United Nations E/ECA/CPRTIIT/3/6

Economic and Social Council

Distr.: General
22 September 2023

Original: English

Economic Commission for Africa
Committee on Private Sector Development, Regional Integration, Trade, Infrastructure, Industry and Technology
Third session
Addis Ababa (hybrid), 14 and 15 November 2023

Item 4 of the provisional agenda*
Presentation of reports by the secretariat

Advancing energy and digital technologies for a prosperous and inclusive green industrialization

I. Introduction

1. The work on science, technology and innovation undertaken by the Economic Commission for Africa (ECA) is led by the Technology, Climate Change and Natural Resources Management Division. The overall objective is to support members of ECA in their efforts to harness technology and innovation to meet their development goals. This is achieved by undertaking rigorous policy analysis research, pilot projects, advocacy and consensus-building activities, and contributing original data and frameworks to inform policymaking.

2. The present thematic report discusses the role of energy and digital technologies for prosperous and inclusive green industrialization in Africa. Chapters II and III provide the background and objectives of the report. Chapter IV contains an overview of the role of energy and digital technology in advancing inclusive green industrialization, and chapter V outlines the current use of technology and innovation for green industrialization in Africa. Chapter VI explores approaches to maximizing the path to inclusive green industrialization in Africa. Chapter VII reports on the measures taken by ECA to address the recommendations made by the Committee at its second session and chapter VIII proposes certain issues for discussion.

II. Background

3. The industrialization ambition of Africa remains at the centre of its development efforts, aimed at driving growth and job creation at the necessary scale for a rapidly increasing young population. Accordingly, the continent needs to balance its industrialization endeavours with the strengthening of its climate resilience and action to tackle climate change. This aspiration is given expression in a number of frameworks and strategies of the African Union, including the Science, Technology and Innovation Strategy for Africa 2024, the Action Plan for the Accelerated Industrial Development of Africa, the Green Recovery Action Plan, the African Union Climate Change and Resilient

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Development Strategy and Action Plan (2022–2032), and the African Digital Transformation Strategy.

4. Recent disruptions due to trade turbulence, economic uncertainty, extreme climate, the coronavirus disease (COVID-19) pandemic and geopolitical events have clearly shown the need for Africa to build internal capacity in such critical sectors as agriculture, manufacturing and renewables, with a focus on economic diversification and enhanced intra-African trade under the Agreement Establishing the African Continental Free Trade Area.

5. Africa faces significant challenges in attaining the goals of increased access to electricity while simultaneously reducing reliance on traditional sources of electricity, such as coal and petroleum, and boosting energy efficiency. The International Energy Agency reports that the number of people without access to electricity increased in 2020 for the first time since 2013. The proportion in Africa of the world's population without access to electricity rose to 77 per cent from 74 per cent before the pandemic.[1] About half of the continent's population have no access to electricity.[2] Those people who do have such access pay twice as much as others in the rest of the world. Blackouts, brownouts and other power supply failures cost Africa between 2 and 4 per cent of its gross domestic product ($52 billion–$104 billion) a year.[3]

6. At the same time the continent's abundant resources present many opportunities to eradicate energy poverty, promote energy efficiency and develop high tech industries. From a technology perspective, Africa has an abundance of critical minerals, such as the copper, cobalt and lithium needed in solar systems and batteries, for high-tech and green product development. It could seek to develop energy solutions that may be used in electric vehicles, drones, mobile devices, bioelectronics and nanodevices, among other applications. Similarly, Africa has access to vast renewable energy resources, such as solar, wind and water resources, almost all year round. With suitable investments in people, institutions and technologies, Africa can move from being a net exporter of petroleum and minerals to a key player in renewable and green energy production and export.

7. Harnessing the continent's potential to develop energy and digital technologies to boost shared prosperity and green industrialization will require a number of policy measures designed to address the digital and renewable energy technology gaps, close digital divides, bridge the finance gap, engage the private sector with a view to attracting foreign investments in critical sectors and infrastructures, strengthen the regulatory environment, ramp up investments in research and development and build continental and international partnerships to advance technology development and acquisition efforts.

III. Objective

8. The overall objective of the present report is to highlight the continent's potential in the aftermath of the multiple crises of the last few years, to advance the policy agenda and to encourage actions that harness energy and digital technologies for inclusive green industrialization. The report is also aimed at stimulating dialogue on the key attributes and benefits of energy and digital

[1] See International Energy Agency, "SDG7: data and projections", Paris, 2023. Available at https://www.iea.org/reports/sdg7-data-and-projections.

[2] See World Bank, "Access to electricity (% of population) – Sub-Saharan Africa", Databank, 2023. Available at https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=ZG.

[3] See Gregor Schwerhoff and Mouhamadou Sy, "Where the sun shines: renewable energy sources, especially solar, are ideal for meeting Africa's electrical power needs", *Finance and Development*, vol. 57, No. 1 (March 2020), p. 54.

technologies, on whether existing policy and governance arrangements are fit for purpose in a rapidly changing world, and on the ways in which regional integration can help to bring about investment in crucial infrastructure and the skills that are required to unlock the full potential of energy and digital technologies. The outcomes of those dialogues will inform the work of ECA and its members.

IV. Overview of the role of technology for inclusive green industrialization

9. Africa is poised to leverage renewables and digital technology for its green industrialization and the advancement of its supply chain networks. An emerging wave of industrial transformation is under way, spurred by significant policy strides at the global level which advocate investment and growth in clean energy technologies. Current industrial agendas are placing growing emphasis on the cultivation of supply chains and manufacture for clean energy technology. This encompasses not only such energy technologies as green hydrogen, energy storage and the digitization of grids, but also enhancements in industrial processes to optimize the use of critical minerals and the adoption of emerging technologies such as artificial intelligence and additive manufacturing.

10. The changing geopolitical landscape of energy supply and demand further complements the ongoing energy shift, in particular in the interactions between Africa and Europe. Africa is favourably positioned to harness the benefits presented by enhancements in clean energy technology. It is essential for Africa to seize this opportunity and capitalize on the substantial advantages that can be unlocked through clean energy advancements, robust power markets and the proliferation of emerging technologies across key sectors, such as agriculture, manufacturing, health care and energy.[4]

V. Journey of Africa towards inclusive green industrialization

A. Greening energy technologies in Africa

11. A limited number of African nations currently possess energy systems that fulfil the criteria of stability, reliability, accessibility, and affordability. The prevalent reliance on biomass represents a significant challenge, necessitating increased efforts to diminish this dependence – a major contributor to deforestation. The solution lies in elevating the commitment by Africa to embracing emerging energy technologies that facilitate the adoption of renewable sources, providing energy that is not only more cost-effective and accessible but also environmentally sustainable. The present section looks at a few emerging energy technologies that Africa should pursue – noting that the greenhouse-gas emissions from renewable energy have a shorter life cycle than those from conventional fossil fuels. For example, the life cycles of greenhouse gas emissions from solar photovoltaic and wind energy are 4 and 1.5 per cent, respectively, of those of fossil fuels.[5] Such technologies play an essential role in reducing greenhouse gas emissions and mitigating climate change.

[4] See RES4Africa Foundation, *Africa's Energy Future Is Renewable*, Rome, 2023. Available at https://res4africa.org/wp-content/uploads/2023/06/Africas-Energy-Future-is-Renewables-Flagship2023.pdf.

[5] See Thomas Bruckner and others, "Energy systems", in *Climate Change 2014: Mitigation of Climate Change – Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel*

12. While each technology may be studied and discussed independently to highlight its specific features, in practice, these technologies could generate better outcomes if they were used in combination. In particular, hybrid systems that use multiple energy sources are needed to guarantee reliable supply in all weather conditions. Various emerging technologies for energy capture, conversion, storage and use are discussed below.

1. Technologies for renewable energy generation

13. There are several emerging energy storage technologies, the most advanced of which include lithium ion, lead acid, redox flow, sodium-sulfur, sodium metal halide, zinc hybrid and cathode batteries, and such types of storage as pumped hydropower, flywheels, compressed air energy and ultracapacitors. Each of these has its advantages and disadvantages. The lithium battery is perhaps the one most widely used in laptops, mobile phones and electric vehicles, scooters and bicycles. Africa is a key producer of many of these so-called “green minerals” and its reserves of minerals for potential future production are extensive. The Democratic Republic of the Congo alone produces over 70 per cent of the world’s cobalt, for instance. A key priority for African countries, policymakers, mining communities and citizens, however, is to ensure that that this abundance serves the continent’s aspirations for inclusive and sustainable growth and transformation. Currently, 70 per cent of the continent’s exports are of raw, unprocessed commodities.

14. The African continent is also uniquely positioned to become a leader in green hydrogen production. Green hydrogen, which is produced with the help of renewable energy inputs, is becoming an increasingly important decarbonization tool and can position Africa as a major exporter to Europe and beyond. The Africa Green Hydrogen Alliance, launched at the twenty-sixth meeting of the Conference of the Parties to the United Nations Framework Convention on Climate Change by Egypt, Kenya, Mauritania, Morocco, Namibia and South Africa, is aimed at connecting up existing initiatives and leadership efforts, with the potential to generate new industry awareness, opportunities and action on the continent.

2. Energy storage technologies

15. Where energy storage is concerned, the most advanced technologies also include lithium ion, lead acid, redox flow, sodium sulfur, sodium metal halide, zinc hybrid and cathode batteries, and storage types such as pumped hydropower, flywheels, compressed air energy and ultracapacitors, each with its own advantages and disadvantages. As with energy generation, the lithium battery is the one most widely perhaps used in laptops, mobile phones and electric mobility. Rapid technological advancement over the period 2010–2018 drove prices per kilowatt-hour down from $1,160 to $176 and this price is expected to drop still further. Lithium ion batteries hold more charge per volume, require less maintenance, if any at all, and have a long life span of up to 15 years. Although these batteries can be used both in small devices, such as mobile phones, and in large-scale installations, such as power utilities, they are still relatively expensive.

16. Lead acid batteries offer a cheaper energy storage solution for home solar systems and use in motor vehicle to start and run accessories. They are easily disposable but require maintenance as they are prone to leaking, have a shorter life span (about five years) and are bulkier. For their part, flow batteries contain water-based electrolytes that store chemical energy; they are bulky and

on Climate Change, Intergovernmental Panel on Climate Change Fifth Assessment Report (Cambridge, United Kingdom and New York, Cambridge University Press, 2014).

expensive. Unlike other batteries, they can be discharged fully, have a lifespan of up to 30 years, and require no maintenance.

17. The transition away from fossil fuels will generate high demand for certain minerals. Thus, for example, a lithium ion batteries large enough to power a call requires 35 kg of aluminium, 20 kg of copper, 10 kg of cobalt and many other vital inputs. Africa is a key producer of many of these "green" minerals, and its reserves of such minerals for potential future production are substantial. As noted above, the Democratic Republic of the Congo alone produces over 70 per cent of the world's cobalt. It and Zambia each provide 5 per cent of the global supply of copper. Zimbabwe holds significant reserves of lithium; South Africa is a major producer of manganese, and Madagascar and Mozambique of nickel and graphite: the list is extensive. As noted above, it is vital that this abundance serves the continent's aspirations for inclusive and sustainable growth and transformation. Currently, 70 per cent of the continent's exports are of raw and unprocessed commodities. In 2009, African countries signed the Africa Mining Vision, which cemented the need for the continent's resources to serve as a springboard for new higher-value economic activities that create jobs, raise incomes and generate long-lasting opportunities.

18. Green hydrogen can help to green the continent's emission-intensive industries, such as steel and cement production and the technology can also be used to produce fertilizers and other chemicals. Africa can also export green hydrogen to European and global industries as a substitute for natural gas and fossil fuels. Lastly, green hydrogen can be used at the domestic level for heating, cooking and other applications.[6] As noted above, the recently launched Africa Green Hydrogen Alliance aims to connect existing initiatives and leadership efforts, with the potential to generate new industry awareness, opportunities and action on the continent.

3. Distributed energy generation

19. Africa is a large continent with a population widely dispersed in small, rural and often isolated communities that may be hard to reach. Even in countries with higher population density, geography may pose a challenge to the extension of national electricity grids. Renewable energy technologies, such as solar-powered micro-grids, can provide high-quality uninterrupted electricity to nearly half a billion people in unpowered or underserved communities and offer a least-cost solution to closing the energy access gap by 2030.

20. Renewable energy micro-grids are rapidly expanding in Africa, with homegrown companies such as PowerGen (with operations in Kenya, Nigeria, Sierra Leone and the United Republic of Tanzania) attracting international investments and partners. Microgrids have also been used to provide power to small businesses in Africa – for example, small businesses that need to refrigerate food, or those involved in carpentry, water treatment and sales, or milling maize, cassava and sorghum.

B. Adequate financing for climate resilience and green industrialization in Africa

21. A robust and regenerative green and blue economy will provide a strong pillar sustaining efforts by Africa to generate resources for recovery from the COVID-19 pandemic, scale up climate actions, protect its biodiversity and ecosystem, accelerate national implementation of projects in pursuit of the Sustainable Development Goals, invest in energy and technology infrastructure,

[6] See Paul Day, "Africa explores vast clean hydrogen potential", Reuters, 6 July 2023. Available at https://www.reuters.com/business/energy/africa-explores-vast-clean-hydrogen-potential-2023-07-06/.

and ensure the livelihoods of its population. While a sustainable green and blue economy will ensure that economic growth has positive environmental and social impacts, it will require adequate financing to reach its full potential.

22. African countries pay higher prices for private financing than those paid by countries from other regions, in part because of a biased perception of risk.[7] By offering private investors development finance as guarantees, blended finance can play an important role in reducing investment risk and crowding in private investors in Africa. In addition, it can direct investment to regional and local development priorities, including energy and green infrastructure projects. Blended finance has scored notable successes in Africa. Overall, projects in Africa received 34 per cent of the private capital that was mobilized between 2018 and 2020 ($16.5 billion annually) and, of those, projects in economic infrastructure and services received the largest portion, notably banking and business services, with $17.7 billion, and energy, with $9 billion.[8]

23. As an innovative finance instrument, green, social and sustainability-linked bonds can help to bridge the green financing gap in Africa. While sharing characteristics with traditional bonds, green, social and sustainability-linked bonds exclusively direct financing to projects with positive climate and environmental outcomes; raise financing for projects and assets with positive social outcomes and aim to finance social and environmental projects and assets that are aligned with achievement of the Sustainable Development Goals.

24. Debt-for-nature swaps are climate and nature transactions aimed at achieving positive environmental outcomes while improving countries' debt sustainability. In 2018, the Government of Seychelles issued the first-ever sovereign blue bond in Africa, comprising debt-for-nature swaps, which raised $15 million from international investors. The resources thus raised were redirected to ocean conservation and the development of blue economy growth, with positive environmental and social impacts. Debt-for-nature swaps can catalyse affordable financing that leads to meaningful and measurable impact in the borrowing country, tackling debt and environmental issues at the same time. The ensuing debt relief affords the borrowing country additional fiscal space to invest in climate-resilient infrastructure and to pursue a green transition.

C. Digital technologies

1. Emerging technologies

25. The fourth industrial revolution presents Africa with an invaluable opportunity to accelerate its industrialization objectives by leveraging emerging digital technologies. Advances in artificial intelligence, additive manufacturing, machine learning, blockchain, automation and robotics mean that Africa can create high-tech innovative industries geared towards the continent's economic and social needs. Some of these digital technologies and areas for innovation are outlined below.

(a) Smart grids

[7] See William Gbohoui, Rasmané Ouedraogo and Yirbehogre Modeste Some, "Sub-Saharan Africa's risk perception premium: in the search of missing factors", International Monetary Fund, Working Paper No. 2023/130, 23 June 2023. Available at https://www.imf.org/en/Publications/WP/Issues/2023/06/23/Sub-Saharan-Africas-Risk-Perception-Premium-In-the-Search-of-Missing-Factors-534885.

[8] See Organisation for Economic Co-operation and Development, "Private finance mobilised by official development finance interventions", Development Co-operation Directorate, OECD Publishing, Paris, 2023. Available at https://www.oecd.org/dac/2023-private-finance-odfi.pdf.

26. Smart grid systems help to provide consistent and stable energy for industrial activities. Smart grids use digital technologies, such as sensors and software to ensure a better match between the supply and demand of electricity in real time while minimizing costs, and maintaining the stability and reliability of the grid.[9] Smart grids can establish a two way flow of information between supplier and user to increase the efficiency of network operations.[10] In Africa, smart grid solutions can be used to leapfrog elements of traditional power systems in terms of both technology and regulation. This could accelerate national and regional electrification time frames, improve service delivery, minimize costs and reduce environmental impact. Smart grids can be applied to both mini and national grid systems.

(b) Application of digital innovations in agriculture

27. Agriculture is a crucial sector in many African economies. Emerging technologies such as precision agriculture, drone technology and remote sensing can improve crop yields, reduce waste and enhance the overall efficiency of the agricultural supply chain. With the largest area of arable uncultivated land in the world and a youthful population, almost 60 per cent of whom are under the age of 25, emerging digital technologies can be employed to double or even triple agricultural productivity on the continent.[11] According to the International Federation of Accountants (IFAC), in Africa, 33 million smallholder farms contribute as much as 70 per cent of the food supply, yet many of them still rely on traditional methods for cultivating their crops. Drone technology and artificial intelligence can be further accelerated across the continent to empower farmers to enhance their crop yields, economize their time and try out predictive models to assist them in planning.

(c) Artificial intelligence and data analytics

28. By 2030, artificial intelligence is projected to contribute a staggering $15.7 trillion to global gross domestic product, with $6.6 trillion coming from increased productivity and $9.1 trillion from consumption effects.[12] There are already a number of applications of artificial intelligence in Africa, in particular in the sectors of health, agriculture, city planning, water supply, clean energy forecasting, climate change predictions, economics and finance, and also in governance. For example, the Tumaini application that uses artificial intelligence to diagnose diseases and pests from pictures uploaded by farmers. The application uses image-recognition technology, drawing on a dataset of more than 50,000 images, and is used in Benin, the Democratic Republic of the Congo and Uganda.[13] In Uganda, a non-profit organization, Sunbird AI, is working with the Ministry of Energy to study villages' electrification needs and to plan potential solutions, such as prioritizing electricity in important areas.

29. While artificial intelligence carries big promise for the development of Africa, artificial intelligence innovations are unequally distributed and dominated by players outside the continent. Africa, with its many developing

[9] See International Energy Agency, Smart Grids. Available at https://www.iea.org/energy-system/electricity/smart-grids.

[10] See Morgan Bazilian and others, "Smart and just grids: opportunities for sub-Saharan Africa", Energy Futures Lab, Imperial College London (n.d.). Available at https://justtransitionforall.com/wp-content/uploads/2022/10/Smart_or_Just_Grid_final.pdf.

[11] See Food and Agriculture Organization of the United Nations and International Telecommunication Union, *Status of Digital Agriculture in 47 Sub-Saharan African Countries*, Rome, 2022. Available at https://www.fao.org/3/cb7943en/cb7943en.pdf.

[12] See Price Waterhouse Coopers International, "Sizing the prize: What's the real value of AI for your business and how can you capitalise?", 2017. Available at https://www.pwc.com/gx/en/issues/data-and-analytics/publications/artificial-intelligence-study.html.

[13] See Consultative Group on International Agricultural Research, "Tumaini: an AI-powered mobile app for pests and diseases". Available at https://www.cgiar.org/innovations/tumaini-an-ai-powered-mobile-app-for-pests-and-diseases/.

countries is at risk of becoming a mere provider of data without being able to leverage data as an asset that has commercial and social value. These technologies also lack basic guard rails and government entities, which have insufficient finance and human resources, struggle to support safe and equitable digital transformation.

(d) Three-dimensional printing or additive manufacturing

30. Three-dimensional printing, also known as additive manufacturing, is revolutionizing the way in which product manufacturing works and is proving to be a game-changer for Africa. With its ability to foster complex geometries, faster prototyping and more customization, it is helping to streamline the manufacturing process, making it more efficient and cost-effective. From aerospace and medical components to consumer products, three-dimensional printing is being used across various industries in Africa to produce small-batch, high-value products.

31. These technologies can enable local production of goods and spare parts, reducing the need for imports and creating job opportunities. This is particularly important in regions with limited access to traditional manufacturing infrastructure. South Africa has one of the most comprehensive Additive Manufacturing strategies on the continent and has recently announced the launch of a project on three-dimensional construction printing for sustainable human settlements project to combat the shortage of housing in the country.[14] Similarly, Malawi built the world's first three-dimensional printed school in 2021.

(e) Financial technology

32. Mobile phones have become widespread in Africa, providing a platform for various services, including financial transactions. Financial technology (known as fintech) solutions can drive financial inclusion, enable secure transactions, and facilitate access to credit for small and medium-sized enterprises. As more than half of all Africans have insufficient or no access to banking services, fintech companies are moving in to digitize payments. Furthermore, cash is still used in around 90 per cent of transactions in Africa, which means that fintech revenues have huge potential to grow.[15]

33. This potential materialized in a record number of fintech start-ups between 2020 and 2021. The number of technological start-ups in Africa tripled to some 5,200 companies, almost half of which these are fintechs. According to analysts,[16] the African electronic payments market is expected to continue to grow by 20 per cent every year to $40 billion by 2025, compared to an average growth of 7 per cent for the sector globally. Furthermore, blockchain technologies could enhance the efficiency, security and transparency of payment systems across Africa, thus lowering trading costs.[17] Blockchain can also be of assistance in modernizing the mining industry and bringing more data transparency along the path of minerals such as cobalt across the supply chain.

[14] See South Africa, "Minister Blade Nzimande: launch of 3D construction printing for sustainable human settlements project", 27 January 2023. Available at https://www.gov.za/speeches/launch-3d-construction-printing-sustainable-human-settlements-27-jan-2023-0000.

[15] See McKinsey and Company, "Fintech in Africa: The end of the beginning", 30 August 2022. Available at https://www.mckinsey.com/industries/financial-services/our-insights/fintech-in-africa-the-end-of-the-beginning.

[16] See Rafiq Raji, "African fintech is booming despite challenges", Commentary, Center for Strategic and International Studies, 8 December 2022. Available at https://www.csis.org/analysis/african-fintech-booming-despite-challenges#:~:text=African%20fintechs%20could%20earn%20revenue,services%20firms%20at%20lower%20costs.

[17] See Amadou Sy and others, "FinTech in sub-Saharan African countries: a game changer?", International Monetary Fund, Washington, D.C., 2019. Available at https://www.imf.org/en/Publications/Departmental-Papers-Policy-Papers/Issues/2019/02/13/FinTech-in-Sub-Saharan-African-Countries-A-Game-Changer-46376.

2. Infrastructure development and access

34. To accelerate the adoption of digital technologies, the continent needs to address key challenges, one of which is the infrastructure gap and the low level of connectivity. According to the Broadband Commission, connecting an additional 1.1 billion people online globally by 2030 and bridging the connectivity gap will cost $100 billion. The lack of adequate infrastructure in remote and rural areas poses a significant challenge to achieving widespread connectivity. Limited terrestrial infrastructure, such as fibre-optic networks, in remote regions makes it difficult to extend broadband services. Geographical barriers, including vast landscapes, challenging terrains and inadequate road networks, hinder infrastructure expansion.

VI. Follow-up on recommendations of the second session of the Committee

35. The second session of the Committee on Private Sector Development, Regional Integration, Trade, Infrastructure, Industry and Technology made several recommendations to ECA regarding its work on emerging technologies, in response to which ECA implemented various initiatives, as detailed below.

36. In response to the request that ECA conduct studies to identify practical finance solutions besides public-private partnerships to bridge the gap between development needs and available resources, the Commission has supported the launch and further development of the Sustainable Debt Coalition initiative, which highlights the difficult fiscal position of emerging markets and developing economies and the debilitating impacts of debt on climate action and development.

37. In response to the recommendation that ECA continue to support its members in building and strengthening capacity in science, technology and innovation-oriented policymaking, the Commission has launched a guide on policy design and implementation in the areas of science, technology and innovation.[18]

38. To build the technical capacity of its members in advancing the implementation of science, technology and innovation-oriented policies and keeping abreast of emerging digital technology trends, ECA has launched the African Research Centre on Artificial Intelligence in Brazzaville and is in the process of establishing a centre of excellence in science, technology, engineering, arts and mathematics in Kigali, in collaboration with the Ministry of Education of Rwanda. In a similar venture, ECA is joining the Giga initiative[19] and the Smart Africa Alliance,[20] in an effort to connect every African school to the Internet by leveraging innovative financing models and supporting Governments contracting for connectivity.

39. To support its members in designing and implementing their digital strategies, legal and regulatory regimes, tools and applications under the African Digital Transformation Strategy for Africa (2020–2030), ECA is

[18] See Economic Commission for Africa, *Science, Technology and Innovation Policy Design and Implementation Guide: Towards a Framework*, Addis Ababa, 2023. Available at https://repository.uneca.org/handle/10855/49550.

[19] Giga: initiative launched by the United Nations Children's Fund and the International Telecommunication Union which aims to connect every school to the Internet by 2030. For more details, see https://giga.global/about-us/.

[20] Smart Africa Alliance: innovative commitment from African Heads of State and Government to accelerate sustainable socioeconomic development on the continent, through affordable access to broadband and use of information and communications technologies. More details available at https://smartafrica.org/who-we-are/.

providing technical support to the Governments of Botswana, Ethiopia, the Gambia, Mauritius and Nigeria. Through its Centre of Excellence on Digital Identity, Trade and Economy, ECA is supporting the development of the strategy of the Gambia to create a national digital identity system and services, and also the development of the country's digital transformation strategy.

40. As part of its technical support for members in emerging energy technologies, ECA is helping the Government of Botswana to build its climate resilience and adaptation capacity, by transforming Lobu small stock farm into a centre of excellence for small stock development. In addition, in collaboration with the United Nations University Institute for Natural Resources in Africa, ECA has created an online platform, known as Justis, to connect businesses, researchers, policymakers and green investors. The platform's goal is to establish an online marketplace for green energy products and services, promoting an inclusive and equitable energy transition.[21]

VII. Way forward

41. Policy measures are needed to reap the potential benefits of emerging technologies while managing associated risks. First, policymakers need to fill the large existing infrastructure gap in the region, starting with electricity and Internet services, while removing barriers to connectivity and addressing knowledge gaps and digital divides. Second, there is need to address the growing lag between fast-moving innovation and slower-moving regulation. Third, policymakers should look for innovative financing models that can keep pace with the growth of critical high-value sectors.

42. The continent's economic and development potential is inextricably linked to research and development. The poor public funding available in Africa for research is well documented. In 2006, member countries of the African Union committed themselves to spending 1 per cent of their gross domestic product on research and development. By 2019, however, such funding in Africa only measured 0.42 per cent, in sharp contrast to the global average of 1.7 per cent.[22]

43. In an effort to build domestic capacity and increase its sustainability, Africa plans to manufacture 60 per cent of its vaccines within the continent by 2040. The recently announced Dakar-based vaccine manufacturing initiative could serve as a blueprint for vaccine manufacturing facilities across the continent.[23] Similarly, African countries need to put in place well-articulated plans to accelerate research and development with a focus on technology, health care, pharmaceuticals and clean energy.

44. It is vital to ensure that all African children and young people have high-quality education opportunities that prepare them for the fourth industrial revolution. The global school shutdowns and health crisis have exacerbated already challenging realities for African countries, which have limited infrastructure to connect to distance learning and essential services. The pandemic highlighted the urgent need to accelerate connectivity for online learning for African children and their communities, while simultaneously improving the continent's rates of education exclusion. Over one third of children between the ages of 12 and 14 are out of school.[24]

[21] For further information on the Justis portal, see https://justis.africa/home.

[22] Figures from the Institute of Statistics of the United Nations Educational, Scientific and Cultural Organization.

[23] See Douglas Okwatch, "Africa to ramp up vaccine production", *Africa Renewal*, 21 July 2023. Available at https://www.un.org/africarenewal/news/africa-ramp-vaccine-production.

[24] Figures from the Figures from the Institute of Statistics of the United Nations Educational, Scientific and Cultural Organization. `Available at https://uis.unesco.org/en/topic/education-africa.

45. Not surprisingly, tertiary enrolment rates are also exceedingly low. Research by ECA shows that, currently, a child in Africa has a 6–8 per cent chance of getting into university, compared with 80 per cent for a child in a more developed country.[25] Without urgent action, the situation could deteriorate still further, as the region faces a rising demand for education due to a fast-growing young population, which will constitute 42 per cent of the world's young people by 2030.[26]

46. The convergence of green and digital technologies heightens the necessity for African member States to unify their regulations. Digital technologies transcend national borders and climate change knows no boundaries. Accordingly, it is imperative for African countries to synchronize their laws and regulations. This harmonization serves a dual purpose: it attracts investments and it amplifies the influence of Africa on the global stage. Standardizing digital identification systems, for instance, would empower consumers to engage with confidence in intra-African trade, boosting the implementation of the Agreement Establishing the African Continental Free Trade Area. In addition, unified green technology regulations promote sustainable practices and attract environmentally responsible investments.

47. Africa has a vast unfulfilled need for adequate financing. Estimates point to an infrastructure financing need of $170 billion annually by 2025 and a climate adaptation need of $438 billion annually by 2030. Advocacy by ECA of reform of the global financial architecture so that it is better suited to the needs of developing economies is supported by the Sustainable Debt Coalition and the Working Group on the Global Financial Architecture, through the convening of African Ministers of Finance, Planning and Economic Development, the African Union, the African Development Bank and the International Monetary Fund. African Governments can mobilize efforts to adopt innovative financing instruments, such as: blended finance, which can reduce investment risk and crowd in private investors in key sectors, including energy and green infrastructure projects; green, social and sustainability-linked bonds, which can be used to bridge green financing gaps in Africa; and debt-for-nature swaps, which are aimed at positive environmental outcomes while improving countries' debt sustainability.

[25] See ECA, "Advancing entrepreneurial universities in Africa: Ethiopia, Ghana and South Africa", Addis Ababa, 2023. Available at https://repository.uneca.org/handle/10855/49508.

[26] See Hicham El Habti, "Why Africa's youth hold the key to its development potential", World Economic Forum, 19 September 2022. Available at https://www.weforum.org/agenda/2022/09/why-africa-youth-key-development-potential/.

VIII. Issues for discussion

48. In its deliberations, the Committee might wish to give its attention to the following questions:

(a) What policy measures and market mechanism could be deployed to reduce private financing costs in Africa and ensure adequate and affordable financing for green energy and digital technology solutions to support economic and social recovery, enhance climate resilience, digitalization and industrialization?

(b) What policies and strategies should African countries put in place to build local capacity to develop emerging green energy and digital technology products and services to create wealth and achieve inclusive green industrialization?

(c) What steps should African countries take to harness and scale up green energy technologies, such as green hydrogen production?

(d) What policy options could African Governments deploy, with a view to regulating emerging technologies such as artificial intelligence and machine learning in a way that balances public interests with innovation and knowledge generation?

(e) How will national energy and infrastructure regulation affect the pace of private sector investment participation and what regulatory reforms would speed up private investment?

(f) What steps should countries take to strengthen their science, technology and innovation-related institutional arrangements to support emerging digital and energy technology policies in terms of design, implementation and general oversight, so as to meet targeted national objectives?

(g) How can Africa leverage strategic partnerships to boost green energy and digital technology solutions, eliminate energy poverty, close digital divides and address the usage gap?