions simulated in this scenario, including IFs' parametrization and magnitude.

Table A.1 **Economies included in the intervention group**

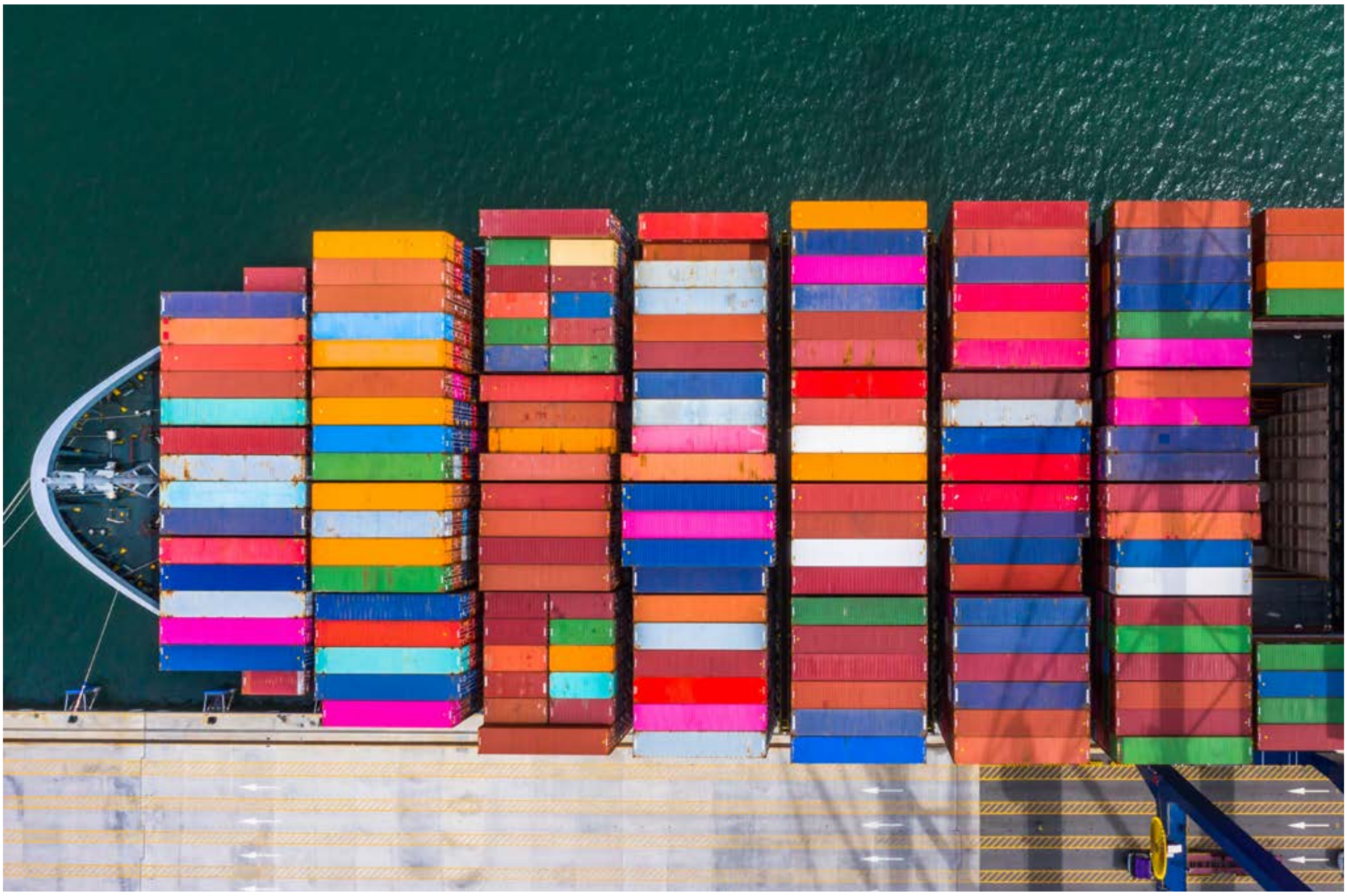
• Afghanistan	• Ecuador	• Liberia	• Senegal
• Albania	• Egypt	• Libya	• Serbia
• Algeria	• El Salvador	• Madagascar	• Seychelles
• Angola	• Equatorial Guinea	• Malawi	• Sierra Leone
• Argentina	• Eritrea	• Malaysia	• Solomon Islands
• Armenia	• Eswatini	• Maldives	• Somalia
• Azerbaijan	• Ethiopia	• Mali	• South Africa
• Bahamas	• Fiji	• Mauritania	• South Sudan
• Bangladesh	• Gabon	• Mauritius	• Sri Lanka
• Barbados	• Gambia	• Mexico	• St. Lucia
• Belarus	• Georgia	• Micronesia	• St. Vincent and the Grenadines
• Belize	• Ghana	• Mongolia	• State of Palestine
• Benin	• Grenada	• Montenegro	• Sudan
• Bhutan	• Guatemala	• Morocco	• Suriname
• Bolivia (Plurinational State of)	• Guinea	• Mozambique	• Syrian Arab Republic
• Bosnia and Herzegovina	• Guinea-Bissau	• Myanmar	• Tajikistan
• Botswana	• Guyana	• Namibia	• Thailand
• Brazil	• Haiti	• Nepal	• Timor-Leste
• Brunei Darussalam	• Honduras	• Nicaragua	• Togo
• Burkina Faso	• Hong Kong SAR, China	• Niger	• Tonga
• Burundi	• India	• Nigeria	• Trinidad and Tobago
• Cabo Verde	• Indonesia	• North Macedonia	• Tunisia
• Cameroon	• Iran (Islamic Republic of)	• Oman	• Turkey
• Central African Republic	• Iraq	• Pakistan	• Turkmenistan
• Chad	• Jamaica	• Panama	• Uganda
• Colombia	• Jordan	• Papua New Guinea	• Ukraine
• Comoros	• Kazakhstan	• Paraguay	• United Arab Emirates
• Congo	• Kenya	• Peru	• United Republic of Tanzania
• Costa Rica	• Kiribati	• Philippines	• Uzbekistan
• Côte d’Ivoire	• Kosovo	• Qatar	• Vanuatu
• Cuba	• Kuwait	• Republic of Moldova	• Venezuela (Bolivarian Republic of)
• Democratic People’s Republic of Korea	• Kyrgyzstan	• Rwanda	• Yemen
• Democratic Republic of the Congo	• Lao People’s Democratic Republic	• Samoa	• Zambia
• Djibouti	• Lebanon	• Sao Tome and Principe	• Zimbabwe
• Dominican Republic	• Lesotho	• Saudi Arabia	

Table A.2 **Interventions in the *industrialization push scenario***

Area of intervention	Impacted variable	Impacted group	Parameterization	Magnitude
1. Direct interventions in the manufacturing sector	Manufacturing capital	*Intervention group*	• *ksm*, manufactures • 1.01 over 25 years	*Total capital stock (USD) increases by 70% relative to the current path (CP) by 2050. MVA by region ranges from 16 to 25% of GDP by 2050.*
	Investment in manufacturing		• *ids*, manufactures • 1.1 over 10 years	*Investment grows to 10% of GDP, and catches up with the East and South-Eastern Asia region average by 2050.*
	Manufacturing exports		• *xsm*, manufactures • 1.1 over 10 years	*Manufacturing exports reach just over 30% of GDP, against 18% in the CP.*
2.a Interventions to strengthen the industrial ecosystem (Infrastructure)	Government spending on infrastructure		• *gdsm*, infrastructure • 1.3 over 5 years	*Infrastructure spending reaches 3% of GDP in 2030 and remains 0.5 percentage points above the CP through to 2050.*
	Road network		• *infraroadm* • 1.25 over 5 years	*Road density per land area increases from 3.4 km per 1,000 inhabitants in the CP to 4.5 km per 1,000 inhabitants. This is still below the high-income industrial HIIEs' average (5.2 km).*
	Electricity access		• *infraelecaccm*, rural • 1.25 over 5 years	*Total access to electricity reaches 96% by 2050, against 91% in CP. Rural access reaches 94, against 85% in the CP.*
	Fixed broadband		• *ictbroadm* • 1.25 over 5 years	*Broadband subscriptions per 100 population grow to 45 by 2050, up from 33 in the CP, and are below the HIIEs' average (50).*
2.b Interventions to strengthen the industrial ecosystem (Institutions)	Government effectiveness		• *goveffectm* • 1.2 over 10 years	*Government effectiveness in the intervention group reaches 3.3 by 2050 against 2.7 in the CP, and is below the HIIEs' average (4.3).*
	Corruption		• *govcorruptm* • 1.2 over 10 years	*Corruption in the group reaches 6.1 by 2050 vs. 4.9 in the CP, and is below the HIIEs' average (9.8).*
	Government business regulation		• *govbusregindm* • 0.9 over 10 years	*Informal employment in the intervention group falls to 44%, against 52% in the CP, and still much higher than HIIEs average (8%).*
2.c Interventions to strengthen the industrial ecosystem (Skills)	Primary survival	*Regions lower than 90%: Africa and the Pacific*	• *edprisurm* • 1.1 over 10 years	*Survival rate in the intervention group grows by 7 percentage points above CP by 2050, but is still not fully universal (100%). Primary gross enrollment rate (GER) is higher than 100%.*
	Lower secondary transition		• *edseclowrtranm* • 1.1 over 10 years	*Transition rates grow by 7 percentage points above the CP, and is near-universal by 2050. Lower Secondary GER is projected to reach 100% by 2050.*
	Upper secondary transition	Regions lower than 90%: Africa, the Pacific and Western Asia	• *edsecupprtranm* • 1.2 over 10 years	*Western Asia and the Pacific reach near universal by 2035, and Africa by 2050. Upper Secondary GER catches up to other regions by 2040-50.*
	Vocational share of lower secondary	*Intervention group*	• *edseclowrvocadd* • 4 over 10 years	*The vocational share reaches just over 5%, double the HIIEs' average. It is roughly the same as the values observed in Germany and the Netherlands.*
	Vocational share of upper secondary		• *edsecupprvocadd* • 8 over 10 years	*The vocational share reaches 24%, and is in line with the HIIEs' average.*
2.d Interventions to strengthen the industrial ecosystem (Technology)	Government spending on *research and development* (R&D)		• *gdsm*, R&D • 1.3 over 5 years	*Government R&D spending grows by 30% over the CP, reaching the HIIEs' average level (0.2% of GDP) by the 2040s.*
	Science and engineering tertiary degrees		• *edterscienshradd* • 10 over 5 years	*The share grows from 20% in the CP to 30% in the intervention group by 2050.*
2.e Interventions to strengthen the industrial ecosystem (Trade)	Export promotion		• *xshift*, manufactures • 0.04 over 10 years	*Exports in the intervention group reach just under 45% of GDP, against 36% in the CP, in line with many HIIEs.*
2.f Interventions to strengthen the industrial ecosystem (Investment)	Foreign direct investment (FDI)		• *xfdifinm* • 1.25 over 5 years	*FDI inflows grow by 0.5 percentage points over the CP annually, leading to a 2% increase in the FDI stock, as a percentage of GDP.*

Table A.3 **Interventions in the *clean energy and just industrialization push scenario***

Area of intervention	Impacted variable	Impacted group	Parameterization	Magnitude
3. Interventions to support the green transition	Electricity transmission and distribution loss	*Intervention group*	• *infraelectranlossm* • 0.8 over 10 years	*The loss of electricity during transmission and distribution falls by 2 percentage points from the CP, equivalent to a 20% relative reduction.*
	Renewable energy capital cost to output ratio		• *qem*, Hydro, Geothermal, • Other Renewables 0.9 over 10 years	*Due to technological advances, the cost of energy production falls by 5% for geothermal and 10% for hydro and other renewables compared to the CP. By 2050, production of these energies grows between 12 and 28% higher than the CP.*
	Solar and wind energy capital cost to output ratio		• *qem*, solar and wind • 0.8 over 10 years	*Due to technological advances, the cost of energy production falls by 18% from the CP in the intervention group. By 2050, solar production is 70% higher than in the CP and wind production is nearly 50% higher.*
	Coal capital cost to output ratio		• *qem*, coal • 1.2 over 10 years	*The capital-to-output cost ratio for coal increases, making it more expensive to produce. By 2050, coal production falls 15% below the CP and peaks globally by 2040.*
4. Interventions to make the transition fairer	Welfare transfers		• *govhhtrnwelm*, unskilled • 1.25 over 10 years	*Welfare transfers from governments to unskilled households increase by 60% in the intervention group by 2050.*
	Female labour force participation		• *labparm*, female • 1.1 over 10 years	*The female labour participation rate in the intervention group increases by 5 percentage points to 54% by 2050.*



A.2 ASSESSING REGIONAL BOTTLENECKS FOR THE FUTURE OF INDUSTRIALIZATION

The regional assessment of industrialization enablers conducted in PART B builds on a set of indicators compiled from multiple data sources, which are processed to achieve maximum geographical coverage and cross-country, cross-indicator comparability. The analysis is based on 14 indicators grouped into seven dimensions, following a taxonomy developed from contributions of regional experts who participated in the production of the IDR26. These are complemented by three additional cross-cutting indicators.

A.2.1 Data selection

The main source used in this analysis is the SDG Global Database (UNSD 2025a), which is maintained by the Statistics Division of the United Nations Department of Economic and Social Affairs. The SDG Global Database compiles data from the United Nations System and agencies, including UNIDO, who act as the custodian of specific indicators. These were complemented with data from:

- BACI (Base pour l'Analyse du Commerce International), maintained by the Centre d'Études Prospectives et d'Informations Internationales (CEPII) (Gaulier and Zignago, 2010).
- The Global Material Flows Database, maintained by the International Resource Panel of the United Nations Environment Programme (UNEP IRP, 2025).
- ILOSTAT (ILO, 2025).
- The United Nations Trade and Development Statistics (UNCTAD, 2025a).
- The World Development Indicators (World Bank, 2025a), the World Governance Indicators (World Bank, 2025b), and the World Bank Group Scorecard (World Bank, 2025c).

The indicators were selected based on their relevance to illustrate the enablers for future industrialization and on the availability of sufficient country-level coverage across the regions and subgroups covered in the analysis.

A.2.2 Data gaps imputations

The missing data points in the original datasets were filled using standard imputation techniques. This process followed a three-step algorithm designed to apply the most appropriate imputation method given the data's characteristics and the pattern of missing data:

1. Linear interpolation whenever there are missing values between two years with data;
2. Automatic ARIMA (Auto Regressive Integrated Moving Average)[1] to impute forward values whenever there are at least five consecutive years with available data;
3. Last Observation Carried Forward (LOCF) to impute missing data forward in time, and the Next Observation Carried Backward (NOCB) method for backward imputation, whenever the previous two methods could not be applied.

A.2.3 Setting targets and dealing with outliers

To mitigate the potential outliers in single-year observations, country-level values were defined as the average of the three most recent years for each country and indicator, after the imputation procedure (described above) was used.[2] Depending on the indicator, these years correspond to 2021-2023 or 2022-2024 (see Table A.4).

For each indicator included in the analysis, the next step was to establish a quantitative and fixed target. Since higher values represent better outcomes for all indicators,[3] the target for each was set at the 95th percentile (p95) of its distribution of country-level values, after the averaging procedure described above.

In addition to time-related outliers, some countries may display exceptionally high values in certain indicators. To prevent distortions arising from country-level outliers, values for each indicator were capped at their respective targets (upper-tail winsorisation).

A.2.4 Regionalization

After filling in all gaps in the country-level series and handling outliers, the next step was to aggregate these data points at the regional and subregional levels. For this, country-level data for each dimension was aggregated into the defined regions and subregions using simple averages. The list of countries included in each region and subregion is presented in the first table of each regional chapter.

A.2.5 Normalization

After regionalization, the resulting data were normalized to ensure comparability across all indicators. Each indicator was normalized on a scale from 0 to 1 using a min-max normalization technique. This method adjusts the data points so that a score of 1 corresponds directly to achieving the predefined fixed target. A value of 1 reflects optimal target achievement. The normalization is applied to each regional value in each indicator (regional simple average) based on the country-level target for that indicator. This ensures that each data point is comparably scaled, making it easier to compare indicators.

Table A.4 **Indicators used in regional assessments of bottlenecks.**

Category	Indicator	Description	Time range	Perc. 95	Source
Institutions	Government effectiveness	An index of perceptions of the quality of public service, civil service, policy formulation and implementation and government credibility.[1]	2022-2024	1.59	World Governance Indicators
Institutions	Political stability	An index of perceptions of the likelihood of political instability and politically motivated violence, including terrorism (see notes).	2022-2024	1.22	World Governance Indicators
Infrastructure	Access to electricity	The percentage of the population with access to electricity.	2021-2023	100	SDG Global Database
Infrastructure	5G coverage	The percentage of the population covered by at least a 5G mobile network.	2021-2023	96	SDG Global Database
Labour force	Information and Communication Technology skills	The percentage of youth and adults who can use basic arithmetic formulas in a spreadsheet.	2022-2024	57	SDG Global Database
Labour force	Tertiary school	The percentage of the tertiary school-age population enrolled in tertiary education.	2022-2024	98	World Development Indicators
Technology	R&D expenditure	R&D expenditure as a share of GDP	2021-2023	3.29	SDG Global Database
Technology	Scientific researchers	Researchers (in full-time equivalent) per million inhabitants.	2021-2023	6,347	SDG Global Database
Trade and integration	Export diversification	The product diversification index of exports.[2]	2022-2024	11.9	UNCTADStat
Trade and integration	Intraregional trade	The share of trade (imports plus exports) with partners in the same region and income group (developing or advanced).	2021-2023	78	CEPII
Production greening	Share of renewables	Renewable energy consumption as a share of total final energy consumption.	2021-2023	81	SDG Global Database
Production greening	MVA per material consumption	The MVA in 2015 USD per unit of material consumption for manufacturing.[3]	2022-2024	14,606	Global Material Flows Database and UNIDO
Finance and investment	Loans to SMEs	The share of small-scale industries with a loan or line of credit.	2021-2023	68	SDG Global Database
Finance and investment	Debt stability	The country at the low or moderate risk of debt distress (binary).[4]	2022-2024	1	World Bank Group Scorecard
Cross-cutting issues	Informality and gender	The share of overall informal workers in manufacturing.	2022-2024	87	ILOstats
Cross-cutting issues	Informality and gender	The share of female informal workers in manufacturing.	2022-2024	100	ILOstats
Cross-cutting issues	Informality and gender	Share of male informal workers in manufacturing.	2022-2024	82	ILOstats

Notes: 1) Data on government effectiveness and political stability range from -2.5 to 2.5; 2) Export diversification is measured as the reciprocal of the normalized Herfindahl-Hirschman Index (1/HHI) for export products; 3) To restrict data on material consumption in industry, six categories of material consumption (out of 22) were chosen that are more likely to be consumed in manufacturing: "ferrous ores", "non-ferrous ores", "non-metallic minerals" with "industrial or agricultural dominant", "products mainly from metals nec.", "products mainly from non-metallic minerals", and "other products mainly from fossil fuels, e.g., plastics". 4) Data on debt stability is not averaged over the three most recent years. Instead, if the country is at high risk of, or in debt distress in any of those years, it is considered as not in debt stability. GDP = Gross domestic product; MVA = Manufacturing value added; R&D = Research and development; SMEs = Small and medium-sized enterprises.

A.3 COUNTRY AND ECONOMY GROUPS

A.3.1 Country/area classification by geographical region

Box A.1 **Africa**

Central Africa
Angola
Cameroon
Central African Republic
Chad
Congo
Democratic Republic of the Congo
Equatorial Guinea
Gabon
Sao Tome and Principe

Eastern Africa
Burundi
Comoros
Djibouti
Eritrea
Ethiopia
Kenya
Madagascar
Malawi
Mauritius
Mozambique
Rwanda
Seychelles
Somalia
South Sudan
Uganda
United Republic of Tanzania
Zambia
Zimbabwe

Northern Africa
Algeria
Egypt
Libya
Morocco
Sudan
Tunisia

Southern Africa
Botswana
Eswatini
Lesotho
Namibia
South Africa

Western Africa
Benin
Burkina Faso
Cabo Verde
Côte d'Ivoire
Gambia
Ghana
Guinea
Guinea-Bissau
Liberia
Mali
Mauritania
Niger
Nigeria
Senegal
Sierra Leone
Togo

Source: UNIDO elaboration

Box A.2 **Americas**

Latin America and the Caribbean

Central America
Belize
Costa Rica
El Salvador
Guatemala
Honduras
Mexico
Nicaragua
Panama

South America
Argentina
Bolivia (Plurinational State of)
Brazil
Chile
Colombia
Ecuador
Guyana
Paraguay
Peru
Suriname
Uruguay
Venezuela (Bolivarian Republic of)

The Caribbean
Anguilla
Antigua and Barbuda
Aruba
Bahamas
Barbados
British Virgin Islands
Cayman Islands
Cuba
Curaçao
Dominica
Dominican Republic
Grenada
Haiti

Jamaica
Montserrat
Puerto Rico
Saint Kitts and Nevis
Saint Lucia
Sint Maarten (Dutch part)
St. Vincent and the Grenadines
Trinidad and Tobago
Turks and Caicos Islands

Northern America
Bermuda
Canada
Greenland
United States of America

Source: UNIDO elaboration

Box A.3 **Asia-Pacific**

Asia

Central Asia[a]
Kazakhstan
Kyrgyzstan
Tajikistan
Turkmenistan
Uzbekistan

Eastern Asia
China
China, Hong Kong SAR
China, Macao SAR
China, Taiwan Province
Democratic People's Republic of Korea
Japan
Mongolia
Republic of Korea

South-Eastern Asia
Brunei Darussalam
Cambodia
Indonesia
Lao People's Democratic Republic
Malaysia
Myanmar
Philippines
Singapore
Thailand
Timor-Leste
Viet Nam

Southern Asia
Afghanistan
Bangladesh
Bhutan
India
Iran (Islamic Republic of)
Maldives
Nepal
Pakistan
Sri Lanka

Western Asia
Bahrain
Cyprus
Iraq
Israel
Jordan
Kuwait
Lebanon
Oman
Qatar
Saudi Arabia
State of Palestine
Syrian Arab Republic
Turkey
United Arab Emirates
Yemen

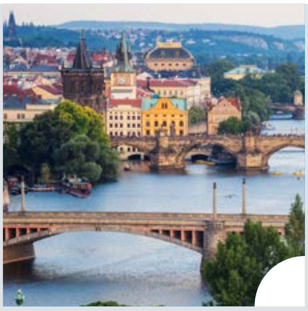
South Caucasus[b]
Armenia
Azerbaijan
Georgia

The Pacific
Cook Islands
Fiji
French Polynesia
Kiribati
Marshall Islands
Micronesia (Federated State of)
Nauru
New Caledonia
Palau
Papua New Guinea
Samoa
Solomon Islands
Tonga
Tuvalu
Vanuatu

Note: a) The analysis of this sub-region is included in Chapter 7; b) The analysis of this sub-region is included in Chapter 7.

Source: UNIDO elaboration

Box A.4 **Europe**



Eastern Europe

Central Eastern Europe
Belarus
Bulgaria
Czechia
Hungary
Poland
Republic of Moldova
Romania
Russian Federation
Slovakia
Ukraine

Northern Eastern Europe
Estonia
Latvia
Lithuania

Southern Eastern Europe
Albania
Bosnia and Herzegovina
Croatia
Montenegro
North Macedonia
Serbia
Slovenia

Western Europe
Andorra
Austria
Belgium
Denmark
Finland
France
Germany
Greece
Iceland
Ireland
Italy
Liechtenstein
Luxembourg
Malta
Monaco
Netherlands
Norway
Portugal
San Marino
Spain
Sweden
Switzerland
United Kingdom

Source: UNIDO elaboration

Box A.5 **Oceania**

Australia
New Zealand

Note: The analysis of this region is included in Chapter 6.

Source: UNIDO elaboration

A.3.2 Country/area classification by stage of development

Box A.6 **High-income industrial economies (HIIEs)**

Australia
Austria
Bahrain
Belgium
Bulgaria
Canada
Chile
China, Taiwan Province
Croatia
Cyprus
Czechia
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Iceland
Ireland
Israel
Italy
Japan
Latvia
Liechtenstein
Lithuania
Luxembourg
Malta
Nauru
Netherlands
New Zealand
Norway
Poland
Portugal
Puerto Rico
Republic of Korea
Romania
Russian Federation
San Marino
Singapore
Slovakia
Slovenia
Spain
Sweden
Switzerland
United Kingdom
United States
Uruguay

Source: UNIDO elaboration

Box A.7 **High-income industrializing economies (HINGEs)**

Andorra
Anguilla
Antigua and Barbuda
Aruba
Bahamas
Barbados
Bermuda
British Virgin Islands
Brunei Darussalam
Cayman Islands
China, Hong Kong SAR
China, Macao SAR
Cook Islands
Curaçao
French Polynesia
Greenland
Guyana
Kuwait
Monaco
Montserrat
New Caledonia
Oman
Palau
Panama
Qatar
Saint Kitts and Nevis
Saudi Arabia
Seychelles
Sint Maarten (Dutch part)
Trinidad and Tobago
Turks and Caicos Islands
United Arab Emirates

Source: UNIDO elaboration

Box A.8 **Upper middle-income economies (UMIEs)**

Albania
Algeria
Argentina
Armenia
Azerbaijan
Belarus
Belize
Bosnia and Herzegovina
Botswana
Brazil
China
Colombia
Costa Rica
Cuba
Dominica
Dominican Republic
Ecuador
El Salvador
Equatorial Guinea
Fiji
Gabon
Georgia
Grenada
Guatemala
Indonesia
Iran (Islamic Republic of)
Iraq
Jamaica
Kazakhstan
Libya
Malaysia
Maldives
Marshall Islands
Mauritius
Mexico
Mongolia
Montenegro
Namibia
North Macedonia
Paraguay
Peru
Republic of Moldova
Saint Lucia
Serbia
South Africa
St. Vincent and the Grenadines
Suriname
Thailand
Tonga
Turkey
Turkmenistan
Ukraine
Venezuela (Bolivarian Republic of)

Source: UNIDO elaboration

Box A.9 Lower middle-income economies (LMIEs)

Angola
Bangladesh
Benin
Bhutan
Bolivia (Plurinational State of)
Cabo Verde
Cambodia
Cameroon
Comoros
Congo
Côte d'Ivoire
Djibouti
Egypt
Eswatini
Ghana
Guinea
Haiti
Honduras
India
Jordan
Kenya
Kiribati
Kyrgyzstan
Lao People's Democratic Republic
Lebanon
Lesotho
Mauritania
Micronesia (Federated State of)
Morocco
Myanmar
Nepal
Nicaragua
Nigeria
Pakistan
Papua New Guinea

Philippines
Samoa
Sao Tome and Principe
Senegal
Solomon Islands
Sri Lanka
State of Palestine
Tajikistan
Timor-Leste
Tunisia
Tuvalu
United Republic of Tanzania
Uzbekistan
Vanuatu
Viet Nam
Zambia
Zimbabwe

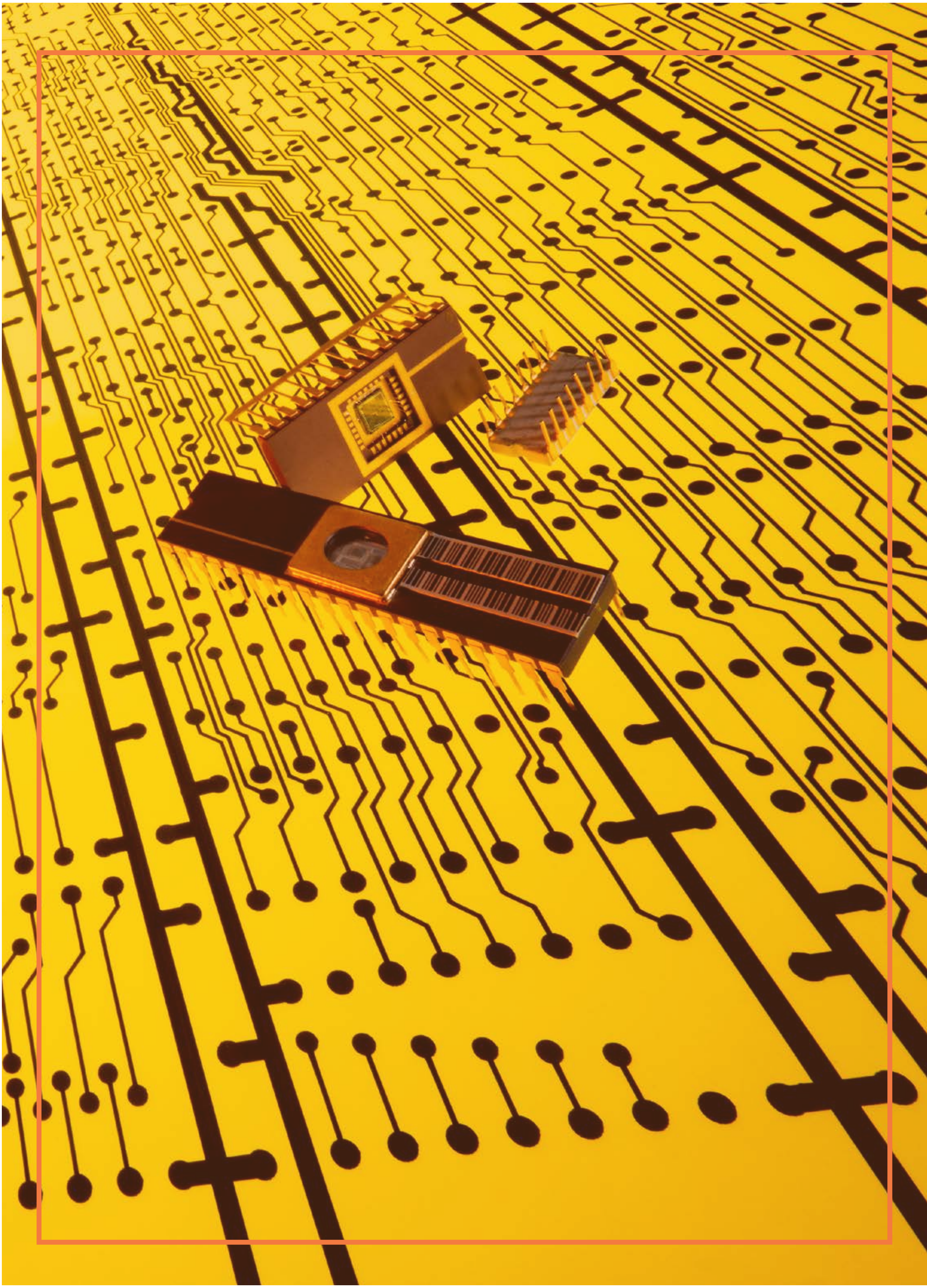
Source: UNIDO elaboration

Box A.10 Low-income economies (LIEs)

Afghanistan
Burkina Faso
Burundi
Central African Republic Chad
Democratic People's Republic of Korea
Democratic Republic of Congo
Eritrea
Ethiopia
Gambia
Guinea-Bissau
Liberia
Madagascar
Malawi
Mali
Mozambique
Niger
Rwanda
Sierra Leone
Somalia
South Sudan
Sudan

Syrian Arab Republic
Togo
Uganda
Yemen

Source: UNIDO elaboration



ENDNOTES

[1] This technique leverages the past values of the time series to predict future observations but does not impute data backwards to preserve the chronological integrity of the dataset.

[2] The data on debt stability is not based on the averages. See the notes of Table A.4.

[3] The data on export diversification was transformed so that higher values represent better outcomes – see notes of Table A.4.

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