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**of the Commission**

## Issues paper

# Sustainable industrialization and diversification of Africa in the digital era

## I. Key messages

1. Key messages include:

(a) With climate change, West and East Africa could lose up to 15 per cent of their gross domestic product (GDP) by 2050. North and Southern Africa could lose as much as 10 per cent of GDP, and Central Africa 5 per cent;

(b) Forty-two of the 63 elements used by low carbon technologies and the fourth industrial revolution are found in Africa. New green economy minerals offer potential as risks rise of stranded fossil fuel assets amounting to as much as 26 per cent, 34 per cent and 90 per cent of African gas, oil and coal reserves, respectively, being left unused;

(c) Renewable energy potential in the continent is estimated at 350 GW for hydroelectric, 110 GW for wind, 15 GW for geothermal and 1,000 GW for solar: cumulatively 8.8 times the total installed generation capacity of Africa in 2016. African industrialization can be fuelled with clean energy;

(d) Africa must embrace environmentally sustainable industrialization and diversification to find decent jobs for the 170 million African young people set to enter the job market between 2019 and 2030;

(e) Digitalization is opening up new frontiers. Financial technology (fintech) and mobile technologies are decentralizing solar investments, while digital solutions to crop information and insurance are building agricultural climate-change resilience;

(f) Digitally deliverable services from Africa are currently limited, but have grown two-and-a-half-fold since 2005 within a global market estimated to be worth \$2.9 trillion in 2018. Digital technology solutions have been found to increase agricultural yields by 20 per cent from advisory services, 70 per cent from market linkage services and 40 per cent from digital financial services;

\* E/ECA/COE/39/1.



(g) If emerging digitalization can be scaled, it could be transformational, helping Africa to sustainably industrialize and diversify within a global digital economy estimated to be worth more than \$11.5 trillion.

## II. Introduction: sustainable industrialization and diversification in Africa

2. Industrialization has been the proven engine for economic diversification and development. Its contribution to one of the most remarkable episodes of growth in history, in which growth rates in excess of 6 per cent were sustained for 30 years, is still hailed as the growth “miracle” of East Asia.

3. Nevertheless, few African economies have fully industrialized and diversified. The share of African employment in industry has remained stubbornly low, at around 10 per cent for 30 years (see figure I). Manufacturing value added in the GDP of Africa has in fact fallen slightly from 13 per cent in the 1970s to 11 per cent in the 2010s (see figure II). Although services have grown in importance for African jobs and wealth, just under 60 per cent of Africans continue to work in agriculture, mostly in basic subsistence farming.

4. Old pathways to industrialization are also no longer an option. The industrialization of Europe and North America during the eighteenth and nineteenth centuries, and the Asian growth miracles and economic transformation of China during the twentieth and early twenty-first centuries, were powered by the intensive use of carbon. Doing so increased atmospheric concentrations of carbon dioxide by 50 per cent, contributing to environmental degradation and global warming.

Figure I  
**Employment in Africa by sector, 1991-2018**

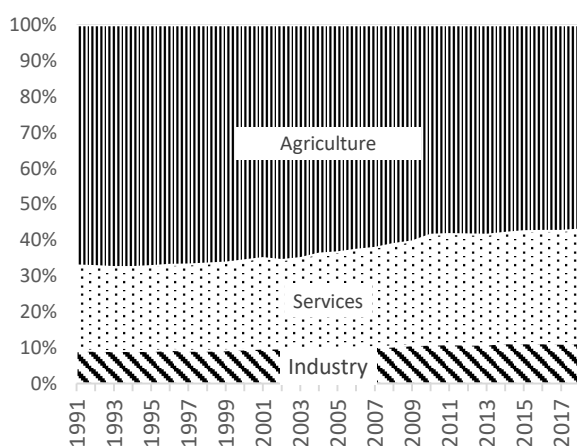
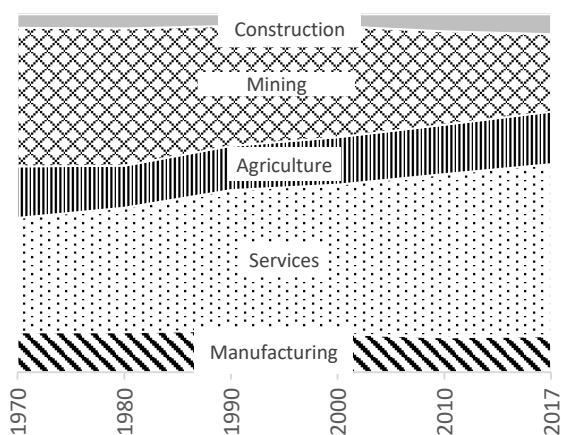


Figure II  
**Value added to the gross domestic product of Africa, by sector, 2017-2017**



Source: Economic Commission for Africa calculations using World Bank (2019a) and United Nations Statistics Division (2019) data.

5. Weather-related shocks attributable to changing climatic conditions are now posing adverse threats to the development of Africa. In March 2019, cyclone Idai caused over \$2 billion in damage in Malawi, Mozambique and Zimbabwe. In the second half of the year, drought in the same region led to food inflation surging to 8 per cent in Mozambique and 19.3 per cent in Malawi (Trading Economics, Mozambique Food Inflation, 2019; and Trading Economics, Malawi Food Inflation, 2020).

6. Industrialization today must therefore be environmentally sustainable. The imperative to divest from fossil fuels consequently presents challenges to

the industrialization of Africa, including the threat of stranded fossil fuel assets. These require innovative and dynamic solutions if the continent is to achieve the Sustainable Development Goals and the goals contained in Agenda 2063: The Africa We Want.

7. The digital era opens up such new options for the development pathway of Africa. While presenting disruptive challenges to traditional development models, digitalization also creates new possibilities for sustainable industrialization and diversification, including in agriculture and services.

8. The present issues paper first surveys what industrialization and diversification mean in the new climate economy. It then assesses how digital technologies are posing challenges and opportunities, before finally considering elements of a climate-smart industrialization pathway in the digital era. In doing so, it shows that the traditional route to development is not an option; Africa must proactively prepare for the new future ahead of it.

### **III. Industrializing and diversifying in the new climate economy**

9. Global warming has already reached 1.1°C above pre-industrial levels (with localized warming much higher for Africa), and the five-year period 2015–2019 was the warmest on record (World Meteorological Organization, 2019). Voluntary nationally determined contributions to climate action submitted by countries to date put the world on track for global warming of 3°C or more by 2100, which translates to significantly higher warming for Africa (Climate Action Tracker, 2019). Even if global warming were kept to 1.5°C, Africa would continue to experience increased temperatures and variable rainfall, with yield losses of staple crops (Intergovernmental Panel on Climate Change, 2019).

10. Although Africa is responsible for a historically negligible share of global carbon emissions, it disproportionately shoulders the consequences. A 2019 study by the African Development Bank (AfDB), the Economic Commission for Africa (ECA) and the United Nations Environment Programme (UNEP) estimated that, with climate change, West and East Africa could lose up to 15 per cent of their GDP by 2050. North and Southern Africa could lose as much as 10 per cent of GDP, and Central Africa 5 per cent.

11. In a high-warming scenario estimate, the Sudan and the United Republic of Tanzania would both lose an estimated 18.6 per cent of their GDP by 2050. Guinea-Bissau, Liberia and Mauritania would all lose more than 16 per cent of their GDP by that point. The Niger could lose as much as 19.8 per cent of its GDP (AfDB, ECA and UNEP, 2019).

12. Climate change would also undermine enablers for industrialization in Africa, including infrastructure, energy, water and raw materials.

13. The unusual El Niño and La Niña events of 2015/16 attributable to climate change had a devastating impact on hydropower production from the Kariba Dam, which supplies most of the electricity consumed in Zambia and Zimbabwe, causing operations to cease in early 2016. Failure to integrate climate change into the planning and design of power and water infrastructure could entail losses of hydropower revenues of 5–60 per cent, depending on the basin (World Bank, 2015).

14. In 2019, cyclones Idai and Kenneth wiped out roads, bridges and crops as they swept through South-East Africa, causing economic damage estimated at \$2 billion and slowing Mozambican GDP growth by as much as 2 percentage points (Nhamire, 12 April 2019).

15. Shifts in demand towards clean energy elsewhere in the world could also risk Africa being left with stranded, devalued fossil fuel assets. In limiting global warming to 2°C, as much as 26 per cent, 34 per cent and 90 per cent of the gas, oil and coal reserves, respectively, of Africa could be left unused (Bos and Gupta, 2019).

16. Climate change challenges can, however, be turned into development opportunities for industrialization and diversification if countries adopt a new climate economy approach.

17. Africa can fuel its industrialization with clean energy. Renewable energy potential on the continent is estimated at 350 GW for hydroelectric, 110 GW for wind, 15 GW for geothermal and 1,000 GW for solar: cumulatively 8.8 times the total installed generation capacity of Africa in 2016 (International Renewable Energy Agency, 2018).

18. Morocco, for instance, has built the world's largest concentrated solar facility, the Noor complex, helping to achieve the country's goal of 52 per cent renewable energy by 2030 while creating jobs and powering industry. In South Africa, recent renewable energy auctions have led to lower prices for energy from solar and wind than those for energy from new coal plants (International Renewable Energy Agency, 2018).

19. There are opportunities, too, in green economy minerals. The Democratic Republic of the Congo holds 47 per cent of the world's cobalt (which is needed for batteries), while Namibia and Zimbabwe have 100 per cent of the world's caesium reserves and 89 per cent of the world's rubidium reserves. (Both are used in mobile-cellular global positioning systems.) In fact, 42 of the 63 elements used by low carbon technologies and the fourth industrial revolution are found in Africa (United Nations University-Institute for Natural Resources in Africa, 2019).

20. Digitalization opens up new opportunity frontiers. Data-driven water management technologies, such as water-efficient crops and remote sensors, conserve water better. Smart grids and smart cities allow more efficient management of energy distribution, reducing costs. Fintech, satellite technologies and mobile-based information systems enhance agricultural yields, reduce post-harvest losses and improve climate resilience.

21. For example, in Kenya and Nigeria, M-Kopa Solar and Lumos, respectively, are using fintech and mobile technologies for decentralized renewable energy investments.

22. In fact, action on climate change could deliver economic benefits estimated to be as much as \$26 trillion by 2030, as well as more jobs, health benefits through reduced air pollution and better opportunities for women and young people (New Climate Economy, 2018).

23. This is a growth story agenda and opportunity that Africa cannot afford to miss if it is to meet its development aspirations as encapsulated in various national development plans, including the 2030 Agenda for Sustainable Development and Agenda 2063 of the African Union.

## **IV. The digital era: challenges and opportunities for industrializing and diversifying**

### **A. Africa in a digitalizing world**

24. The world economy is undergoing profound change. In 2009, the world's top 20 largest companies by market capitalization included only three tech

companies. By 2018, that number had surged to eight, with four of the top 10 – Amazon, Alibaba, Facebook and Tencent – not even having appeared in the top 100 in 2009 (United Nations Conference on Trade and Development (UNCTAD), 2019).

25. Although there is no commonly agreed definition of the size of the global digital economy, estimates suggest its worth was in the region of \$11.5 trillion in 2016, equivalent to 15.5 per cent of global GDP (Huawei and Oxford Economics, 2017). This amounts to double its value in 2000.

26. Most of the value in the digital economy remains in only a few countries or regions, including the United States of America (35 per cent), Europe (25 per cent), China (13 per cent) and Japan (8 per cent) (UNCTAD, 2019). Nevertheless, changes in these economies create the possibility of spillover effects in African and other countries, including restructuring and replacing where value is captured in global value chains (Foster and others, 2018).

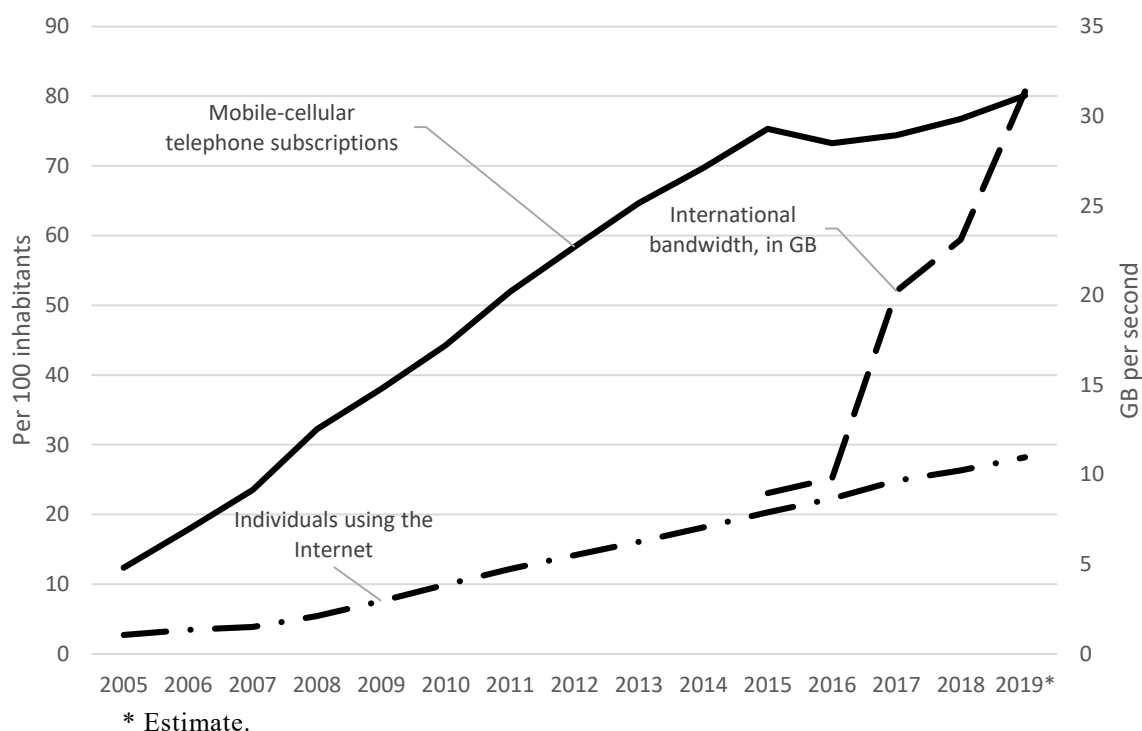
27. Africa is host to 618 active tech hubs (GSMA, 2019) and more than 70 fabrication labs (FabFoundation, 2020), fuelled by African venture start-up funding estimated to have reached over \$1.3 billion in 2019 (WeeTracker, 2019). The capacity of Africa to adopt digital technologies remains constrained, however, by the digital divide it faces with much of the world.

28. Persisting electricity challenges still left 32 African countries among the bottom 50 in the “Getting electricity” subcategory of the World Bank Doing Business index as of 2018.

29. African countries also lag in the use of more advanced digital technologies, such as cloud-computing applications and e-commerce, and the deployment of smart machines, such as robots and 3D printers (ECA, Friedrich-Ebert-Stiftung and Office of the United Nations High Commissioner for Human Rights (OHCHR), 2019). Imports of information and communications technology goods accounted for only 5 per cent of merchandise imports in Africa in 2017, compared with a global average of 13 per cent (United Nations Statistics Division, 2019). The share of robots sold in Africa in 2015 (about 0.2 per cent of world sales) was one fifteenth its share of world GDP (about 3 per cent) (Banga, 2019).

30. Nevertheless, Africa is catching up in basic digital indicators. In 2005, only 4 per cent of Africans used the Internet; this has increased rapidly, to 34 per cent in 2019 (see figure III). In the same period, the share of Africans with mobile-cellular telephone subscriptions increased from 12.5 per cent to 80 per cent, while international Internet bandwidth in Africa increased from 9 to 31 GB per second between 2010 and 2019.

Figure III  
Basic digital indicators for Africa, 2005–2019



Source: Economic Commission for Africa calculations using International Telecommunication Union data (2019).

## B. Industrialization in a digitalizing world

31. Digital technologies are transforming industry in what is now regarded as the fourth industrial revolution (see figure IV). This includes the adoption of technologies such as industrial robots and 3D printing in manufacturing, and the use of big data and artificial intelligence in product development and e-commerce in marketing and sales.

32. As a result, industrialization is not what it used to be: changes in where value is created, and how it is captured, are reducing the share of value that was traditionally accounted for by manufacturing production (Mayer, 2018). A greater share of the value of manufacturing is shifting to pre- and post-production services. In pre-production, data-driven and computer-aided design is attracting more value. In post-production, services embedded in software and enhanced after-sales services account for more value (Haskel and Westlake, 2018).

33. The implication for Africa is that, even if it falls behind in the adoption of these new technologies, they can still have an impact on African economies through global value chains. For instance, rather than locate a shoe factory in Africa to benefit from lower wages for labour, a manufacturer may instead set up a 3D printing plant in Germany. Even if manufacturing moves to Africa, the valuable parts of pre- and post-production may remain elsewhere.

Figure IV

**Characteristics of industrialization, from 1.0 to 4.0****Industry 1.0 (eighteenth century)**

Mechanization, steam power and weaving loom → shift from cottage industry to mechanical production

**Industry 2.0 (nineteenth century)**

Electrical energy → assembly line and mass production

**Industry 3.0 (twentieth century)**

Electronics and information and communications technologies → automated and networked production

**Industry 4.0 (twenty-first century to date)**

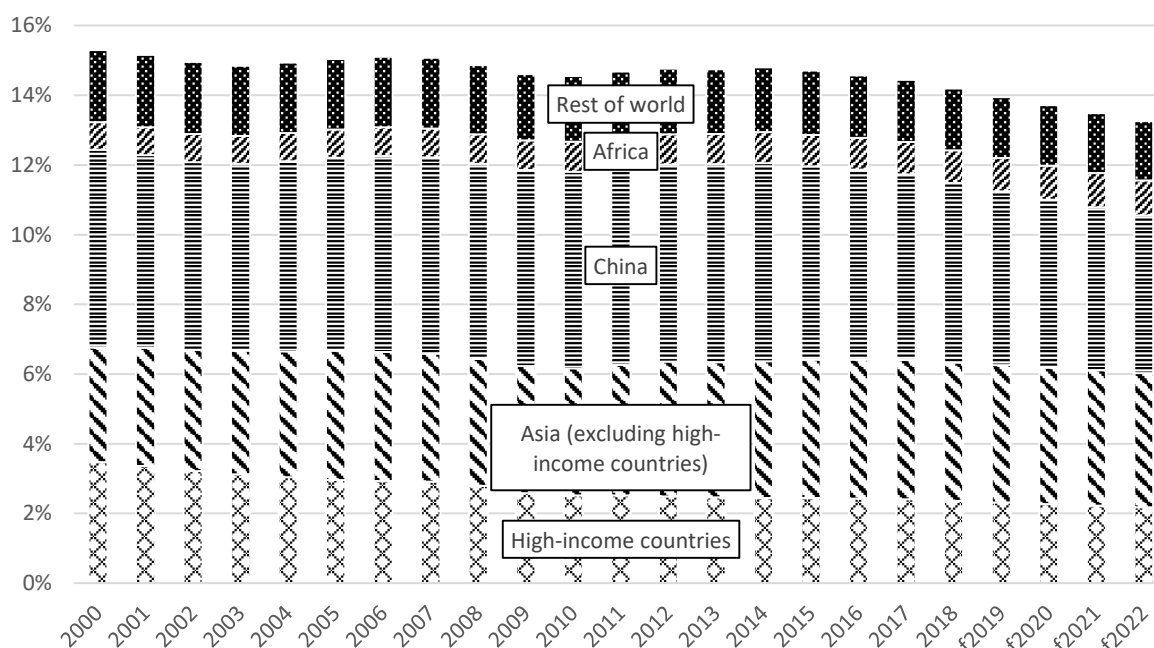
Artificial intelligence, advanced automation and robotics, 3D printing, big data and e-commerce → automated production with a prominent role for intangibles and the "servicification" of production

*Source:* Adapted from Economic Commission for Africa, Friedrich-Ebert-Stiftung and Office of the United Nations High Commissioner for Human Rights (2019).

34. Digital technologies also enable and directly entail the automation of routine tasks. The jobs accounted for by those routine tasks are at risk of being displaced by such technologies, just as artisanal weavers were displaced by the weaving loom in the first industrial revolution. The estimated extent of this displacement varies by study. Although specific studies on Africa are unavailable, some expect 47 per cent of jobs in the United States to be at risk (Frey and Osborne, 2017), 57 per cent in Organization for Economic Cooperation and Development (OECD) countries (Oxford Martin School, 2018), 69 per cent in India, 77 per cent in China and 40–60 per cent in the European Union (Bowles, 2014). Other recent studies suggest that as few as 6 to 12 per cent of jobs are at risk of being fully automated (Arntz, Gregory and Zierahn, 2016), but that 50 per cent of work tasks within those jobs could be automated using current technology (Manyika and others, 2017).

35. These forecasts are tentatively emerging in the data. The share of total jobs that are in industrial manufacturing has slowly been falling, from 15.3 per cent in 2000 to 14.2 per cent in 2018, and is predicted to fall to 13.2 per cent in 2022, according to International Labour Organization (ILO) projections (see figure V).

Figure V  
Share of total world jobs in manufacturing, by region



f = International Labour Organization (ILO) forecast.

Source: Economic Commission for Africa calculation using ILO data (2019).

36. So far, much of this decline has been in high-income countries, which have shed just over 13 million manufacturing jobs since 2000 (a decline of 17 per cent), although China – which hosts 36 per cent of the world’s manufacturing jobs – has also lost over 9 million manufacturing jobs since the number of such jobs peaked in that country in 2014.

37. Although Africa has so far weathered this trend –African manufacturing jobs have increased by 820,000 on average in each of the past five years (ILO, 2019) – the world share of jobs in manufacturing may continue its decline as a result of digital automation, reducing the number of “could-have-been” manufacturing jobs available to relocate to Africa. For instance, although there may be an opportunity for Africa to capture some of the labour-intensive manufacturing jobs of China as Chinese wages continue to increase, a recent survey of Chinese light manufacturing firms indicated that only 10 per cent would choose to relocate their operations in response to rising wages in the country, while 54 per cent would choose instead to upgrade technology (Xu and others, 2017).

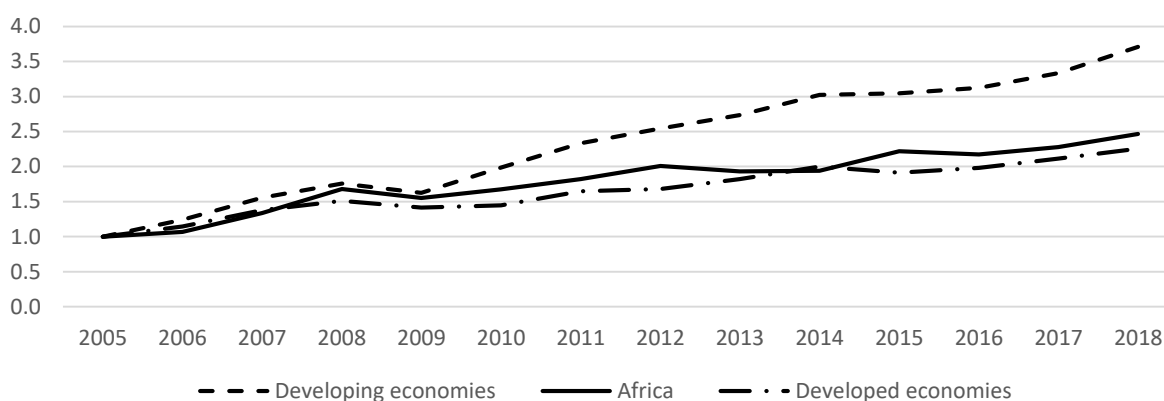
38. With 170 million African young people entering the workforce between 2019 and 2030, policymakers must look into new ways to diversify their economies and create decent jobs (ILO, 2019). The old pathways to industrialization are no longer an option.

### C. Opportunities for diversifying through digital services

39. Digitalization is changing services. Traditionally, the services sector concerned non-tradables: manufactures could be sold for foreign exchange; haircuts could not. Digital channels of service supply are enabling services to be delivered beyond local labour markets. As of 2018, digitally deliverable services amounted to \$2.9 trillion globally (UNCTAD, 2019). While such exports from Africa are currently small, they are growing (see figure VI).



Figure VI  
Exports of digitally deliverable services, 2005–2018



Source: Economic Commission for Africa calculations using United Nations Statistics Division data (2019).

Index: 2005=1.

40. Platform work is an emerging feature of digitally enabled services, allowing clients to outsource tasks across a wide pool of global potential workers (BFA Global, 2019). Platforms such as Amazon Mechanical Turk offer mostly low-capacity tasks, such as data cleaning and labelling. Freelancer and Upwork offer a range of work, including web development and marketing. Andela provides training for the most talented software developers in Africa, before employing them remotely in tech companies around the world. According to Heek (2017), there are about 70 million registered platform workers globally, in the market for work that the World Bank estimates will grow to be worth \$15 billion–\$20 billion by 2020 (Kuek and others, 2015).

41. The presence of online workers is, however, currently concentrated in India, the Philippines and the United States. With the exception of Egypt, Ghana, Kenya, Morocco, Nigeria and South Africa, online platforms currently provide a negligible amount of work in Africa. The quality and conditions of this work can also be poor (Graham and others, 2017; Shah, 2018).

42. To take advantage of these opportunities, African policymakers must sow the seeds of a firm foundation for the digital era by investing in Internet and digital infrastructure and digital middleware - such as payments solutions and digital ID - as well as by improving digital literacy skills.

#### D. Opportunities from diversifying through digital agriculture

43. Digitalization is also changing agriculture. This includes the application of digital technologies to enable precision agriculture, the dissemination of advisory services, the connection of market linkages, digital financial service intermediation and supply chain management solutions.

44. In Senegal, Daral Technologies is using digital technology to ensure the identification and security of livestock. In the Niger, ITechCentre is using digital solutions to disseminate business information to farmers. In Kenya, Musoni uses fintech methods to provide loans to a large numbers of rural smallholder farmers.

45. According to a study by the Technical Centre for Agricultural and Rural Cooperation in 2019, from a sample of 50 impact study data points, digital technology solutions were found to increase average agricultural yields by roughly 20 per cent from advisory services, 70 per cent from market linkage

services and 40 per cent from digital financial services. They can also contribute to climate resilience, by better designing and disseminating crop insurance products and improving yields.

46. According to the Technical Centre for Agricultural and Rural Cooperation study, there were at least 390 distinct, active digital agricultural solutions across Africa, with 60 per cent of these having been launched in the past three years, reaching 33 million African smallholder farmers. Nevertheless, the sector currently lacks precise quantitative data or evidence on net employment impacts. Scaling up the adoption of digital technologies in African agriculture could have a transformational impact. Just under 60 per cent of the African workforce is currently in agriculture, and this is where the incidence of poverty in Africa is greatest (World Bank, 2019a).

47. Mechanization and technology adoption in the agricultural sector of Africa has in the past been poor. While some fear digital technologies may suffer a similar fate (World Bank, 2019b), others see the falling price of smartphones and smart technologies adapted to analogue systems as offering new opportunities for African farmers. African countries need to increase smartphone access and connectivity in rural areas, improve rural digital literacy, invest in “middleware” infrastructure such as agronomy maps and shift financing for agricultural digitalization from being primarily donor-funded to privately funded (Technical Centre for Agricultural and Rural Cooperation, 2019).

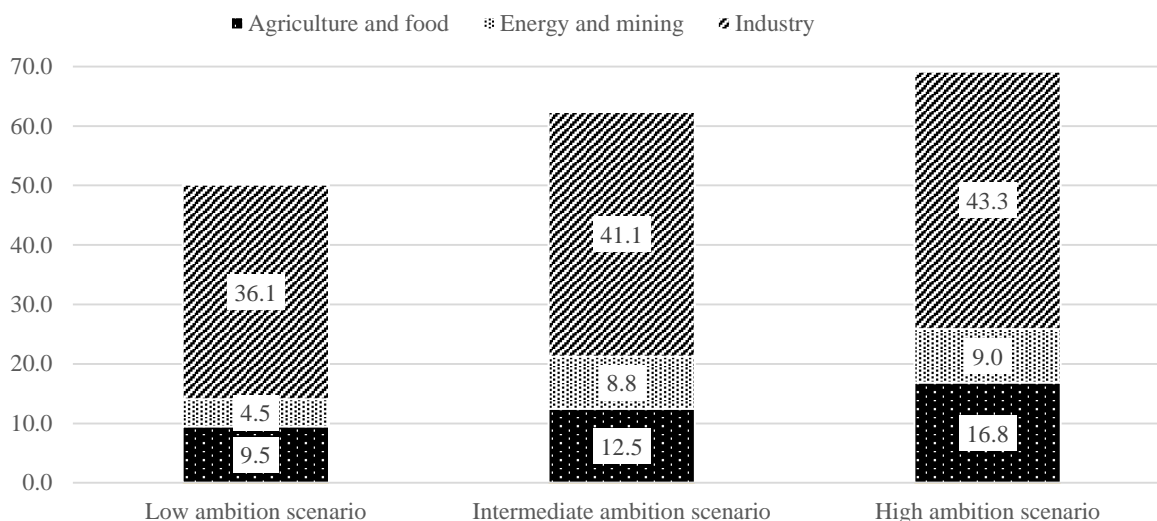
## **E. Using the African Continental Free Trade Area to boost industrialization and digitalization**

48. Industrial exports of Africa are forecast to benefit most from the African Continental Free Trade Area, helping to promote industrialization. Modelling by ECA forecasts the Free Trade Area to increase intra-African exports of industrial products by 25–30 per cent (or \$36 billion–\$43 billion) (see figure VII).

49. The Free Trade Area will also present a platform for a digital single market, possibly as a protocol to the Agreement Establishing the African Continental Free Trade Area (ECA, African Union, AfDB and UNCTAD, 2019). It will offer a framework for developing technology standards, harmonization of market digital regulations and interoperability to support cross-border commerce. Digital technology will spur cross-border trade by enhancing process automation and reduce costs, while opening up new opportunities for digital commerce and services in areas of supply chain logistics, further creating job opportunities.

Figure VII  
**Change in intra-African exports by main sector, as compared with a baseline of no African Continental Free Trade Area in place by 2040, various scenarios)**

(Billions of United States dollars)



*Note:* Higher-ambition scenarios result from more ambitious liberalization reforms; that is, if countries exclude fewer valuable products within their permitted Free Trade Area exclusion lists.

*Source:* Economic Commission for Africa calculations based on the MIRAGE computable general equilibrium model.

## V. A climate-smart industrialization and diversification pathway in the digital era

### A. Pathways for greening and upgrading traditional manufacturing

50. Opportunities exist in embracing new avenues for greener manufacturing in the digital era.

51. Technologies such as 3D printing enable smaller African businesses and entrepreneurs to participate in manufacturing in ways once unique to large, State-backed enterprises (Akileswaran and Hutchinson, 2019). For instance, Kijenzi uses 3D printing to provide medical components for rural clinics in Kenya, while Akhani 3D printing uses a range of technologies in South Africa.

52. Other technologies, such as computer-aided design and 3D scanning, can facilitate the reverse engineering of traditional manufacturing. While reverse engineering has long amounted to an industrialization strategy of countries such as China and the Republic of Korea, digital technologies make this relatively easy.

53. Nevertheless, manufacturing must increasingly be fuelled by access to clean and renewable energy sources. Digitalization can enable smarter use of renewable energy, transportation systems, production and distribution processes (International Institute for Sustainable Development, 2010). In so doing, digitalization can increase energy efficiency and reduce greenhouse gas emissions.

54. Countries must ensure synergistic implementation of policies for industrial development, digitalization and green growth. Many countries have adopted industrialization policies and are increasingly formulating national frameworks for digitalization. The challenge is that many are yet to elaborate and set in motion green growth policies and strategies.

55. In countries where they have been adopted, green growth strategies are providing the needed basis for sustainable industrialization. Examples of green growth frameworks are the climate-resilient green economy strategy of Ethiopia, the green economy strategy and implementation plan of Kenya, the AKOBEN programme in Ghana, the Green Economy Accord in South Africa and the green growth development strategy of Uganda.

## **B. Pathways for green diversification**

56. Commodity-based industrialization has long been an alternative pathway for African development beyond traditional labour-intensive manufacturing (ECA, 2013; 2015). By adding value to their raw material locally, African countries can bring about diversification and growth. Further attention must now be given to commodities likely to benefit from green growth, such as cobalt for batteries and clean energy.

57. Digital technologies also offer pathways to boost agricultural production. For example, TechnoServe's use of satellite imaging reportedly helped improve coffee production processes in South Sudan (Murray, 20 January 2016). If African countries can increasingly adopt such digital technologies, they can potentially attach more value to their commodity-based exports, while better ensuring their sustainability. Such digital technologies can also contribute to agricultural climate resilience, for instance, by leading to better designed and disseminated crop insurance products and advisory services.

58. Digital technologies also offer pathways to expand and diversify into digitally delivered services, for example, via work platforms like Upwork, Freelancer and Andela. While there is evidence of this already in Egypt, Ghana, Kenya, Morocco, Nigeria and South Africa, countries must develop strategies to intentionally nurture and take advantage of the possibilities offered by such new work forms.

## **C. Pathways for promoting digitalization in Africa**

59. Although Africa is catching up with the rest of the world in basic digital indicators, it remains far behind in the adoption of advanced digital technologies. The continent must build better digital economy foundations.

60. **Levelling up the workforce:** Greater consideration needs to be given to identifying exactly which digital skills should be invested in, and how. Priorities include: (a) core job-neutral digital skills, such as basic computing; (b) job-specific digital skills, like computer programming, data analytics, coding and network management; and (c) job-neutral soft skills, such as communication, management, analytical and critical thinking and creativity.

61. **Upgrading digital hardware:** Simply ensuring access to fast Internet is found to have a large positive effect on African employment rates, including for less educated worker groups (Hjort and Poulsen, 2019). Improved digital connectivity must also include improved Internet coverage, to help spread digitalization, particularly in rural agriculture, as well as the lowering of costs, to help the competitiveness of African digitally enabled service suppliers. More basic enabling infrastructure must also be improved, including electricity

reliability and cost: of the bottom 50 countries in the “Getting electricity” sub-category of the World Bank Doing Business index, 32 are African.

62. **Upgrading digital middleware:** Upgrades must also be made to the middle layer between infrastructure and technology businesses, such as digital payment solutions and digital ID. These create a bridge with digital hardware to create a conducive ecosystem for African tech to flourish. For this, Governments need to adopt appropriate regulation for the development of private sector payment solutions, like mobile money, while nurturing the adoption of application programme interfaces in government services, to help tech businesses integrate with government provisions, and establishing digital ID systems to create trust and help fintechs satisfy “know-your-customers” regulations.

63. **Fostering African smart cities:** Digitalization can redefine how cities are planned, designed and managed. Smart cities use digital technology to improve efficiency, competitiveness, productivity, liveability and sustainability through intelligent infrastructure and services. For example, Smart Village, established in 2001 in Egypt, boosted the information and communications technology sector, creating more than 50,000 jobs (BearingPoint Institute, n.d.).

## VI. Policy issues and key questions

64. The following topics are to be considered for discussion:

(a) How should Africa prepare to avert the threats and risks imposed upon it by climate change, including those of weather-related shocks, damaged infrastructure and stranded fossil fuel assets?

(b) How might Africa follow an environmentally sustainable industrialization pathway to take advantage of the economics of climate change, including green mineral assets and clean energy potential?

(c) With 170 million African young people set to enter the workforce between 2019 and 2030, how should African economies diversify to create decent jobs in a greener economy?

(d) How can the digital technologies of the fourth industrial revolution be harnessed to mitigate the effects of climate change, while creating new pathways for jobs creation?

(e) Can the African Continental Free Trade Area contribute to the development of the digital economy and e-commerce in Africa? Is there merit to the suggestion of fostering an African “digital single market”, possibly as a protocol to the Agreement Establishing the African Continental Free Trade Area?

(f) What policies are needed to promote digitalization in Africa?

## References

African Development Bank, Economic Commission for Africa and United Nations Environment Programme (2019). *Climate Change Impacts on Africa's Economic Growth*. Addis Ababa: ECA.

Akileswaran, Kartik and Georgina Hutchinson (2019). Adapting to the 4IR: Africa's development in the age of automation. Tony Blair Institute for Global Change.

Arntz, Melanie, Terry Gregory and Ulrich Zierahn (2016). The risk of automation for jobs in OECD countries: a comparative analysis. Social, Employment and Migration Working Paper, No. 189. Paris: OECD

Banga, Karishma (2019). Digital transformation for industrialisation and reverse engineering in Africa. African Export-Import Bank, ECA and UNCTAD, *Digital Transformation for Intraregional Trade and Industrialization in Africa*.

BearingPoint Institute (n.d.). Smart cities: the key to Africa's third revolution.

BFA Global (2019). Digital commerce and youth employment in Africa. Mastercard Foundation.

Bos, Kyra and Joyeeta Gupta (2019). Stranded assets and stranded resources: implications for climate change mitigation and global sustainable development. *Energy Research & Social Science*, vol. 56.

Bowles, Jeremy (2014). The computerisation of European jobs. Brussels: Bruegel.

Cervigni, Raffaello, and others (2015). *Enhancing the Climate Resilience of Africa's Infrastructure: The Power and Water Sectors*. Washington, DC: World Bank.

Climate Action Tracker (2019). The Climate Action Tracker Thermometer.

Economic Commission for Africa (2013). *Economic Report on Africa 2013: Making the Most of Africa's Commodities – Industrialization for Growth, Jobs and Economic Transformation*. Sales No. E.13.II.K.1.

\_\_\_\_\_ (2015). *Economic Report on Africa 2015: Industrializing through Trade*. Sales No. E.15.II.K.2.

\_\_\_\_\_ (2019). *Economic Report on Africa 2019: Fiscal Policy for Financing Sustainable Development in Africa*. Sales No. E.19.II.K.2.

Economic Commission for Africa, African Union, African Development Bank and United Nations Conference on Trade and Development (2019). *Assessing Regional Integration in Africa IX: Next Steps for the African Continental Free Trade Area*. Sales No. E.19.II.K.3.

Economic Commission for Africa, Friedrich-Ebert-Stiftung and Office of the United Nations High Commissioner for Human Rights (2019). *Digital Trade in Africa: Implications for Inclusion and Human Rights*. Addis Ababa: ECA.

FabFoundation. Fab Lab Network. Available at <https://www.fablabs.io/labs/>. Accessed on 30 January 2020.

Foster, Christopher, and others (2018). Digital control in value chains: challenges of connectivity for East African firms. *Economic Geography*, vol. 94, No. 1, pp. 68-86.

Frey, Carl Benedikt and Michael Osborne (2017). The future of employment: how susceptible are jobs to computerisation? *Technological Forecasting and Social Change*, vol. 114, issue C, pp. 254-280.

Graham, Mark, and others (2017). *The risks and rewards of online gig work at the global margins*. Oxford: Oxford Internet Institute.

GSMA (2019). 618 active tech hubs: the backbone of Africa's tech ecosystem. Available at <https://www.gsma.com/mobilefordevelopment/blog/618-active-tech-hubs-the-backbone-of-africas-tech-ecosystem>.

Haskel, Jonathan, and Stian Westlake (2018). *Capitalism without Capital: The Rise of the Intangible Economy*. Princeton, New Jersey, and Oxford: Princeton University Press.

Heek, R. (2017). Digital economy and digital labour terminology: making sense of the “gig economy”, “online labour”, “crowd work”, “microwork”, “platform labour”, etc. Working Paper No. 70. Centre for Development Informatics, University of Manchester.

Hjort, Jonas, and Jonas Poulsen (2019). The arrival of fast Internet and employment in Africa. *American Economic Review*, vol. 109, No. 3, pp. 1032-1079.

Huawei and Oxford Economics (2017). Digital spillover: measuring the true impact of the digital economy. Available at <https://www.huawei.com/minisite/gci/en/digital-spillover/index.html>.

Intergovernmental Panel on Climate Change (2019). *Special Report: Global Warming of 1.5°C*. Available at [www.ipcc.ch/sr15](http://www.ipcc.ch/sr15). Accessed on 12 January 2020.

International Institute for Sustainable Development (2010). *The digital economy and the green economy: opportunities for strategic synergies*.

International Labour Organization (2018). *World Employment Social Outlook: Trends 2018*. Geneva: International Labour Office.

\_\_\_\_\_ (2019). *Employment by sector: modelled estimates*. Geneva.

International Renewable Energy Agency (2018). *Renewable energy auctions: cases from sub-Saharan Africa*.

International Telecommunication Union (2019). *Global and regional information and communications technology data set*.

Kuek, Siou Chew, and others (2015). *The global opportunity in online outsourcing*. Washington D.C.: World Bank.

Manyika, James, and others (2017). *A future that works: automation, employment, and productivity*. McKinsey Global Institute.

Mayer, Jörg (2018). *Digitalization and industrialization: friends or foes?* United Nations Conference on Trade and Development research paper No. 25. Geneva.

Murray, Sarah (2016). Camera drones and cow fitness trackers help drive farm yields. *Financial Times*, 20 January.

New Climate Economy (2018). *Unlocking the inclusive growth story of the 21st century: accelerating climate action in urgent times*. Washington, D.C.: Global Commission on the Economy and Climate.

Nhamire, Borges (2019). Southern Africa cyclone damage cost seen topping \$2 billion. *Bloomberg*, 12 April.

Oxford Martin School (2016). *Technology at Work v2.0: The Future is Not What It Used To Be*.

Shah, Saurabh (2018). Nepali reality in the gig economy. *The Record*, 15 March 2018.

- Trading Economics. Malawi Food Inflation. Available at <https://tradingeconomics.com/malawi/food-inflation>. Accessed on 21 January 2020.
- Trading Economics. Mozambique Food Inflation. Available at <https://tradingeconomics.com/mozambique/food-inflation>. Accessed on 21 January 2020.
- Tsan, Michael, and others (2019). *The Digitalisation of African Agriculture Report 2018–2019*. Technical Centre for Agricultural and Rural Cooperation.
- United Nations (2016). Smart Cities Programme.
- United Nations Conference on Trade and Development (2019). *Digital Economy Report 2019: Value Creation and Capture – Implications for Developing Countries*. Sales No. E.19.II.D.17.
- United Nations University-Institute for Natural Resources in Africa (2019). Africa's development in the age of stranded assets.
- United Nations Statistics Division. National accounts: analysis of main aggregates. Available at <https://unstats.un.org/unsd/snaama/Basic>. Accessed on 12 January 2020.
- WeeTracker (2019). *African Venture Capital Report 2019*.
- World Bank (2019a). World development indicators. Accessed on 22 January 2020.
- World Bank (2019b). *World Development Report 2019: The Changing Nature of Work*. Washington, DC.
- World Meteorological Organization (2019). The global climate in 2015–2019. Geneva.
- Xu, Jiajun, and others (2017). Adjusting to rising costs in Chinese light manufacturing: what opportunities for developing countries? Supporting Economic Transformation.
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