

THE FUTURE OF INDUSTRIALIZATION

“Building FutureReady Industries To Turn Challenges Into Sustainable Solutions”

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Foreword (Gerd Müller | Director General of UNIDO)

Our world is facing tremendous challenges: climate change, resource depletion and the destruction of our environment. Continued widespread poverty and hunger are further worsened by armed conflicts and political instability. These challenges result from a complex web of factors. Some are deeply rooted in history, woven into longstanding consumption and production patterns and deprivation in developing countries. Others are more recent, such as demographic shifts and migration, energy crises, and disruptions in global supply chains. Regardless of these factors' origins, one thing is clear: the world's poorest suffer the most from these crises. The exploitation of people and planet must end. Thus we must answer the question: what solutions can we offer to these challenges? Sustainable industrialization is a powerful catalyst for transformative global progress. History shows that the most successful countries are those that have transitioned from being low to high-income through industrialization. Why? Because manufacturing drives productivity and growth, spurring technological advancement and innovation, and creating opportunities in manufacturing and beyond. Every manufacturing job, on average, creates more than two jobs in other sectors of the economy. However, history also teaches us that industrial development can have detrimental impacts on both people and the planet. What we need is a new approach to industrialization, one that prioritizes social and environmental goals to make sure that we prioritize lifting people out of poverty, ending hunger, and effectively fighting climate change.

This paper, prepared for the second edition of UNIDO's Multilateral Industrial Policy Forum (MIPF 2024), highlights a critical issue: the countries most in need of industry's transformative power to drive growth are falling behind. With a few notable exceptions, developing countries are witnessing alarmingly slow industrialization or even deindustrialization. We need immediate action. The future of sustainable industrial growth depends on our ability to address these challenges swiftly and effectively, while navigating the fundamental shifts reshaping the industrial sector. The ongoing energy transition, rapid technological advancements including artificial intelligence, the reconfiguration of global value chains and the evolving nature of how we work and what we consume are just some of the megatrends revolutionizing industrial production and are shaping the industries of the future.

How can countries build competitive, future ready industries? This paper identifies several key areas for action: We need to improve basic conditions such as in infrastructure and institutional capabilities. We must equip workforces with future ready skills We need to enable the use of emerging technologies and help build competitive industrial ecosystems with strong connections to complementary service and agricultural activities. We must strengthen regional integration to address the fragmentation of global supply chains.

We have the technologies, expertise and money to provide effective solutions to address these global challenges. Our goal is a world without hunger and poverty, where industry creates decent jobs and shared prosperity for all, drives low emission economies, and safeguards our planet for current and future generations.

No country can confront these challenges on their own. What we need is true global solidarity and robust international partnerships. We live in an interdependent world, everything is interconnected. Global developments ultimately impact us all. Industrialized countries must live up to their commitments to the developing world. The private sector must play its part. Despite all of the challenges facing us, together we can ensure sustainable industrialization benefits not just some of us, but all of us.

Preface

The world faces a stark reality today. Despite notable strides in poverty reduction between 2000 and 2015, progress has slowed significantly. By 2022, the number of people lifted from extreme poverty compared to 2013 was only one-third.¹ Currently, around 10 per cent of the global population nearly 700 million people still live in extreme poverty² while nearly 800 million suffer from chronic hunger.³ The ambitious goals of eradicating extreme poverty and achieving zero hunger by 2030 now seem increasingly unattainable, especially in developing countries, where the impacts of recent crises, including the COVID19 pandemic, armed conflicts, and climate change, have further exacerbated inequalities.⁴ Sub-Saharan Africa, in particular, continues to grapple with deeply entrenched challenges, with poverty more pervasive than it has been in decades.

The labour market presents an equally troubling picture. Although some recovery from the COVID19 crisis has been reported, a notable jobs gap⁶ of 11.1 per cent persists, affecting 435 million people globally.⁷ Gender disparities are particularly pronounced, with women in low-income countries (LICs) facing a jobs gap of 24.3 per cent, compared to 17.4 per cent for men. Additionally, population growth and migration in developing countries, especially in Africa, have further intensified the need for job creation. Many of these regions experience high birth rates and a rapidly growing youth population, yet they often lack the necessary infrastructure and education systems to harness the potential demographic dividend.

At the same time, there is growing pressure on global supply chains (GVCs), which will have a considerable impact given that around 80 per cent of world trade relies on these interconnected networks of production, distribution, and logistics.⁹ In recent years, GVCs have experienced severe disruptions due to shortages and price increases (including energy, materials, food and key components). These challenges, exacerbated by the pandemic and geopolitical tensions, have forced many firms to find new suppliers in different locations. Meanwhile, the world is consuming natural

resources at unsustainable rates, with the extraction of raw materials tripling over the past five decades. High income countries consume six times more resources and generate ten times the climate impact compared to LICs. This unequal distribution of resource consumption has profound implications for global development, highlighting the urgent need for responsible sourcing practices and sustainability standards that minimize environmental harm while promoting local development in LICs.

Food insecurity poses a significant challenge globally. As consumer preferences shift towards more sustainably produced, higher quality food, demand for affordable options in poorer regions remains urgent. Over 1.7 billion people in urban and peri urban areas are currently experiencing food insecurity,¹² while more than 500 million resource poor smallholder farmers in developing countries are struggling to increase productivity. The need for investment in sustainable agricultural practices is clear. The growing scarcity of essential resources such as water, land and energy disproportionately impact developing countries, placing an even greater strain on food production. To meet global demand by 2050,¹³ food production must increase by 70 per cent. Agroindustries have the potential to transform agricultural practices, enhance food availability, and generate jobs, but require modern infrastructure and better integration into value chains to meet rising global demand.

Climate change further complicates the current situation, disproportionately impacting LICs, with projections indicating that they may experience annual GDP losses of 1 per cent due to climate related disasters – five times more than high income countries. While energy is critical to driving industrial growth and economic development, 685 million people remained without access to electricity in 2022; and population growth in many regions threatens to outpace the expansion of energy infrastructure. Additionally, energy production, which is largely dependent on fossil fuels, contributes approximately 75 per cent of the world faces a stark reality today. Despite notable strides in poverty reduction between 2000 and 2015, progress has slowed significantly. By 2022, the number of people lifted from extreme poverty compared to 2013 was only one-third.¹ Currently, around 10 per cent of the global population nearly 700 million people still live in extreme poverty² while nearly 800 million suffer from chronic hunger.³ The ambitious goals of eradicating extreme poverty and achieving zero hunger by 2030 now seem increasingly unattainable, especially in developing countries, where the impacts of recent crises, including the COVID19 pandemic, armed conflicts, and climate change, have further exacerbated inequalities. Sub-Saharan Africa, in particular, continues to grapple with deeply entrenched challenges, with poverty more pervasive than it has been in decades.

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resources at unsustainable rates, with the extraction of raw materials tripling over the past five decades. High income countries consume six times more resources and generate ten times the climate impact compared to LICs. This unequal distribution of resource consumption has profound implications for global development, highlighting the urgent need for responsible sourcing practices and sustainability standards that minimize environmental harm while promoting local development in LICs.

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Climate change further complicates the current situation, disproportionately impacting LICs, with projections indicating that they may experience annual GDP losses of 1 per cent due to climate related disasters – five times more than high income countries.¹⁴ While energy is critical to driving industrial growth and economic development, 685 million people remained without access to electricity in 2022;¹⁵ and population growth in many regions threatens to outpace the expansion of energy infrastructure. Additionally, energy production, which is largely dependent on fossil fuels, contributes approximately 75 per cent of tured goods, for example for construction, infrastructure development and many industrial sectors, can reduce reliance on otherwise costly imports; iii) Pharmaceuticals: demand for affordable medicines is growing, especially as global supply chains face disruptions; (iv) Energy: industries must reduce emissions and local solutions need to be developed to generate energy from renewable sources such as solar, biomass and hydrogen. Technologies need to be explored to reduce CO₂ emissions from traditional energy sources;

(iv) Mining: many developing countries are rich in critical minerals and rare earth metals which are essential for modern technologies, such as semiconductors and emobility. There is also potential to develop local capacity for value addition in the equipment and maintenance sectors; v) Digitalization: production processes can be connected and controlled smartly, saving resources and substantially increasing industrial productivity; vi) Market development: developing countries offer substantial potential, particularly in terms of traditional and local products, including textiles, furniture, decoration items, handicrafts, food and health products; and finally vii) Value addition to local products: there is tremendous potential to substitute costly imports, and promote the export of higher value added industrial products.

This paper explores the challenges and opportunities associated with industrial development in depth; it is structured as follows: Section 1 presents projections and scenarios on how the world may look by 2050, given the current global challenges we face. Section 2 focuses on the future of industry, examining key industrial megatrends such as the energy transition, digitalization, GVC reconfiguration, and demographic shifts, along with their implications for industrial development. Section 3 discusses solutions for promoting sustainable industrial development, with a special focus on the needs of developing countries. Section 4 concludes the paper and offers final reflections.

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1. The future world

1.1 The world in 2050: Projections on poverty, hunger, jobs, climate change and resource scarcity

When the UN 2030 Agenda for Sustainable Development was adopted, the world had emerged from the 2007-08 global financial crisis, and economic prospects looked promising. Extreme poverty was declining at an unprecedented rate, and the first Millennium Development Goal (MDG) to cut the 1990 poverty rate in half by 2015 had been achieved six years ahead of schedule.²¹ The momentum generated by these successes fuelled ambitious targets set within the 2030 Agenda, which sought to build on the accomplishments of the past decade.

Nearly a decade later, the outlook is less optimistic. The combined effects of climate change, geopolitical instability, and the global pandemic have significantly disrupted the trajectory of progress. Without decisive action to change course, the future remains uncertain. Recent projections from various international organizations on different dimensions of sustainable development paint a sobering picture of what lies ahead if current trends persist (see Table 1). By 2050, it is estimated that approximately 450 million people will still be living in extreme poverty, primarily in sub-Saharan Africa, which will continue to host a significant share of the world’s impoverished population.²² Similarly, the number of malnourished people is projected to reach 230 million, with sub-Saharan Africa and Central and Southern Asia bearing the heaviest burdens.²³ This situation can partially be explained by the fact that employment growth is not keeping pace with the needs of the growing workforce, particularly in regions such as the Middle East and North Africa, where a rapid increase in job opportunities is essential. These projections are in stark contrast with SDGs 1 and 2 targets to eradicate poverty and achieve zero hunger by 2030, highlighting the urgent need for intensified efforts to significantly modify our current trajectory and effectively address these ongoing challenges.

TABLE 1. WHAT CAN WE EXPECT FOR 2050?

DIMENSION	PROJECTION	SOURCE
Poverty	By 2050, the number of people living in extreme poverty is projected to reach nearly 450 million people. With a global population increase to 9.7 billion, the poverty rate would still hover around 4.5 per cent. Sub-Saharan Africa is expected to bear the biggest brunt, with an estimated 342 million people projected to be living in poverty.	UNDP (2023)
Hunger	The number of malnourished people worldwide is projected to remain at approximately 230 million in 2050, with a rate of around 2.5 per cent. Sub-Saharan Africa and Central and Southern Asia are expected to have the highest numbers, with 110 million and 45 million people, respectively.	UNDP (2023)
Employment	Between 2020 and 2030, almost 531 million new jobs will be needed globally to absorb the active working-age population, which implies a growth rate of 1.47 per cent. The Middle East and North Africa are expected to experience the fastest employment growth during this period, with a projected increase of 3.33 per cent.	Merotto et al. (2018)
World temperature	Under current policies, CO ₂ emissions are projected to reach around 32 Gt by 2050. If this trend persists beyond 2050, global temperatures could rise by about 2.6°C by the year 2100.	IEA (2021)
Resource extraction	To limit global temperature increase to below 2°C by 2050, we will need over three billion tonnes of minerals and metals that are essential for the energy transition, including for wind power and solar energy. Without immediate and concerted action, resource extraction by 2060 could surge by 60 per cent from 2020 levels.	UNEP (2024)
Water	By 2050, it is projected that 1 billion people (10 per cent of the global population) will experience extremely high water stress ^b , even under the optimistic scenario of limiting the global rise in temperature to 1.3°C and 2.4°C by 2100.	Kuzma et al. (2023)

Source: UNIDO elaboration based on various sources.
Notes: a) IEA’s Stated Policies Scenario (STEPS) considers measures that governments have already implemented as well as specific policy initiatives that are under development. b) Water stress is measured as What can we expect the ratio of water demand to renewable supply. A country facing “extreme water stress” refers to countries that consume at least 80 per cent of their available supply, “high water stress” refers to those countries that use 40 per cent of their supply.

It is particularly alarming that the most severe social deprivation will in the future be concentrated in specific regions of the world, further exacerbating global inequalities (see Figure 1). By 2050, nearly 75 per cent of individuals living in extreme poverty are projected to live in LICs and lower middle income countries (LMICs) in Africa. Likewise, over 80 per cent of those who are malnourished will be living in land LMICs across Africa and the Asia Pacific region. This concentration highlights the disproportionate impacts of global challenges and emphasizes the urgent need for targeted interventions and policies that address regional inequalities and ensure that no one is left behind.

Climate change and resource scarcity add another layer of complexity to the challenges anticipated by 2050, with global environmental conditions expected to deteriorate further. Official projections indicate that CO2 emissions and resource extraction rates will exceed sustainable limits, intensifying the effects of climate change.²⁵ Water stress will also become a critical concern, affecting one billion people by 2050. This will complicate efforts to alleviate poverty and ensure food security in increasingly harsh environmental conditions.

The projections are even more alarming when considering the intersection of environmental and socioeconomic vulnerabilities. The countries where poverty and malnutrition will be most prevalent are also expected to experience the most severe impacts of climate change. As illustrated in Figure 2, recent projections suggest that LICs and LMICs in Africa and the Asia Pacific region are likely to witness the most substantial increases in climate related fatalities by 2050.²⁷ Without decisive climate action, these regions, which are already grappling with socioeconomic challenges, will face even greater risks from climate change.

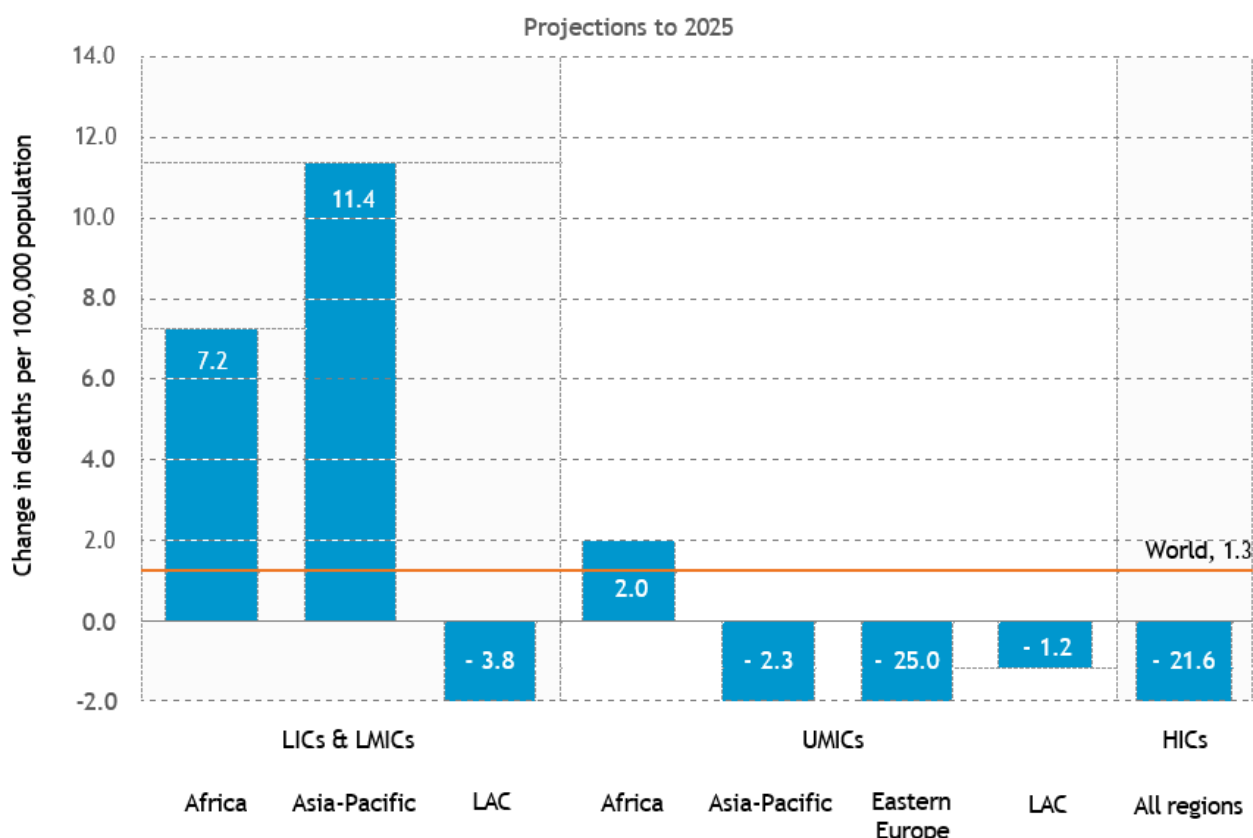
The urgency to change our current trajectory and build a more equitable global economy can not be overstated. Achieving this objective goes beyond economic growth; it requires a holistic approach to address economic inequalities, social injustice and environmental challenges. These challenges disproportionately impact the Global South, and without substantial development initiatives and policy reforms, the disparities between the North and South will only widen. Striking a better balance requires a multifaceted strategy that integrates economic development with social equity and ecological sustainability, promoting a development model that benefits us all, not just a select few.

FIGURE 1. WHERE WILL POVERTY AND MALNOURISHMENT BE CONCENTRATED IN 2050?



Source: UNIDO elaboration based on UNDP projections for the [SDG Integration Platform](#).
Note: Projections show the "COVID Baseline" scenario, assuming a business as usual scenario for the future. Extreme poverty is measured by the number of people projected to be living under the \$1.90 poverty line. Food insecurity is measured by the population projected to be malnourished. LICs = Low-income countries; LMICs = Lower middle-income countries; UMICs = Upper middle-income countries; HICs = High-income countries; EE = Eastern Europe; LAC = Latin America and the Caribbean.

FIGURE 2. WHO WILL BE MOST AFFECTED BY CLIMATE CHANGE?



One crucial question is where to start the necessary shift in trajectory. Historically, industrialization has proven to be an effective strategy for reducing poverty, alleviating malnutrition, and creating productive employment opportunities. Countries such as the Republic of Korea and China exemplify how planned development measures and targeted industrial policies can catalyse significant economic and social transformations. Government led strategies that have promoted export oriented industrialization in the Republic of Korea since the 1960s have resulted in notable reductions in poverty and inequality. The shift from agriculture to manufacturing has fuelled high growth rates, introduced structural changes in the economy, and considerably lowered poverty levels.²⁸ Likewise, China’s remarkable achievements in poverty alleviation over the past four decades are closely linked to its emergence as a global industrial powerhouse. During this period, nearly 800 million people were lifted out of poverty²⁹—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.

The strong link between industrialization and poverty alleviation is supported by recent research, which highlights the critical role of industrialization in reducing poverty.³⁰ Studies show that structural shifts towards a more diversified and high output manufacturing sector, along with the resultant productivity gains, have been instrumental in alleviating poverty, particularly in developing regions of Asia and sub-Saharan Africa. Evidence suggests that economic policies centred on industrial development are essential for enhancing the poverty reducing effects of economic growth, emphasizing the crucial intersection of industrial policy and the improvement of living standards.

1.2 Why industry is essential, for LICs and LMICs

Industrialization is fundamental to development for a number of compelling reasons. Traditionally, it has been recognized for its role as an engine of 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.³¹ By advancing into higher value added, more sophisticated and diversified economic activities, industrialization serves as a cornerstone of socioeconomic progress. Furthermore, it generates more employment opportunities, thereby boosting household incomes, which in turn lead to increased domestic consumption and driving further economic expansion. Additionally, the rise of export oriented industries generates an inflow of foreign exchange, which is essential for economic stability and sustained growth.

In recent years, the focus has shifted to other factors associated with industrialization, such as its role as an engine of innovation, a hub for green technologies, and a source of resilience against economic shocks. The manufacturing sector remains crucial for research and development (R&D), accounting for the majority of new technological patents and spearheading significant advancements in green technologies.³² Moreover, strong industrial capabilities have proven essential in times of crisis, as evidenced by the COVID19 pandemic, where countries with robust manufacturing sectors were better equipped to navigate economic disruptions.³³

Recent research conducted by UNIDO outlined in the latest editions of the Industrial Development Report (IDR) provides compelling empirical evidence that underscores the critical role of industry in fostering development (see Table 1 for a summary).

It should be noted, however, that expanding the industrial sector does not automatically lead to improvements across all dimensions discussed above. 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 result in severe ecological harm, while neglecting labour rights may result in poor working conditions and limited progress in poverty alleviation.

For industrialization to foster sustainable development, it must follow an environmentally sustainable trajectory. This implies weaving sustainability into the design and implementation of industrial policies, ensuring that economic growth occurs without depleting natural resources or causing severe environmental degradation. Furthermore, sustainable industrial development should prioritize inclusive job creation by focusing on generating highquality employment opportunities that provide fair wages and safe working conditions. This dual approach not only drives economic prosperity but also protects the health and wellbeing of both the environment and people.

Given the projected high rates of extreme poverty and malnutrition in many LICs and LMICs, cultivating a vibrant and dynamic manufacturing sector in these countries will be indispensable. Industrialization must be at the heart of their domestic strategies, focused on sectors with high growth potential and the ability to generate a substantial number of jobs. By developing robust

TABLE 2. WHY INDUSTRY IS ESSENTIAL FOR ADDRESSING GLOBAL CHALLENGES

DIMENSION	ROLE OF INDUSTRIALIZATION	SOURCE
Innovation	Manufacturing serves as the hub of innovation: it accounts for 53 per cent of global R&D activity.	UNIDO (2024)
Economic growth	Manufacturing is the engine of growth: 64 per cent of growth episodes over the past 50 years have been attributed to manufacturing.	UNIDO (2024)
Job creation	Manufacturing has greater potential than other sectors of the economy to drive job creation: each job in manufacturing generates more than two additional jobs in other sectors.	UNIDO (2024)
Climate action	Manufacturing drives the development of new technologies to fight climate change: by 2023, nearly 60 per cent of green patents worldwide were held by manufacturing firms.	UNIDO (2024)
Resilience	Industrial capabilities have proven essential for resilience to external shocks: during the COVID-19 pandemic, countries with robust industrial sectors weathered the COVID-19 pandemic crisis better than others.	UNIDO (2021)

Source: UNIDO elaboration.

manufacturing capabilities, these countries can better integrate into diverse global and regional value chains, thereby increasing their economic resilience and growth prospects.

As we reflect on the crucial role of the industrial sector in driving long-term growth in developing countries, one important question emerges: is industry growing sufficiently in these countries?

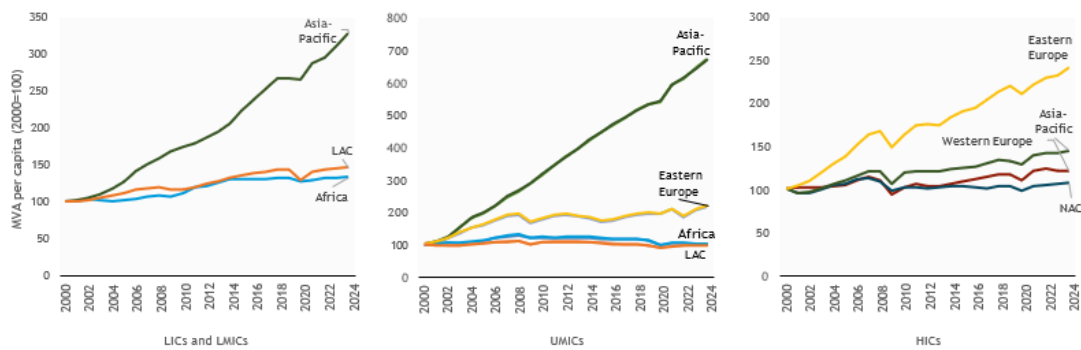
1.3 The industrialization gap in LICs and LMICs

Industrial dynamics have differed considerably across countries and regions over the past decades. While some parts of the developing world have succeeded in expanding their industrial sector and accelerating innovation, others are lagging behind (see Figure 3). Countries in the Asia Pacific region, for instance, have experienced remarkable growth in terms of their manufacturing value added (MVA) per capita, particularly among upper middle income countries (UMICs), with China leading the way. In stark contrast, Africa and Latin America have witnessed much slower growth across all LICs, LMICs and UMICs. These trends highlight the disparities in industrial progress both across regions and income groups. Different industrial dynamics are leading to stronger concentrations of industrial production in specific regions and countries (see Figure 4). In 2000, high income countries (HICs) dominated the share of global MVA, accounting for 75 per cent of global industrial production. By 2030, this concentration is projected to shift, with countries such as China markedly increasing their share of global industrial production. This shift indicates a structural transformation, with a few countries emerging as industrial powerhouses while others struggle to keep pace.

In addition to stronger concentrations of global industrial production, the gap between advanced and less developed countries is expected to continue growing. By 2030, all developing regions, except for UMICs in Asia Pacific, are expected to have an average MVA per capita of 20 per cent or less of that in HICs (see Figure 5). For instance, LICs and LMICs in Africa are projected to have an average MVA per capita of just USD 211 compared to USD 6,344 in HICs. This widening industrialization gap highlights the urgent need for substantial investments and policy reforms to bolster industrial growth in less developed regions.

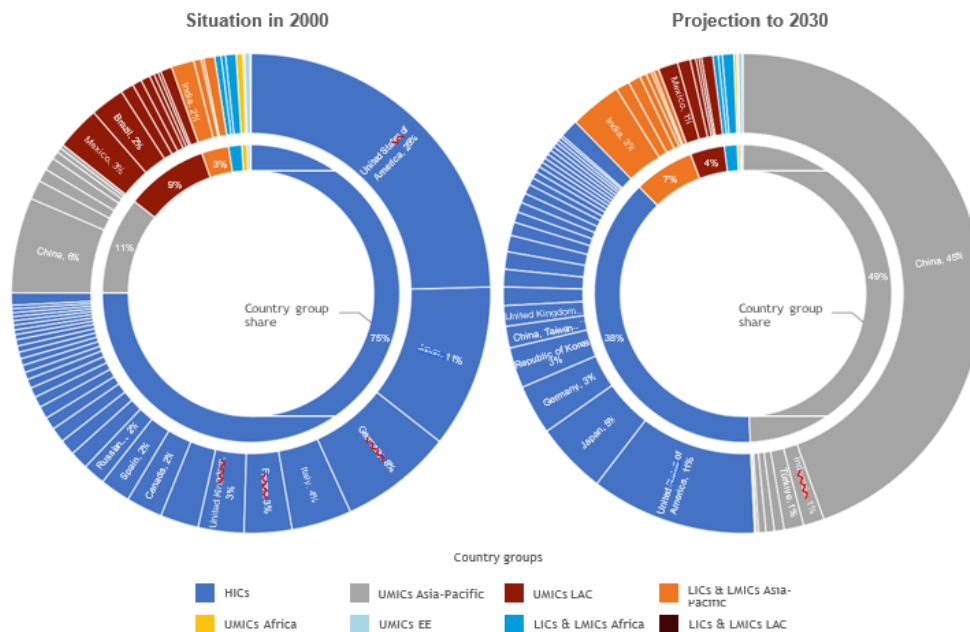
It is now clear that a business as usual approach is not sustainable. Not only will industrial production continue to be concentrated in a few major players, while those countries that need industrial growth the most—those projected to have the highest levels of poverty, hunger and unemployment—are likely to experience the slowest industrial progress. Many of these countries are undergoing a process of deindustrialization or are witnessing only sluggish industrialization, which threatens to leave them behind. Without proactive interventions, these countries risk missing out on the transformative benefits of industrialization and facing prolonged economic stagnation.

FIGURE 3. INDUSTRIAL DYNAMICS IN THE DEVELOPING WORLD



Source: UNIDO elaboration based on UNIDO SDG 9 Indicators Statistical Database.
 Note: Regional averages calculated using population weights. Values for 2023 and 2024 are estimated and forecasted, respectively, by UNIDO Statistics department, available in the UNIDO Statistics Portal and International Yearbook of Industrial Statistics 2023. LICs = Low-income countries; LMICs = Lower middle-income countries; UMICs = Upper middle-income countries; HICs = High-income countries; LAC = Latin America and the Caribbean; NAC = North America; MVA = Manufacturing value added.

FIGURE 4. A CHANGING STRUCTURE OF GLOBAL INDUSTRIAL PRODUCTION

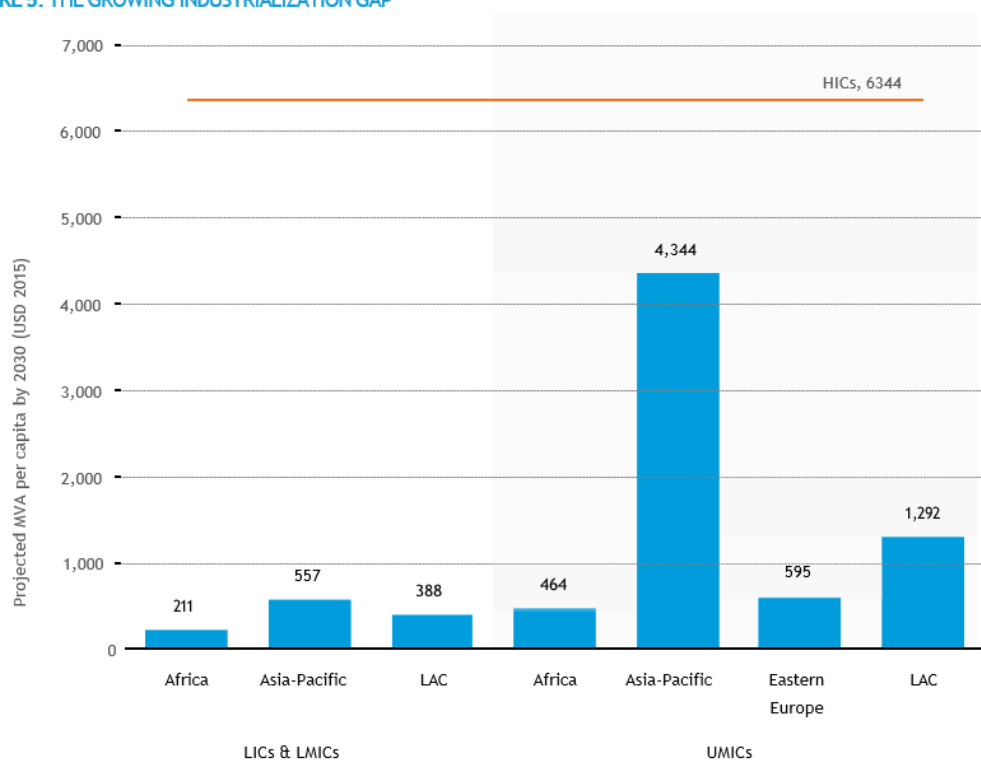


Source: UNIDO elaboration based on UNIDO National Accounts Database.
 Note: Projections to 2030 are made based on historical average annual growth rates (between 2010 and 2019) and applied to the latest available observations (2024) up to 2030. LICs = Low-income countries; LMICs = Lower middle-income countries; UMICs = Upper middle-income countries; HICs = High-income countries; EE = Eastern Europe; LAC = Latin America and the Caribbean.

In this context, shifting course becomes imperative. Developing countries must accelerate industrialization, but the very nature of industry itself is also changing. Megatrends such as the energy transition, the rise of artificial intelligence (AI) and the digitalization of production, GVC reconfigurations, and global demographic trends are reshaping the industrial landscape. These changes present both challenges and opportunities for developing countries; those that can adapt to these megatrends will be better positioned to achieve sustainable industrialization.

The following section delves into the most important transformations currently reshaping the industrial sector and examines their potential impact on industrial development, focusing on the key challenges and opportunities these changes present, with a focus on how they may affect developing countries and their ability to harness these shifts for sustainable growth.

FIGURE 5. THE GROWING INDUSTRIALIZATION GAP



Source: UNIDO elaboration based on UNIDO National Accounts Database.

Note: The bars indicate average projected MVA per capita in constant 2015 dollars for each country group. Averages weighted by projected population. Projections to 2030 are made based on historical average annual growth rates (between 2010 and 2019) and applied to the latest available observations (2024) up to 2030. LICs = Low-income countries; LMICs = Lower middle-income countries; UMICs = Upper middle-income countries; HICs = High-income countries; EE = Eastern Europe; LAC = Latin America and the Caribbean; MVA = Manufacturing value added.

2. The industry of the future

2.1 The main megatrends reshaping industry

Industrial development is evolving rapidly, driven by global shifts in the world economy, technology and environmental priorities. These trends are reshaping how industries operate and adapt to new market realities, making it clear that replicating past models of industrial growth is no longer viable. For developing countries, the stakes are particularly high, as they must navigate this new industrial landscape and find innovative pathways to industrialize in a world where traditional approaches are being replaced by new dynamics.

Today's industrial landscape is radically different from the one that first facilitated the rise of the Asian Tigers and later China. In the late 1970s, these countries benefitted from an expansive global policy space, with favourable conditions for export led growth and integration into the global economy.³⁴ At that time, labour-intensive manufacturing created a massive number of jobs, while environmental sustainability was not a central concern. In contrast, the current global context is marked by less policy space due to trade restrictions, deglobalization trends, and heightened geopolitical tensions. At the same time, technological breakthroughs such as automation and digitalization have reduced demand for low skilled labour and are less conducive to job creation. Lastly, the pressing need to address climate change has turned environmental sustainability into a priority, pushing industries to adopt cleaner technologies and transition towards greener production systems.

Looking ahead, tomorrow's industrial landscape will also differ from today's. Ongoing and emerging global megatrends³⁵ are fundamentally transforming production processes and

redefining how industries operate globally. For policymakers and industry leaders, understanding these structural shifts will be essential for navigating the complexities of future industrialization and formulating strategies that align with the evolving global landscape.

In this section, we focus on four of these megatrends: 1) energy and the green transition; 2) the rise of AI and the digitalization of production; 3) GVC reconfiguration; and 4) global demographic changes. In what follows, we provide a brief summary of each of these megatrends, exploring their implications for industrial development and the challenges and opportunities they present.

2.2 Energy and the green transition

Current trends skilled labour and are less conducive to job creation. Lastly, the pressing need to address climate change has turned environmental sustainability into a priority, pushing industries to adopt cleaner technologies and transition towards greener production systems.

Looking ahead, tomorrow's industrial landscape will also differ from today's. Ongoing and emerging global megatrends³⁵ are fundamentally transforming production processes and redefining how industries operate globally. For policymakers and industry leaders, understanding these structural shifts will be essential for navigating the complexities of future industrialization and formulating strategies that align with the evolving global landscape.

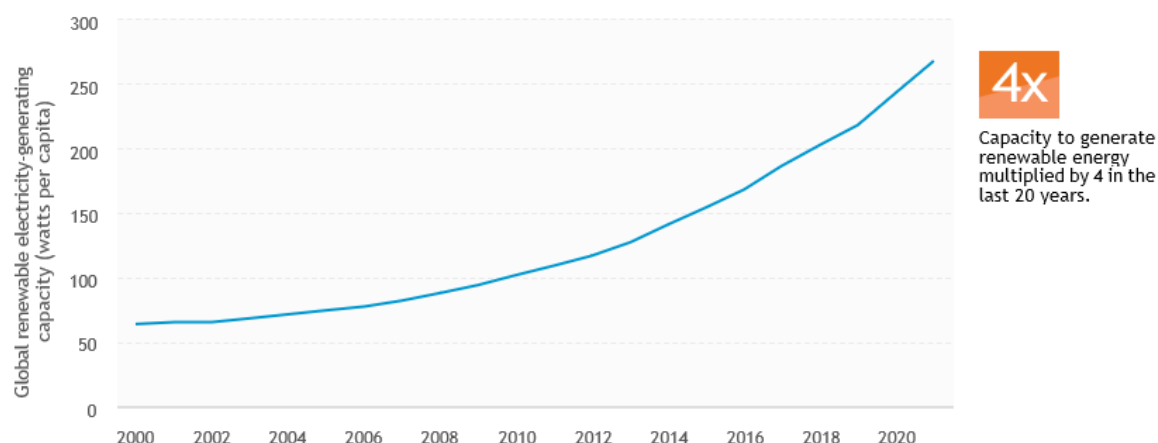
In this section, we focus on four of these megatrends: 1) energy and the green transition; 2) the rise of AI and the digitalization of production; 3) GVC reconfiguration; and 4) global demographic changes. In what follows, we provide a brief summary of each of these megatrends, exploring their implications for industrial development and the challenges and opportunities they present.

It is indisputable that human activity is inflicting significant harm on our planet's ecosystem. Not only has the scientific community reached a strong consensus on this, but it is also reflected in the growing impacts of climate change and our unsustainable consumption of natural resources. We are now witnessing the consequences of these activities through extreme climate events, including heatwaves, wildfires, rising sea levels, and increasingly severe storms. Furthermore, the overexploitation of essential natural resources such as biomass, metals, non-metallic minerals and fossil fuels is contributing to deforestation, soil degradation, and the extinction of species.

Addressing the consequences of human induced environmental degradation, particularly in relation to climate change, has become the greatest challenge global society is facing today. This is of particular relevance given that developing countries, especially SIDS, which face heightened risks from rising sea levels, droughts, floods, and other extreme weather events linked to climate change, are bearing the biggest brunt. In terms of industrial development, this challenge calls for a transition towards green industrialization, a prioritization of public health, and the promotion of clean technologies that reduce emissions and resource use. The shift towards greener production processes requires coordinated action across industries and countries, making it one of the defining issues for the future of industrialization.

The energy transition, characterized by the shift from fossil fuels to renewable energy sources, is central to mitigating the adverse effects of climate change. This transition is gaining momentum, with renewable energy capacity expanding at a record pace for the 22nd consecutive year in 2023 (see Figure 5). By 2028, renewable sources are projected to account for over 42 per cent of global electricity generation.

FIGURE 6. THE RISE OF RENEWABLES



Source: UNIDO elaboration based on UNSD (2023), indicator 12.a.1.

While reducing GHG emissions through clean energy is crucial, it cannot on its own address the broader issue of resource overuse or meet the growing energy demands of developing countries. The production of renewable energy technologies, such as solar panels and electric vehicles (EVs), for instance, relies heavily on metals such as cobalt and lithium. This surge in demand for minerals presents a sustainability challenge, as the current mining rates of these resources risks straining ecosystems and depleting critical natural reserves. There is therefore a growing need to focus not only on clean energy but also on reducing overall resource consumption by embracing principles such as circular economy and efficient resource use to ensure long term sustainability. However, relying solely on renewable energy sources will not be enough to power the economies of many developing countries. For instance, in Africa, charcoal remains a primary energy source for households, while diesel generators continue to supply power for many small and medium enterprises (SMEs) in countries such as Nigeria. Abruptly discontinuing the use of these fossil fuels could lead to economic stagnation. Consequently, integrating the greening and cleaning of fossil fuel use into any transitional strategy is key.

How is it reshaping industrial development?

The energy and green transition is reshaping industrial development in two ways: (i) changing how manufacturing industries source and use energy, and (ii) fostering the emergence of new energy generating industries, such as solar, hydrogen and biomass.

For manufacturing industries, this transition entails adopting clean energy sources, decarbonizing production processes, and embracing circular economy principles to remain competitive and sustainable. In a global market that increasingly prioritizes sustainability, industrial competitiveness will increasingly be tied to industry's capacity to comply with environmental regulations.

At the same time, energy generating industries are undergoing a transformation. The rapid growth of renewable energy sectors such as solar, hydrogen and wind coupled with advancements in energy efficiency, is creating new competitive advantages for countries and firms that lead in these technologies. Leaders in renewable energy production, such as China and Brazil, are already positioning themselves as frontrunners in the green economy. This transition is expected to not only create a dynamic energy industry and generate jobs, but also facilitate the gradual phasing out of older, emission intensive energy sources such as coal and oil.

As the energy transition progresses, the manufacturing sector and energy related industries will require new skills and capabilities. The shift towards net zero carbon emissions and circular production processes will necessitate workers with specialized green skills, particularly in sectors such as renewable energy, waste recycling and organic agriculture. Conversely, workers in emission intensive industries may face job displacement, highlighting the need for reskilling and upskilling programmes focused on environmental sustainability. Investing in the development of green skills will be crucial for facilitating a smooth transition for workers into emerging green industries.

What are the main challenges and opportunities presented by the green transition?

Developing countries that can effectively leverage renewable energy sources and green technologies will be better positioned to capitalize on the green transition, attracting investment and integrating more seamlessly into GVCs.

The energy transition presents a unique opportunity for sustainable industrialization for LICs and LMICs. The emergence of new industries related to solar and wind energy, EVs, battery production, and innovative technologies such as hydrogen and advanced biofuels, offers these countries a pathway to integrate into GVCs. With global investments in clean energy reaching USD

1.8 trillion in 2023 alone,³⁸ developing countries can capitalize on their natural resources, such as minerals needed for green technologies, to secure a foothold in these high-growth sectors. However, they also face financial challenges, as only 15 per cent of global renewable energy investments are directed towards these countries, with a paltry 2 per cent allocated to Africa.³⁹

Demand for critical minerals essential to the energy transition, such as copper, lithium, nickel, cobalt and rare earth elements, is projected to grow by 3.5 times by 2030. These materials are essential components in many of today's fast-growing clean energy technologies – from wind turbines and solar panels to EVs and battery storage. As the world transitions from fossil fuel use to renewable energy, with the aim of achieving net zero CO₂ emissions by 2050, the sustainable sourcing of these inputs becomes increasingly important. For developing countries, these critical minerals represent a significant opportunity for development, fostering job creation, diversifying the economy and substantially increasing government revenues. However, realizing this potential hinges on the renewable energy industry responsibly sourcing these materials, taking the rights and concerns of local communities into account.

The EV industry exemplifies how the energy transition can benefit developing countries. The global EV market is expanding rapidly, with sales projected to reach 17 million units by the end of 2024⁴⁰ and a cumulative value of all EV sales anticipated to reach USD 9 trillion by 2030 and USD 63 trillion by 2050.⁴¹ This growth creates significant opportunities for developing countries to participate in various stages of the EV supply chain, from mineral extraction to battery production and vehicle assembly. Several countries, including Indonesia, Nigeria and Thailand, are already taking steps to boost local EV production and encourage consumer adoption.

Beyond the direct production of green goods, the energy transition also fosters a host of related goods and services that can contribute to local job creation and economic growth. For example, the EV industry's expansion will require the development of charging infrastructure, including new charging stations and electricity management systems. Similarly, the deployment of wind and solar power requires transportation services, installation equipment and ongoing

maintenance work. The recycling of EV batteries is expected to emerge as a major industry, with projections estimating a market size of USD 95 billion by 2040.⁴²

Moreover, the decarbonization of energy intensive industries offers new opportunities for developing countries to attract new investment and to create jobs. Technologies such as hydrogen, carbon capture and storage (CCS), and electric arc furnaces are transforming industries such as steel production, which currently accounts for 8 per cent of global emissions.⁴³ By adopting these new technologies, developing countries can reduce emissions while generating employment in emerging industries and position themselves as key players in the global effort to fight climate change.

Lastly, the relocation of energy production and industrial production to regions with abundant renewable energy resources offers significant benefits. While developed countries are investing in domestic energy transformation initiatives, directing a greater share of green energy funding to developing countries could yield greater impacts. This strategy would not only ensure substantial environmental returns but also accelerate the global transition to a sustainable energy future.⁴⁴ As regards the relocation of industrial production, data centres and industrial plants, for instance, are increasingly being built near geothermal or hydropower sources to minimize emissions. Countries such as Chile and Kenya, which possess vast renewable energy potential, are attracting investment in industries that depend on sustainable energy sources.⁴⁵

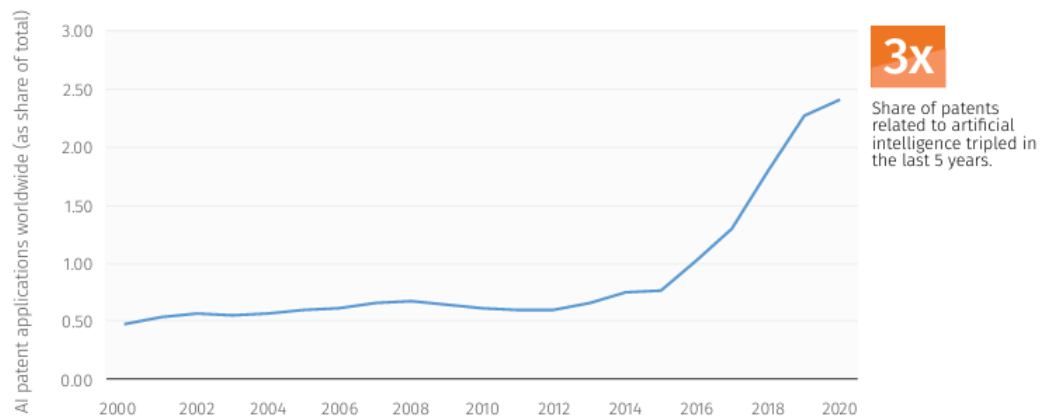
Despite the opportunities presented by the energy transition, several challenges remain. First, the benefits of renewable energy may not be evenly distributed, with some regions benefitting more than others. Infrastructure deficits, particularly in energy transmission and distribution, can limit the ability of many developing countries to fully exploit their renewable energy potential. Moreover, financing for clean energy projects remains inadequate, and without greater international support, many developing countries may struggle to mobilize the resources necessary to build the infrastructure required for green energy. Furthermore, concerns about resource overuse persist, as the production of renewable technologies still relies heavily on materials such as rare earth metals, which may lead to environmental degradation in some regions.

2.3 The rise of AI and the digitalization of production

Current trends The Fourth Industrial Revolution (4IR), driven by recent technological breakthroughs in digitalization, is fundamentally reshaping industrial production. Cutting edge technologies such as AI, big data analytics, cloud computing, the Internet of Things (IoT) and advanced robotics are at the forefront of this transformation. The integration of these technologies has disrupted industrial production across multiple sectors, creating new opportunities for resource optimization, efficiency gains, cost savings and productivity growth.

Advancements in AI and machine learning (ML) are driving this revolution. While the concept of AI has existed since the mid20th century, its real world application in industries was limited by technological constraints. However, the exponential growth of digital data and advancements in deep neural networks have led to significant progress in recent years:⁴⁶ the share of AI related patent applications worldwide has tripled in just five years (see Figure 7). Today, AI is an essential tool for optimizing production processes, improving accuracy in decision making, and creating intelligent systems capable of performing tasks once reserved for human workers.

FIGURE 7. THE RISE OF AI



Source: UNIDO elaboration based on WIPO (2022).

BOX 1. WHAT IS AI?

At its most basic level, artificial intelligence (AI) refers to computer systems and algorithms that can perform tasks typically requiring human cognition, such as problem-solving, decision-making and language comprehension. While AI has garnered significant commercial interest over the past decade, it is part of a broader digital transformation that began with the shift from ana-

logue to digital technology in the 1970s.⁴⁸ This digital transformation, known as the Third Industrial Revolution, saw the rise of computers and the proliferation of the internet, laying the groundwork for today's AI-driven innovations in the 4IR. These advancements have evolved into a wide range of applications, including advanced robotics, natural language processing and machine learning.⁴⁹

The rapid development and deployment of 4IR technologies is also reshaping the sources competitiveness for firms and countries. Those that fail to adopt and integrate these technologies risk falling behind in the global production landscape. Early adopters, in turn, are poised to reap the greatest benefits from the 4IR, while countries that lag in developing the necessary digital infradisplace certain jobs, it will also create new ones; the net effect on employment is likely to vary across sectors, with some industries experiencing localized disruptions and job losses. This emphasizes the need for proactive planning and policies to prepare workers for an Ai driven future.

competitiveness for firms and countries. Those that fail to adopt and integrate these technologies risk falling behind in the global production landscape. Early adopters, in turn, are poised to reap the greatest benefits from the 4IR, while countries that lag in developing the necessary digital infrastructure and skills may face widening gaps in industrial competitiveness. However, the high capability threshold for successfully adopting these technologies poses significant challenges for many developing countries.⁴⁷

How is it reshaping industrial development?

The emergence of Ai related technologies warrants analysis from multiple perspectives. One of the most significant impacts is in automation, where AI is facilitating the development of intelligent systems capable of performing complex tasks with minimal human intervention. While this advancement offers numerous benefits, it has also raised concerns about potential job displacement, particularly in industries that rely heavily on routine manual labour.⁵⁰

However, while automation may reduce the demand for certain types of jobs, it also creates new opportunities in emerging sectors that require advanced technical skills. Recent studies on AI related automation find that the net impact on global employment is generally positive.⁵¹ This is because the productivity gains associated with AI often lead to the emergence of new industries and job opportunities.

Despite its growing prominence, AI has not yet made significant inroads on industries globally. Consequently, we must rely on forecasts to gauge its potential impact on the industrial sector and the effects that come with it. In terms of employment, studies predict that while AI will

While AI holds great promise, developing countries encounter several challenges in its adoption. These challenges include limited access to capital, a shortage of trained maintenance staff and unreliable energy infrastructure.⁵² Furthermore, many firms in low income countries have yet to transition to digital production methods, relying instead on analogue techniques.⁵³ This reliance poses a significant barrier to AI adoption, as these technologies are built on the foundation of digital systems.

The 4IR is further blurring the boundaries of the industrial sector. Technological advancements and new divisions of labour have led to a deeper integration between manufacturing and other sectors, particularly knowledge intensive business services such as information technology (IT) R&D, market analysis and digital platform development. This phenomenon, often referred to as the "sericization" of manufacturing, means that many value added processes now extend across various sectors of the economy, requiring digitalization related solutions and services. Industrial R&D, logistics, product design, product management and other intangible services are becoming integral components of production, erasing the lines between manufacturing and services. In today's GVCs, for instance, products such as smartphones involve contributions from numerous industries, including semiconductors, software development and industrial design. This 21st century phenomenon calls for a shift in industrial policy from focusing on specific sectors to embracing broader production ecosystems and 'industrial commons' that involve manufacturing, services and agricultural processes.

What are the main challenges and opportunities presented by AI?

A widening technology gap between developed and developing countries⁵⁵ threatens to exclude the world's poorest from the ongoing industrial revolution and a technology market projected to soar from USD 1.5 trillion in 2020 to USD 9.5 trillion by 2030.⁵⁶ Advanced economies, which are at the forefront of developing and adopting these technologies, stand to gain the most from increased efficiency and productivity. In contrast, less developed countries risk falling further behind in technological progress and innovation, becoming ever more reliant on imports of technology intensive products. Many LDCs still use analogue technologies for nearly 70 per cent of their manufacturing processes which could potentially be digitalized.⁵⁷ The United Nations High Level Advisory Panel on AI notes that data, computing power and talent are currently concentrated among a small number of private sector players in an even smaller number of countries.⁵⁸

However, AI and digitalization also present inherent risks. Irresponsible use of AI, for example, can exacerbate issues such as fraud, discrimination, bias and disinformation, while displacing and disempowering workers, stifling competition and posing security threats. The complexity and rapid evolution of digital systems challenge traditional regulatory models, making it difficult to ensure that AI serves society's interests rather than undermining them.

Advanced digitalization can significantly enhance industrial competitiveness by enabling firms to optimize their production processes, reduce waste, and increase overall efficiency. The disruption caused by digitalization presents opportunities for developing countries to upgrade their production methods. Moreover, digitalization opens up new market opportunities by facilitating the development of innovative products and services. However, advanced manufacturing relies on digital solutions. As the boundaries between manufacturing and services continue to blur, the importance of knowledge intensive services such as data analytics, cloud computing and automation will grow. The "sericization" of manufacturing also offers developing countries a chance to diversify their economies and tap into new markets. However, to fully realize these benefits, developing countries must invest in the necessary digital infrastructure and ensure that their workforce possesses the skills necessary to operate and maintain these technologies.

2.4 GVC reconfiguration

Current trends

Integration into GVCs has long been understood as a potential pathway for industrial upgrading. By tapping into international production and trade networks, developing countries have been able to enhance their industrial capabilities, generate jobs and boost economic growth.⁶¹ However, successful integration has always relied on a range of factors, including domestic conditions and the broader international trade system. As global supply chains rapidly evolve, driven by geopolitical, economic and environmental dynamics, developing countries now face new challenges and opportunities in securing their place in GVCs.

A series of shocks to international trade flows in recent years has prompted many countries and firms to reassess their trade and production practices. The COVID19 pandemic was a major catalyst, causing widespread disruptions in production, transportation and labour markets. Even as economies began to recover, supply chains continued to face challenges such as transportation bottlenecks, fluctuating demand and imbalances in local labour markets. Additionally, events such as the obstruction of the Suez Canal in 2021 and the recent shipping disruptions in the Red Sea have highlighted the vulnerability of global trade networks to external shocks.⁶²

Largescale regional conflicts have also had significant global repercussions on supply chains and international trade. The armed conflict in Ukraine, coupled with economic sanctions on Russia, has disrupted energy supplies and the export of agricultural commodities and fertilizers. Europe's energy supply chain was upended as it began reducing its reliance on Russian oil and gas, leading to price volatility and market uncertainty. Meanwhile, Ukraine's role as a major grain exporter has been severely impacted, which has severely affected many lower income regions that rely on these imports. The ongoing conflict in Middle East has further compounded disruptions to international supply chains.

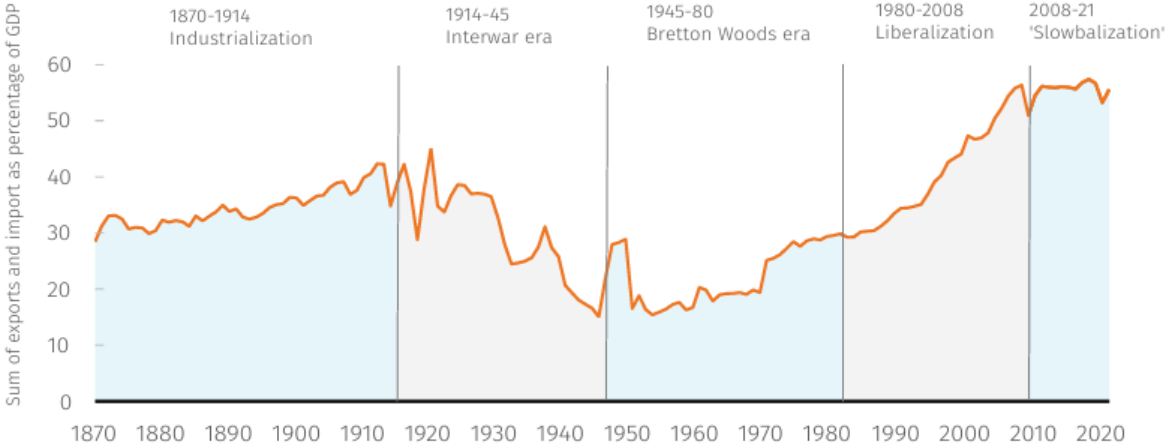
Climate change has become a significant factor in GVC disruptions. The increasing frequency of extreme weather events such as floods, hurricanes, droughts and heatwaves has impacted every stage of the supply chain, from production to transportation.⁶³ For instance, droughts in Europe and China have lowered water levels in major rivers, disrupting shipping routes and hydroelectric power generation.⁶⁴ In Taiwan, Province of China, frequent water shortages have delayed in semiconductor production, a critical component for numerous industries.⁶⁵ As climate change

intensifies, its impact on supply chains is expected to grow, with economic losses from disruptions projected to reach 1.5 per cent of global GDP by 2040 and 2.5 per cent by 2050.⁶⁶

Tensions between the United States, the European Union and China, among others, have led to a resurgence of tariffs and trade restrictions, prompting shifts in the production and sourcing of critical goods, from grains to semiconductors and lithium for batteries, to new regions. This nomic autonomy and reduce reliance on adversarial powers. These shifts are reconfiguring GVCs, with companies diversifying their production locations to mitigate risks. Globalization has been slowing in recent years.

After decades of rapid expansion, international trade and economic openness began to decline following the 2008 financial crisis (see Figure 8). This trend, also referred to as “solubilization”, marks a shift away from the fast paced global trade growth of previous decades. Trade openness (measured as global exports and imports as a share of global GDP) has stagnated, with countries increasingly prioritizing regional trade and domestic production to enhance supply chain resilience. This reconfiguration is altering the traditional patterns of global trade, with significant implications for industrial development worldwide.

FIGURE 8. SLOWBALIZATION



Source: Aiyar & Ilyina, 2023. Jordà -Schularick-Taylor Macroeconomy Database; Penn World Data (10.0); Peterson Institute for International Economics; World Bank; and IMF staff calculations.
Note: Sample composition changes over time.

How is it reshaping industrial development?

Rising geopolitical and economic competition has fuelled the growing trend of “reshoring”, with countries relocating production back within or closer to their own borders or to friendly partners. This shift is driven by concerns over supply chain security, the wish to reduce reliance on foreign production, and domestic political considerations.

As global trade slows, exported industrialization, which has been a key driver of growth for many developing countries particularly in Asia may become more challenging. With laboursaving technologies and reshoring trends gaining traction in advanced economies, policymakers in developing countries now face a more complex global landscape, where traditional models of export led growth are becoming less reliable, and new strategies are needed to maintain industrial competitiveness.

What are the main challenges and opportunities presented by GVC reconfiguration?

Despite the challenges posed by these trends, greater supply chain diversification presents new opportunities for developing countries. As multinational firms seek to mitigate the risks associated with concentrated production, they are increasingly distributing their operations across multiple regions. This shift allows developing countries to integrate into GVCs from which they were previously excluded. Countries such as Viet Nam, Malaysia and Mexico have already experienced a rise in foreign direct investment (FDI) as firms diversify their supply chains, creating opportunities for industrial upgrading and job creation.

Several examples demonstrate how supply chain diversification can boost industrial development in emerging economies. For instance, Chinese solar manufacturing firms have expanded into Southeast Asia, while India has attracted investment from smartphone manufacturers through targeted industrial policies.⁶⁷ Similarly, firms in Japan and the Republic of Korea are investing in semiconductor production in Southeast Asia, helping to strengthen the region's capacity in high tech industries.

The regionalization of GVCs, where production is increasingly concentrated within specific regions rather than distributed across the globe, offers new opportunities for developing countries to strengthen their industrial sectors. Nearshoring has emerged as a key trend in global production, opening up opportunities for developing countries, particularly those located within proximity to major global markets, to attract investment, expand production capabilities, and deepen their integration into regional value chains. Initiatives such as the African Continental Free Trade Area (AfCFTA) highlight the potential for regional trade agreements to strengthen industrial capabilities and promote sustainable development.

2.5 Global demographic changes

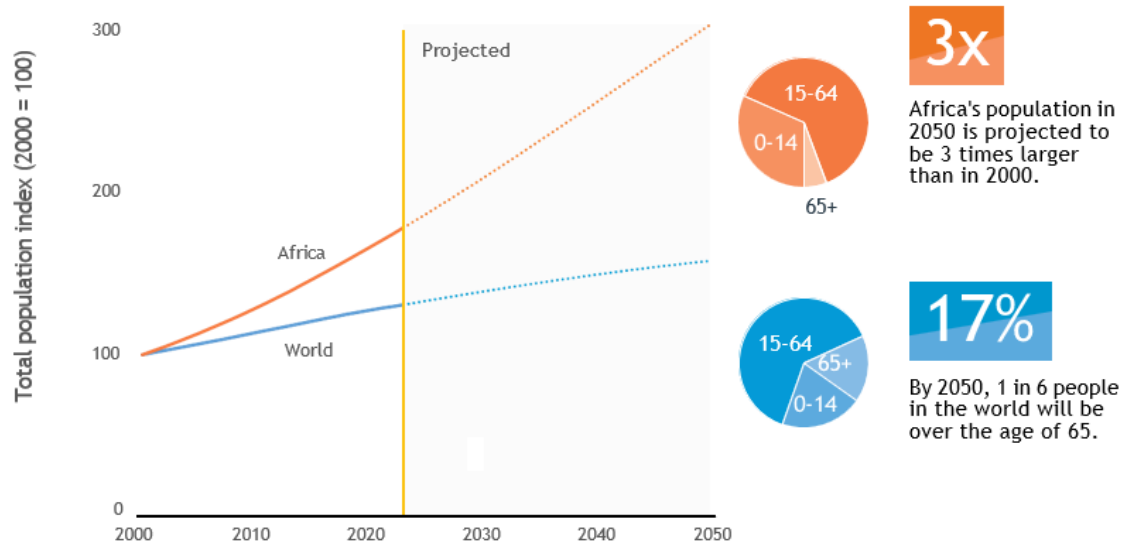
Current trends

The global population structure is changing. While regions including Europe and North America are witnessing near zero growth rates due to declining birth rates, sub-Saharan Africa remains the fastest growing region in terms of population. By 2050, Africa's population is projected to be three times larger than it was in 2000.⁷⁰ Notably, over half of the global population increase by 2050 will be concentrated in just eight countries, primarily in Africa and Asia.

The ability to generate productive employment will be crucial to realizing this potential. In Africa and developing Asia Pacific, demand for jobs is growing increasingly urgent as millions of young people enter the workforce each year. Without sufficient employment opportunities, these regions risk high levels of unemployment and underemployment, which could undermine development efforts and fuel social instability.

At the same time, migration is reshaping populations both across and within countries, with significant economic and social implications. According to the World Bank, approximately 184 million people worldwide are migrants, many of whom are seeking better economic opportunities or escaping from conflict.⁷¹ Migration is not limited to international borders; within countries, large

FIGURE 9. A CHANGING GLOBAL DEMOGRAPHIC STRUCTURE



Source: UNIDO elaboration based on UNDESA (2023).

numbers of people are also relocating, often moving from rural to urban areas in pursuit of jobs and improved living conditions. These movements can help alleviate labour shortages in some regions while intensifying them in others, making it crucial for policymakers to manage migration flows effectively to maximize their developmental benefits.

How is it reshaping industrial development?

Demographic transitions, including population growth, migration and urbanization, are reshaping global demand patterns. As populations expand and incomes rise, particularly in Africa and Asia, demand for food, consumer goods and other essential products will increase. Per capita calorie consumption is expected to rise, and global crop calorie production will need to increase by 47 per cent between 2011 and 2050 to meet this demand.⁷³ These changes in lifestyle and in energy consumption will also drive demand for new types of goods, creating opportunities for industries to expand and diversify.

On the other hand, as the global population ages, demand for healthcare services and related industries will increase. By 2050, the share of people aged 60 and older is expected to double, rising from 12 per cent to 22 per cent.⁷⁴ While the largest share of older people currently lives in higher income countries, it is expected that by 2050, 80 per cent of this ageing population will be living in LICs and LMICs.⁷⁵ This demographic shift will drive increased demand for pharmaceuticals, healthcare services and medical technologies, as ageing populations face higher rates of chronic and acute illnesses.

Urbanization will also have profound implications for industrial development. By concentrating people, capital and resources in cities, which in turn stimulates demand for construction materials, consumer goods and services, urbanization can drive industrial development.⁷⁶ However, the extent to which countries can harness urbanization's industrial potential hinges on their ability to foster productive activities in urban areas. Some countries experience a rise of "consumption cities", where urbanization is primarily driven by resource extraction and nonreadable services, limiting broader industrial development. In contrast, "production cities" focus on manufacturing and industrial growth, fostering more dynamic economic environments.

Urbanization, coupled with the rise of the middle class, presents a significant opportunity for domestic, demand driven industrialization, which can complement export led strategies.

What are the main challenges and opportunities presented by global demographic changes?

Urbanization is accelerating rapidly, unlocking new economic opportunities for developing countries. By 2050, 70 per cent of the world's population is projected to live in urban areas, up from 53 per cent in 2020.⁷² As urban centres become hubs of economic activity and innovation, this shift creates opportunities in sectors such as construction, consumer goods and services. The concentration of people in cities also fosters economies of scale and agglomeration effects, which can boost productivity and industrial growth if managed properly. However, rapid urbanization also presents challenges, including increased demand for energy, housing and infrastructure, and the need for sustainable urban development.

While demographic transitions create new opportunities for industrial development, they also pose significant challenges, particularly in regions such as sub-Saharan Africa, where rapid population growth, intensifies the need for the creation of productive jobs. To benefit from these demographic shifts, developing countries will need to

(i) generate employment opportunities and harness the potential of their young populations; (ii) develop the necessary industrial capabilities to meet evolving demand patterns and healthcare needs, and (iii) foster domestic demand led industrialization to complement export led strategies due to increased urbanization.

The megatrends outlined in this section present both opportunities and challenges for developing countries. As we move forward, it is essential to consider how these trends can be harnessed to build future ready industries that are resilient, inclusive and sustainable. The next section explores how developing countries can navigate these challenges and leverage these opportunities through targeted industrial policies, strategic investments and international cooperation.

3. Developing tomorrow's industry

Future industry must play a leading role in advancing sustainable development as outlined by the 2030 Agenda and the more general sustainable development agenda. In other words, industries must actively contribute to development; in developed countries, where environmental sustainability, in particular, needs to accelerate, and even more so in developing countries, where industry represents the backbone of development and needs to be balanced to meet the needs of economic growth and social development, while avoiding the negative environmental impacts that accompanied industrialization in developed countries.

3.1 Improving basic conditions for industrial production in developing countries

Developing countries face significant challenges in building sustainable industries, particularly in areas such as basic infrastructure, productive capacity and institutional capabilities to design and implement effective industrial policies.

Infrastructure including electricity for powering industry, telecommunications for supporting commerce, and efficient roads, railways and ports for transporting goods has long been recognized as a cornerstone for industrial development. In many developing countries, however, key infrastructure services remain in short supply and of poor quality. Although these problems

are most acute in LICs, they represent a significant challenge in most MICs as well. Moreover, infrastructure coverage tends to be much lower in rural areas, where the majority of the developing world's poor live. At the same time, urban infrastructure coverage is also under pressure, partly because of rapid rural urban migration in many countries.

In Africa, for example, 43 per cent of the population still lacks access to electricity⁷⁷ and approximately 80 per cent of African businesses report frequent power outages.⁷⁸ The continent's road density is only about 20 per cent of the global average, with just 27 per cent of roads paved, far behind India's 60 per cent and China's 66 per cent. Meanwhile, infrastructural demands continue changing as industry modernizes. Digital infrastructure, in particular, is becoming increasingly critical, including data centres, internet connectivity, automation support, digital payment systems and smart manufacturing technologies.

Among the infrastructure sector, telecommunications has made the biggest headway, while electricity, transport and housing are at intermediate stages, and water and sanitation are lagging behind. Efforts are also needed to improve the framework conditions for private investment in infrastructure. Moreover, public investment must reverse the decline of the past decade, which will require greater domestic resource mobilization and greater external assistance. To ensure that increased investment is both effective and sustainable, it must be accompanied by better policies and governance reforms.

Despite economic growth in developing countries over recent decades, this has not consistently translated into positive development outcomes: many LDCs remain highly vulnerable to poverty, food insecurity and inequality. This is largely attributable to a lack of productive capacities, i.e. the set of productive resources, entrepreneurial capabilities, human skills and production linkages that determine a country's ability to produce goods and services. Due to their lack in productive capacity, coupled with limited economic diversification and human capital, developing countries have few means to respond to external shocks meaning their socioeconomic progress remains fragile. Labour productivity in LDCs has also slowed over the past decade, further constraining their development potential and underscoring the urgent need to strengthen productive capacities.

With the 2030 Agenda for Sustainable Development deadline fast approaching, and developing countries increasingly grappling with the effects of geopolitical conflicts, climate change and other unforeseen shocks, it is essential to place productive capacity at the centre of any development strategy. These countries should focus on establishing viable manufacturing hubs, at least within key industrial subsectors, to stimulate entrepreneurship, accelerate industrial development, and create the foundation for the development of productive capacities in other sectors such as infrastructure and technology.

With regard to institutional capabilities, governments have traditionally relied on industrial policy to accelerate the development of domestic production capacity in selected industries and enhance the competitiveness of local producers through protectionist measures, technological upgrading, training and investment promotion. In all cases of successful industrial development throughout history, the state has played an indispensable role. As highlighted in Section 1, countries such as the Republic of Korea and China, along with many others, have achieved industrial production and export growth through strategic planning. They have leveraged state owned enterprises, sovereign wealth funds, development banks, industrial and technology parks, special economic zones, business incubators and substantial investment in infrastructure essential for industry.

In recent years, industrial policy has experienced a resurgence, driven by challenges such as the global financial crisis, rapid technological advancements, the COVID19 pandemic, and the need for a green transition. Notably, this wave of industrial policy interventions has been driven by large economies, with China, the European Union and the United States accounting for nearly half of all new measures in 2023. In contrast, far fewer policy initiatives have been implemented in LDCs. According to the IMF, over 2,500 industrial policy measures were introduced globally last year, with more than two thirds involving regulatory and trade distorting measures that discriminated against foreign commercial interests.

For low and middle income countries, modern industrial policies are essential but often underfunded, putting them at risk of falling further behind in global production. To address growing inequalities, developing countries need industrial policies that focus less on regulation and more on creating incentives for industrial firms to build industrial capacity and to enhance skills and knowledge in the workforce. Targeted policies, including investment in infrastructure and human capital, should be prioritized to drive productive capacity and structural transformation. Each developing country has unique political, socioeconomic and institutional contexts that determine how productive capacity can best be developed and leveraged.

3.2 Building a foundation for industrial development

To ensure industrial development with a focus on developing countries' specific needs, the process must begin by equipping the workforce, especially in the countries of the Global South, to build the foundation for them to master new technologies and drive innovation. This will lead to a transition away from traditional factory structures to a new organization of industrial production on the shop floor and within networks of companies, aligning with broader industrial development programmes. Cooperation between less and more industrialized countries must be promoted, with a special emphasis on regional collaboration.

Equipping the labour force

As innovation accelerates and new technologies are used to address development challenges, the demand for employees with specialized technical skills is growing. The skill sets required for employment in modern industry are evolving quickly. Basic education in technical disciplines and in science, technology, engineering and mathematics (STEM) is often the entry point for these roles. China and India currently lead in STEM education, producing over 5 million STEM graduates annually, followed by the United States and Russia.

There is also a growing demand for specialized, flexible, high level training beyond traditional formal education. Foundational skills in STEM must be translated into competencies required to operate the modern, digitalized shop floors of factories. This requires close collaboration between firms and the educational institutions, including on the job training, demonstrations, and opportunities for experimentation. Partnerships between universities and employers can help provide workers with specific manufacturing skills, e.g. through apprenticeship, mentoring and coaching, as well as internship programmes for students and new graduates.

Human machine interaction is another important area of development for industries of the future. As automation continues to expand, the dynamics between workers and machinery are likely to shift towards a new division of labour. With repetitive and physically demanding tasks increasingly being performed by industrial robots and other automated systems, human workers will likely shift their focus towards production supervision and troubleshooting. In some industries, such as semiconductor manufacturing, much of the workforce is already engaged in

these types of activities given the high degree of automation. Workers will also need to develop proficiency in digital tools, such as manufacturing software platforms, computer aided design (CAD), AI and production monitoring systems.

The international community can play a vital role in supporting developing countries strengthen and expand their vocational training institutions by creating curricula and learning materials that address the specific skill needs of firms in specific industries. These efforts should focus on scaling up training and skills development initiatives to foster industrial development while ensuring equal access to education for women, marginalized groups and youth. To build thriving competitive industries, it is essential to implement innovative training and skills development methods.

Flexible working arrangements are crucial to accommodate the growing need for remote and online work, enabling employees to communicate, access the information they need and engage in continuous lifelong learning and skill upgrading. The COVID19 pandemic demonstrated that tasks such as communication, planning and monitoring can also be performed from remote locations or home while other tasks still require onsite presence. Remote work can increase workforce participation among individuals who were previously excluded from traditional onsite work environments, including women with childcare responsibilities, workers located far from major industrial zones, and individuals with physical disabilities. At the same time, for remote work to become a reality, organizations must adapt their management practices and enhance collaboration with workers, alongside making greater investments in information and communication infrastructure.

To further enhance industry's productivity and promote economic prosperity through greener and more sustainable development, developing economies need largescale investments to not only address the lack of digital connectivity but to also introduce smarter, more efficient, greener and cleaner production technologies. Developing countries must strengthen local research and innovation ecosystems by equipping local stakeholders with the necessary knowledge, resources and funds while also fostering an enabling institutional and regulatory environment for R&D to thrive.⁸¹ They must also become the beneficiaries of increased investments aimed at developing capacity for technology use and facilitating technology and knowledge transfer from developed countries, including through joint R&D efforts. Innovation should not be confined to the world's leading companies, it must also extend to businesses in developing countries, including SMEs.

Developing countries also need support from advanced industries and the global development community to establish basic digital infrastructure and implement 4IR technologies, IoT, AI, etc. These tools are crucial for enhancing the profitability and sustainability of production in specific sectors. To facilitate this transition, guarantees and insurance against risks and defaults for investments in industrial innovation within developing countries.

Moving beyond the factory

The industry of the future will look markedly different than today's; decentralized and intelligently connected production systems powered by sustainable energy with an inbuilt smart reuse of resources and materials in a closed loop with no contamination will replace high smokestacks and polluting processes. In the factories of the future, workers will become valuable contributors to creative manufacturing processes, providing useful products and services for all.

Understanding the entire ecosystem of production along industrial value chains is crucial, not only for optimizing productivity growth across the economy but also for maximizing spillover effects to other sectors and fostering job creation. To effectively harness market potential and competitive advantage, industry in developing countries must analyse industrial value chains in their full complexity, identifying the actors and interactions that can inform strategies for entering specific stages of these chains. This approach necessitates planning and policies that extend beyond the firm level as well as government incentives that support firms and agencies in establishing robust and innovative businesses.

Manufacturing generates stronger spillover effects to other sectors than vice versa. Industrial ecosystems encompass a range of activities beyond those associated with the factory floor, including R&D, design, production, distribution and aftersales services. They also involve ancillary functions such as analysis, testing and logistics. It is essential to be aware of the connections between these activities and their links with specialized functions such as regulatory services, intellectual property services, quality compliance infrastructure, and investment and business support services. To develop a comprehensive ecosystem for industrial production, support is needed to establish its integral components. Governments should implement programmes for firms and tech centre based R&D, and establish specialized agencies to promote quality, investment and technology transfer. Additionally, they should formulate policies that provide regulatory support. Industry must collaborate and cofinance initiatives, with special focus on supporting SMEs and the informal sector.

As international trade conditions are reshaping patterns of global production, developing countries may face challenges in accessing new markets and moving into higher value segments of production. Smaller developing countries, in particular, often lack the domestic market size necessary to justify largescale investments in industrial production and upgrading without integration into global markets. Even larger economies such as India and Brazil are likely to be affected by the shortening and fragmentation of GVCs, especially given their reliance on imported industrial inputs and export markets for certain industries.

To address these challenges, industry can establish more regionalized supply chains that use shorter, more cost effective and less polluting transport routes while incorporating SMEs in developing countries. Legal frameworks must support the development of more localized supply chains, extending beyond mere reductions in CO₂ emissions or the adoption of renewable energy and cleaner production technologies. They should also address social sustainability, fair trade, biodiversity and promote local production and value creation in developing countries.

Stronger regional integration is essential to achieve the scale and production complementarities required to compete effectively on the global level. The European Union's trade negotiations with the United States and China exemplify how a high income economic bloc can leverage regional coordination. By fostering regional trade agreements, facilitating mutual FDI, developing cross regional infrastructure, and engaging in joint negotiations with other countries and economic blocs, countries can better integrate into GVCs, particularly in an era of rising geopolitical tensions. Moreover, regional integration can help insulate developing countries from geopolitical pressures, allowing them to benefit from continuing trade relations with different parts of the international trade system.

Furthermore, industrial policy coordination at the regional level will be crucial. To minimize redundancies in production capacity and improve return on investment for state support, countries within regional economic blocs should align the design and implementation of

industrial policy measures, focusing on targeted sectors, policy tools and the scale of such interventions. Trade measures to protect domestic industry will benefit from regional coordination to limit intraregional fragmentation. Regional investment funds can be established to support cross border regional value chains, such as the development of new manufacturing facilities and job training programmes. Multilateral lending organizations must play a key role in financing these regional level industrial initiatives that are too high risk for individual countries to undertake on their own.

3.3 Shaping the future of industry for sustainable development

To ensure that industry better serves both current and future needs, three interrelated issues need to be addressed:

1. The sourcing and production of industrial goods must be based on principles of sustainability, ensuring social and environmental compatibility and focusing on local value addition;
2. Food security for all must be ensured by expanding agroindustry that taps into new sources of food, producing safe foods with higher nutritional value and where there is more space for the generation of local content in developing countries, and
3. The production and use of energy in industry needs to be ‘greened’ and the impacts of energy and industrial production on the environment must be minimized.

Sustainable supply chains

The sourcing of materials is essential for industrial production, whether for food, textiles, electronics or automobiles. Without access to reliable, high quality materials, industry faces difficulties in meeting demand and maintaining profitability. Manufacturing firms need to rethink their business models and identify new ways of sourcing products in a more sustainable and riskproof way in the face of evolving barriers to trade. Global challenges and emerging industrial megatrends (see above) underscore the need for manufacturing firms to adapt their business models. As it is becoming increasingly difficult to predict supply and demand, manufacturing firms need to invest more in foresight and the ability to quickly adapt to changing conditions.

Industry, particularly in developing countries, must be supported in creating cost effective supply chains for their industrial inputs to remain productive and competitive. This includes support in optimizing and futureproofing existing supply networks, organizing logistics more efficiently, creating greater transparency throughout the chain, minimizing risks and establishing partnerships with suppliers that need industry’s help in improving production processes and adhering to high standards of quality and sustainability.

Additionally, a robust sourcing strategy can contribute to environmental sustainability while ensuring that local suppliers earn income and add value to products in a sustainable way. Governments need support in establishing regulatory frameworks that require companies to rigorously adhere to human rights and environmental due diligence. At the same time, manufacturing firms need to be supported if they are to comply with these regulations and to adopt voluntary standards for sustainable sourcing.

Regulators, industry and consumers as well as industrialized and industrializing countries share the responsibility for creating sustainable supply chains; development agencies play a crucial role in facilitating, catalysing, and incentivizing best practices, ensuring an inclusive process that

incorporates the voices of all actors involved in global supply chains. International platforms can promote the development and implementation of legislation and standards for sustainable supply chain management and sustainable investment in industry, emphasizing environmental and social standards in industry and trade and local value addition in developing countries. Industry and certifying bodies must also incorporate the criterion of local value addition in their sustainability standards schemes for production and trade.

Furthermore, industry should be supported in adopting new digital tools to measure the implementation of sustainable practices throughout the supply chain, enhancing overall transparency for both businesses and consumers. They also need support for rationalizing, derisking and futureproofing their supply chains by way of chain specific foresight of demand and supply, optimizing production and logistics (e.g. through digital real time data management and automation) and advanced business planning.

Industry must also establish efficient and reliable supplier networks in developing countries, empowering local producers to adopt best practices in production, manufacturing and quality and sustainability standards. This may involve creating local supplier clusters, collection centres and regional procurement hubs in developing countries as well as supporting SMEs in developing and improving their products, upgrading production technologies and develop and formulating bankable business plans that adhere to standards and meet the criteria for economic profitability and sustainable production. It is also often necessary to help specific industries comply with quality protocols and food safety standards by developing quality compliance infrastructure and developing quality management capacity among firms.

In this context, industry must enhance the integration of women and youth into production processes along the value chain, ensuring equal pay, skills, capacity and entrepreneurial development.

Ending hunger

The development of agroindustry is essential for producing more, better and safer food, while ensuring it is distributed at affordable prices to all. Agroindustry can significantly contribute to achieving the SDG 2 target of doubling agricultural productivity by sourcing primary and semi processed foods from a diverse range of suppliers, including smallholder farmers, helping them improve the quality of their products, adopt more efficient and sustainable production practices and add more value to their production practices. To address environmental concerns, agroindustry can be strategically organized in industrial parks and special economic zones designed to minimize resource use, pollution and waste.

Agroindustry in developing countries requires support to implement advanced food processing technologies and design better food products with higher nutritional value in combination with support in developing bankable business models. The new foods produced should also incorporate new primary inputs from newly discovered plant species, biotechnology, and the blue economy. Integrating these elements in new food products necessitates R&D and product development.

This support should extend to the development of entire agricultural value chains that focus on adding value to local products through efficient and sustainable agroindustry at an appropriate scale, This approach should also incorporate cleaner production concepts, green energy solutions, and adhere to circular economy principles and life cycle management. Agroindustrial parks can serve as key accelerators for food value chain development by applying sustainable

industrial production practices, which entails providing support to industrial parks planning, establishment and management.

Meanwhile, agriculture and agroindustry in developing countries must explore strategies to minimize postharvest losses by promoting the development of relevant postharvest infrastructure and technologies, better logistics and the establishment of efficient supplier networks where agroindustry can help suppliers improve their production processes and product quality.

At the global level, agroindustry should develop initiatives for more sustainable sourcing of food products from developing countries. Sustainable sourcing must adhere to the principles of decent work, cleaner and greener production, empowerment of local talent and value addition to local products.

Clean energy and climate protection

To set the world on a path to achieve climate goals while fostering growth, energy ecosystems in all countries and regions must be profoundly transformed. The energy transition we actually need extends beyond the energy sector and intersects with all facets of society, from infrastructure, industry and agriculture to transport, housing and communications, potentially reshaping the way we produce, consume and live. There are no one size fits all solutions; instead, each country and region requires tailored energy transition pathways based on technological advancements, fuel substitution, electrification and decarbonization. In addition, concerns about energy security have evolved to encompass resilience, diversification of supply, climate change, the energy water food nexus, shifts in supply chains and access to critical minerals and metals. Key technologies driving the energy transition are converging, disrupting the energy landscape and reshaping the sector as they gain traction. While increasing the share of renewable electrification in the energy mix is a common goal, significant disparities exist in the deployment of specific key technologies across different regions.

To accelerate a more equitable and comprehensive energy transition and promote cleaner production systems in industry, it is essential to mobilize industry leaders, while also empowering SMEs, entrepreneurs, women, workers and the next generation. Their involvement is crucial for the development and implementation of innovative energy production and energy saving solutions in industry.

Countries, especially in the Global South, must anticipate the changing energy needs of industry (e.g. the shift from hydrocarbons to electricity and other sustainable alternatives). Strategies should be developed accordingly to secure green energy supplies for industry.

Furthermore, the international development community must support countries in establishing ambitious regional, national and global clean energy targets as outlined in the United Nations Global Roadmap for Accelerated SDG 7 Action and help translate these into national legislation, policies and development programmes.

Developing countries need support in partnership building and in attracting investments to build the infrastructure necessary for diversified clean energy production. Relevant green energy solutions shall include, in particular, green hydrogen, solar thermal energy, solar voltaic, wind energy, biomass, geothermal energy, hydropower, and efficient power grids and flexible energy transfer solutions.

Industry in both developing and developed countries must also adopt energy saving and energy efficient solutions, including investing in energy efficient machinery and equipment, using smart grids and energy storage solutions, implementing onsite solar and wind energy, harnessing onsite energy from residue and waste, and optimizing energy savings in transport.

In addition, industry must focus on sustainable extraction and production of critical minerals and metals essential for electrolysis and other largescale clean and renewable energy solutions, including EVs. Industry needs to be incentivised to introduce sustainable mining and cleaner production protocols. Energy intensive industries, such as steel and metals, cement, chemicals and fertilizers, need to embrace new energy saving technologies and onsite energy generation methods and more energy efficient production and supply.

Another critical area of support for developing countries is the establishment of eco industrial parks and sustainable special economic zones, designed to enhance industrial production efficiency, while minimizing environmental impact in line with circular economy principles. This includes support for master planning, the development of effective park management systems, business planning and technology transfer to the firms involved.

4. Concluding remarks

At the heart of any sustainable, long term solution to the world's most pressing challenges lies industrialization, a proven engine of economic growth and social progress. However, today's approach to industrial development must be markedly different from past practices. It must prioritize sustainability, inclusivity and resilience to empower the global population, particularly in developing countries, to achieve prosperity without jeopardizing the environment or exacerbating existing inequalities. At the same time, it must keep pace with rapid technological advancements, leveraging new materials and implementing new production processes to create innovative products.

Addressing these challenges necessitates a comprehensive set of enablers for industrialization, ranging from basic framework conditions (such as infrastructure and energy sources) to specific capabilities and skills within the private sector, labour force and government. To harness these capabilities for sustainable industrialization, forward-looking industrial policies are essential. Traditional models of industrial development are inadequate in a rapidly changing world characterized by megatrends that are fundamentally reshaping industries.

To support industries that are resilient and future ready, policymakers must focus on several crucial trends. The rise of AI and digitalization is revolutionizing production processes, enhancing efficiency and transforming job markets. The energy transition is equally important, and calls for a transition from fossil fuels to renewable energy sources, driving the need for clean technologies and green innovation. In addition, the reconfiguration of GVCs is reshaping how goods are produced and traded across borders, presenting both risks and opportunities for developing countries aiming to integrate into the global economy. Finally, demographic changes, including population growth in developing countries and ageing populations in advanced economies, further complicate the global labour market by creating new demands for jobs, healthcare, food and resources. The future of industrialization hinges on the ability to harness these trends, adapt to them and embed them within cohesive and strategic industrial policies that prioritize long term sustainability over short term gains.

In a rapidly evolving global landscape, policy exchange and learning are essential for successful future industrial development. Events such as UNIDO's Multilateral Industrial Policy Forum

(MIPF) play a crucial role in facilitating this exchange, providing a platform for countries to share knowledge, collaborate on innovative solutions, and learn from each other's successes and how to best address challenges. The interactive nature of the Forum featuring roundtables, gamechanger sessions and fireside chats encourages participants to engage in meaningful discussions. AI, the energy transition and GVC resilience are central themes of the 2024 edition of MIPF, offering an ideal opportunity for policymakers, industry leaders and experts to explore how to align industrial policies and strategies with emerging megatrends.

As we look ahead, industrialization will continue to be a powerful catalyst for economic transformation. However, achieving this potential requires the development of smart, forward-looking policies that effectively address the complex global challenges and trends we are facing, ultimately shaping the industries needed for sustainable development.

United Nations Industrial Development Organization (UNIDO)