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ECA POLICY BRIEF

Renewable energy development for industrialization and economic diversification in Central Africa

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The present policy brief highlights the vast potential of renewable energy in Central Africa and the barriers that have impeded its development. It sets out the importance of harnessing this potential to support the industrialization and diversification of productive structures in Central African countries through subregional, continental and global coordination

Abstract of key considerations for policymakers

The coronavirus disease (COVID-19) health crisis, which has turned into a socioeconomic crisis, has highlighted the structural weakness of the economies of Central Africa, which are poorly diversified, insufficiently industrialized and rely on low-value-added exports. They are heavily dependent on exports of primary commodities, especially oil, which makes them highly vulnerable to sharp price fluctuations in international markets, and are exposed to various external and global shocks and to debt unsustainability. The global shift to a low-carbon economy in the long term, an inevitable choice to mitigate climate change, will cause a dramatic decline in demand for fossil fuels, leading to divestment and stranded assets in the fossil-fuel producing countries of Central Africa. Accordingly, countries must strive to strengthen their economies. Beyond protection against shocks, economic diversification is increasingly recognized as essential for economic development. It is usually accompanied by industrial upgrading through technology diffusion, leading to higher productivity and greater efficiency in the allocation of productive factors within and across sectors. Central African countries need inclusive and technology-intensive industrialization and structural change to enhance their socioeconomic development, which cannot be achieved without having access to sustainable energy services. Affordable and reliable energy is a co-requisite for improved industrial productivity and competitiveness and thus a crucial element in economic diversification. Precarious access to electricity and underdevelopment of the energy sector have had negative repercussions on the development of the economic, industrial and social fabric of the subregion. Central Africa has vast potential to develop renewable energy, which can be harnessed for industrialization, economic diversification, development and poverty alleviation.

I. Introduction

Central Africa continues to rely heavily on the production and export of raw materials, especially oil. The industrial sector of the subregion contributes little to total value added, as it remains focused either on resource-based manufacturing or traditional low-technology activities that are characterized by limited productivity. Consequently, Central African economies are poorly diversified and are vulnerable to exogenous shocks linked to fluctuations in commodity prices. In addition, as the world is taking a path towards net zero emissions – with more countries setting their net zero targets and developing their decarbonization strategies – new economic risks have appeared for large oil and gas exporters, including Central African countries, which must move away from volatile and unsustainable resource rents that have little positive impact on employment creation, poverty reduction, and growth. Accordingly, countries must endeavour to strengthen the structure of their economies by diversifying away from non-renewable resources and by adding value to their exports.

The Douala Consensus[1] reaffirms industrialization and structural transformation as the key strategies for enhancing economic growth. These growth strategies are aligned with the 2030 Agenda for Sustainable Development and Agenda 2063: The Africa We Want, of the African Union.

Industrialization has played a key role in the economic growth of developed countries. Manufacturing, the main driver of industrialization in the past, has promoted technological innovation and has accelerated gross domestic product (GDP) growth, mainly through exports of value-added goods. This can be observed in the positive correlation between economic development and a thriving manufacturing sector.

Beyond economic growth, industrial development influences the well-being of the population. Given that industrial development is the outcome of a complex set of factors, it is intrinsically linked with numerous key sectors and services. Countries with industrialized economies often enjoy a higher level of education, a wider set of public services, better health-care systems, greater information dissemination and lower levels of poverty than developing countries (UNIDO, 2020).

Structural transformation through industrialization, economic diversification and innovation can accelerate economic development and contribute to poverty reduction in Central Africa; however, energy will play a crucial part in fuelling that structural transformation.

Industrialization has traditionally been closely linked with the development of manufacturing industries. The first three industrial revolutions were driven by the mass production of manufactured goods through the utilization of machinery and automation. This landscape of industrialization has acquired greater complexity as part of the transition to the fourth industrial revolution, which is being driven by advanced digital technologies at the nexus of biotechnology, nanotechnology and new materials. The ongoing COVID-19 pandemic has even accelerated the integration of digital technologies across economies, as a part of global efforts to stay connected and build forward better.

1 The Douala Consensus was adopted at the thirty-third session of the Intergovernmental Committee of Experts for Central Africa, under the theme: "Made in Central Africa: from a vicious circle to a virtuous circle", in Cameroon on 29 September 2017.

This digitalization process has blurred the boundaries between sectors. Digitalized industries are more closely interconnected, allowing primary industries to advance to higher levels of value addition in global value chains and fostering new technology-intensive and value-added industries.

This evolution places even greater emphasis on the critical role of energy as a vital input in powering digital technologies and, in so doing, fuelling structural transformation, industrialization and economic transformation. Accordingly, it is fundamental for the Governments of Central Africa to carefully reflect the complexity of current industrialization trends in their industrial policies, in which the provision of sufficient, reliable and sustainable energy should be given full importance.

Governments should, among other things, strive to create and implement sound, efficient and sustainable energy policies to achieve structural change by seizing the opportunities emerging from new industries while upgrading the basic manufacturing sector.

II. Overall energy situation

A. Access to energy

In Central Africa, energy access rates are well below what will be required to attain the Sustainable Development Goals of the 2030 Agenda, and below the average of Africa as a whole.

As of 2019, primary energy demand in Central Africa was 72.85 million tons of oil equivalent. With 15 per cent of the continent's population, the subregion accounts for only 8.7 per cent of the continent's energy demand. The Democratic Republic of the Congo (30.74 million tons of oil equivalent) and Angola (15.57 million tons of oil equivalent) are the subregion's largest energy consumers, accounting together for more than 60 per cent of the total demand (42 per cent and 21 per cent, respectively). The average energy consumption per capita in Central Africa is approximately 0.61 tons of oil equivalent (Enerdata, 2021).

An average of 47 per cent of the Central African population has access to electricity, with countries such as Gabon and Sao Tome and Principe having electricity access rates above 70 per cent, and countries such as Burundi, Chad and the Democratic Republic of the Congo having electricity access rates below 30 per cent.

These averages mask the large differences in per-capita consumption across Central Africa and between rural and urban areas. Rural areas in all countries, except Gabon (62.51 per cent) and Sao Tome and Principe (55.74 per cent), have electricity access of less than 50 per cent. Urban areas are better served (for example, in Gabon, up to 96.67 per cent of the urban population has access to electricity), but some continue to suffer from low access rates; for example, in Chad, only 41.84 per cent of the population in urban areas has access to electricity. Within urban areas, the poorest communities and peri-urban areas are the most likely to suffer from energy poverty.

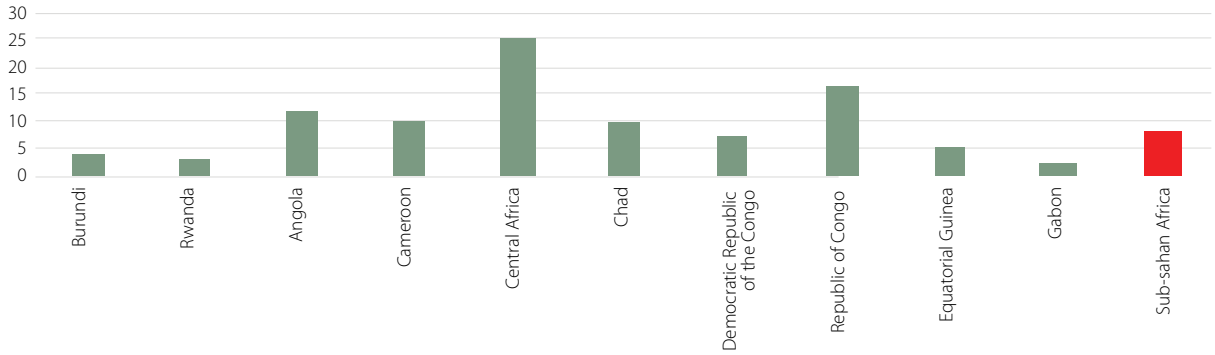
The lack of access to modern energy has led to a heavy reliance on traditional biomass (mainly fuelwood charcoal and agricultural waste), which has been exploited unsustainably and is associated with indoor pollution-related health problems, deforestation and environmental degradation.

With regard to the use of energy for industrial purposes, the limited availability of reliable and affordable electricity has conditioned the industrial structure of Central African countries. The sector is dominated by light manufacturing industries with relatively low energy intensity.

In addition, the implementation of policies promoting the expansion and diversification of manufacturing into industries such as natural resource processing, metal smelting and refining, metal product manufacturing, and fossil fuel processing, has been undermined by energy poverty in the subregion, owing to the fact that those industries are energy-intensive and therefore require an adequate electricity supply.

Similarly, problems of reliability of power supply for commercial and industrial purposes have had devastating effects on business productivity, job creation and income growth in Central Africa. Interruptions in power supply, through power outages and load shedding, not only deteriorate the productivity of industries, but also hamper or completely halt economic activities. Central African countries on average experience the greatest number of power outages of any subregion of the continent. While industries in member countries of the Organization for Economic Cooperation and Development (OECD) experience an average of one hour of power outage each month, Central Africa experiences an average of 10.8 times more power outages, which last on average 9.3 hours (ECA calculations). The associated firm revenue losses are also particularly high in the subregion, especially in the Central African Republic (see graph). The uncertainties in electricity supply and the resultant costs have led many enterprises to rely upon expensive diesel generators to provide electricity, leading to high production costs and significant greenhouse gas emissions (Karekezi, and others, 2012).

Average sales losses due to energy outages in Central Africa



Source: *ECA calculations, based on data from the African Development Bank energy utilities database (n.d.) and the World Bank enterprise survey database (n.d.).*

On average, backup generators account for more than 8 per cent of total installed capacity in Central Africa. In the Democratic Republic of the Congo and Equatorial Guinea, backup generators account for half of the total installed capacity. In addition, more than 70 per cent of firms utilize generators in Chad and the Democratic Republic of the Congo to produce their own power during outage periods (ibid). The use of generators increases the price of electricity for firms by three to six times the price of grid-provided power. The increased price of electricity hampers technology innovation by industries, which, in turn, hinders the industrial competitiveness of

the subregion in global value chains. Fluctuating oil and gas prices are also a problem for industries that rely on having a stable energy supply and production costs. In addition, shortages of petroleum products (such as gasoline and diesel) are common among the countries that are highly dependent on imported energy, which compounds the problem of inadequate supply of electricity to firms, as gaining access to diesel to power their in-house generators sometimes becomes a challenge.

Nevertheless, the subregion has significant potential to produce renewable energy, which can be harnessed to increase its energy supply.

B. Supply of energy

Central Africa has among the most abundant energy resources on the African continent. With its vast transboundary water resources, it holds 58 per cent of the continent's hydroelectrical potential, in addition to solar and wind energy potential, as well other primary energy resources that include oil, natural gas, uranium and biomass.

1. Oil and gas resources

Proven oil reserves in Central Africa were estimated at 89 billion barrels, representing approximatively 30 per cent of total continental oil reserves in 2020, while annual average crude oil production has recently reached 2.4 million barrels a day, or 105 million tons annually, of which 59 per cent came from Angola (Enerdata, 2021). Of the 11 Central African States, 7 are net exporters of crude oil products: Angola, Cameroon, Chad, Congo, Democratic Republic of the Congo, Equatorial Guinea and Gabon. On average, revenue from the oil sector represents 35 per cent of subregional GDP and a third of total government revenue. In particular, the Congo, Angola, Equatorial Guinea, Gabon and Chad all depend heavily on the production and export of crude oil, whose contribution to their GDP is 43.4 per cent, 25.1 per cent, 22.3 per cent, 18.8 per cent and 17.8 per cent, respectively (Enerdata, 2021).

Central Africa is also home to a significant quantity of natural gas reserves; in 2020, it was estimated at 29.8 trillion cubic feet and was principally located in Angola, the Congo and Equatorial Guinea. As of 2020, Angola held 13.5 trillion cubic feet of proven gas reserves; however, most of its production was flared or reinjected into oil fields to increase oil recovery. With 10.1 trillion cubic feet of proven natural gas reserves, the Congo also has natural gas reserves large enough to cover domestic needs, but its production of natural gas has remained marginal.

2. Renewable energy potential

Central African countries have huge potential for harnessing renewable energy; with more than 150 gigawatts (GW) (or approximately 58 per cent) of the continent's potential, the hydropower resources of the subregion alone would be sufficient to meet the power needs of the entire African continent. The Democratic Republic of the Congo, with 100 GW, hosts approximately two thirds of this potential, followed by Cameroon with roughly 25 GW. The remaining 25 GW is shared among the other countries of the subregion.

In addition, Central Africa possesses significant small- and micro-hydropower potential at tens of thousands of sites across the subregion; yet, only a small share of this hydropower potential is being exploited. For example, in Cameroon, 4 per cent of its technically feasible hydropower potential has been harnessed, followed by the Democratic Republic of the Congo with less than 3 per cent, and Gabon with only 2 per cent harnessed. This is principally due to a lack of funding.

Non-hydro renewables, such as solar photovoltaic, wind and bioenergy, are also important. The cumulative technical potential for solar, wind and biomass stands at 3,868 terawatt-hours. Solar irradiation is between 5 and 7.5 kilowatt-hours per square metre per day. The wind power potential of the subregion is poor along the equator. Chad

is the only country in Central Africa with an average wind speed of more than 5 metres per second throughout the country, allowing for the possibility of wind energy development.

While these non-hydro renewables offer significant potential for to increase capacity, they represent a relatively small share, compared with hydropower, and they remain untapped across the subregion, owing to a lack of appropriate policies, strategies and programmes at the national and subregional levels.

Notwithstanding the abundance of resources in Central Africa, its installed electricity capacity remains low. Total installed capacity in 2020 amounted to 13.8 GW, with a net electricity production of approximately 41 terawatt-hours. Three countries (Angola, Cameroon and Democratic Republic of the Congo) are responsible for more than 80 per cent of the subregional production. Approximately 60 per cent of total installed capacity comes from hydropower, with most of the rest coming from thermal plants. Chad, Equatorial Guinea and Gabon use mostly oil, whereas the Congo complements its hydropower with gas-fired thermal plants. Energy-import dependency is high among Central African countries (accounting for 12 per cent of subregional demand), especially in Sao Tome, where the share of imported energy in total consumption reaches 99 per cent. Imported energy accounts for more than 20 per cent of total consumption in Angola, Cameroon, the Central African Republic, Equatorial Guinea and Rwanda.

There are fewer power grid connections among the countries of Central Africa than in any other subregion of the continent. Even with the completion of planned connections between Cameroon and Chad, the Congo and the Democratic Republic of the Congo, and Angola and the Democratic Republic of the Congo, Central Africa would still have fewer connections than any other subregion of Africa.

Considering the pressing challenges of energy poverty for industrialization, entrepreneurship and economic diversification, it is crucial to make use of the subregion's renewable energy potential to increase the affordability and reliability of modern energy.

III. Renewable energy for industrialization and economic diversification

Given that energy demand is expected to increase in Central Africa, renewable energy will play a critical role in powering the subregion's inclusive and sustainable industrial development.

A. Renewable energy can trigger industrialization and diversification

The energy demand of industries in Central Africa is projected to nearly quadruple by 2050. Similarly, electricity demand by those industries is expected to increase five-fold by 2050 (Economic Commission for Africa, 2022). In this context, it is imperative to tackle the energy poverty of Central

Africa using locally available renewable energy in order to efficiently accommodate the growing energy demand for industrial development while mitigating climate change.

In addition, an enhanced energy supply is essential for digitalization, as a reliable power supply sets the foundation for a digital transformation across industries, which is at the core of the fourth industrial revolution. Digitalization is one way for Central African countries to leverage their potential, boost manufacturing and create more productive jobs. Digital technologies can help the countries of the subregion to develop new value chains and strengthen current ones by lowering the unit costs of production, information exchange and transactions (te Velde, and others, 2018).

The deployment of renewable energy resources will support countries in their efforts to develop decentralized energy systems, which are crucial for a reliable energy supply for businesses, especially for small and medium-sized enterprises in rural areas. Decentralized renewable systems can be tailored to the volume and type of demand by, for example, simultaneously offering electricity and heat, both of which are particularly relevant in many industrial settings. These systems can be customized to make optimal use of locally available energy, thereby maximizing resource efficiency. Decentralized solutions also have the benefit of reducing reliance on fossil fuel-based energy systems, which are subject to price fluctuations and supply unreliability, and thus hedging against energy insecurity. Together with more conventional, centralized, grid-connected systems, especially in urban industrial settings, a decentralized energy system empowers utility-scale industries and small and medium-sized enterprises, thereby laying the foundation for economic diversification.

Increased demand for decentralized systems also creates local markets for the installation, maintenance and operation of renewable energy technologies, resulting in job creation and growth of small and medium-sized enterprises. Such improved conditions attract investment, thereby creating a virtuous circle in which further technological innovation increases the cost-effectiveness of renewable energy in comparison with conventional fuels.

Central Africa will find it difficult to achieve industrialization and economic diversification without using sustainable energy to support a more diverse, modern and complex economy. Renewable energy will firmly set the subregion on a path towards inclusive and sustainable industrial development.

B. Potential impact of renewables on selected industries

Central African countries can promote sustainable industrial development more efficiently by introducing renewable energy technologies. The sustainable, reliable and cost-effective characteristics of those technologies contribute to a more efficient use of energy, thereby improving economic performance and creating new opportunities for supply-chain improvement and industrial upgrading. The following sections will address the impact that renewable energy can have on industrial sectors in Central Africa.

1. Agriculture

The production of food and agricultural raw materials is a key source of livelihood in Central Africa. The sector accounts for more than 15 per cent of exports in six Central African countries, and more than half of the population relies on it. Considering the sector's critical role as an income source and countries' increasing food demand, enhancing the productivity of agriculture can significantly contribute to economic performance, food security and poverty eradication. The positive effects of renewable energy technologies on agriculture can be divided into direct effects and enabling effects. Access to renewable energy is an indispensable element for sustainable

agricultural and rural development and can reduce local pollution and global carbon dioxide (CO2) emissions. Renewable energy technologies can also help to catalyse rural development by directly empowering smallholder farmers, whose capacity to farm has been greatly hampered by energy poverty in the subregion. For example, by using solar- and hydro-powered mini-grid generation, farmers can adopt more efficient pathways for food processing and value-added production, including storage, milling, drying and grinding. As irrigation is a vital part of producing successful crop yields, farming efficiency can be increased by incorporating renewable energy technologies into irrigation. Solar pump irrigation is an example of decentralized energy systems that provide an eco-friendly solution for power-deficient areas.

Renewable energy technologies can also considerably increase the efficiency of the sector by reducing food waste, which is largely attributable to the lack of cold chain capacity, inefficient processing and drying, and inadequate storage and transport. Ultimately, having increased access to power via renewable energy technologies can prevent production losses. Tackling food loss and waste through reliable off-grid, solar-powered, cold-storage systems is critical to helping the continent in its efforts to meet its agricultural productivity goals, while minimizing the adverse effects of fossil fuel-based agricultural value chains.

2. Mines and ores

The mining process requires the use of electricity at a great scale, especially for the refinement of ores. As mining operations are very energy-intensive, they are also quite susceptible to energy price-volatility. The decreasing costs of wind and solar photovoltaic technologies provide strong financial incentives for Central African countries to expand the use of renewable energy technologies in their industries. Many solutions are available to the mining sector to reduce its carbon footprint and increase energy efficiency by using renewable energy to meet its needs for electricity and thermal energy (Igogo, and others, 2020). For example, the sector could benefit from decentralized renewable power systems, which can provide a power supply that is customized to their day-to-day operations, rather than being subjected to an unreliable grid supply or costly grid connections. Globally, there are already examples of countries (e.g., Australia, Chile, Mauritania and South Africa) that are creating an enabling environment in their mining sector to accommodate renewable energy solutions (Watson Farley and Williams, 2020).

3. Oil and gas

As the pressure to act to mitigate climate change increases, Central Africa countries will have to consider options to reduce the environmental footprint caused by the oil and gas industry, which is one of the largest industries in the subregion. The major oil and gas operators in Central Africa are already facing increasing global pressure owing to their greenhouse gas-emitting activities. Electrification, through renewable energy technologies applied to selected upstream and downstream processes, can help to reduce greenhouse gas emissions while reducing costs and improving energy efficiency. For upstream activities, renewables could be deployed alongside more traditional diesel-powered generators, and gas boilers could be replaced with electric steam production systems to support separation units (Beck, and others, 2020). The use of hydrogen is also an interesting option for the sector. To a certain extent, the expertise and infrastructure of the oil and gas industry may be an advantage for the subregion's transition to renewable energy.

C. Potential for renewable energy and electric battery production

Central Africa has an abundance of critical minerals (e.g., cobalt, copper, graphite and lithium manganese) that are used in the energy storage technologies that are integral to renewable energy and electric battery production. This

makes it possible to create a robust value chain for electric batteries, electric vehicles, and renewable energy in the subregion.

The need for copper, which is commonly used in vehicles and infrastructure, is projected to increase with the growing prevalence of electric vehicles. While conventional vehicles need 18–49 pounds of copper, battery electric vehicles contain 183 pounds, most of which is used for batteries.[2] Neodymium, which is used in producing the magnets that are required for wind turbine generators and electric vehicle motors, is a rare earth element for which there is currently no substitute (Chen, 2019). With sufficient funding and policies to foster small-scale mining, Burundi could expand its presence in the global value chain for neodymium.

The Democratic Republic of the Congo is particularly well placed to take a leadership position in the energy transition industry, considering that it accounts for nearly 70 per cent of the world's cobalt production, and also has other minerals that are used in the production of batteries (Bridle, and others, 2021). The Democratic Republic of the Congo has more than 25 million tons of cobalt reserves identified in its subsoil, which is approximately two thirds of the world's identified reserves. The country has also been considered as a new source for lithium, with an estimated reserve of 400 million tons in Manono, a town and territory in Tanganyika Province (Australian Mining, 2019).

As a commodity exporter still locked in the mining and mineral processing stage, the Democratic Republic of the Congo is at the bottom of the world's battery and electric vehicle value chain, currently capturing only 3 per cent of its total value, which is expected to reach $8.8 trillion by 2025 (Bloomberg Finance L.P., 2021). For example, almost all the cobalt mined in the country is exported to Belgium or China for refining, with insignificant economic benefits accruing to the country. The five segments of that global value chain are a $11 billion mineral exploitation component; a $44 billion minerals-to-metals transformation facet; a $217 billion sector precursor production sector; a $387 billion battery cell manufacturing line; a $1.8 trillion cell assembly section; and electric vehicle manufacturing portion valued at least $7 trillion. Moving from the first segment to the third would allow Central African countries to capture gains that far exceed those of the very first and least profitable stage of the value chain (Bloomberg Finance L.P., 2021).

Accordingly, Central Africa needs to leverage its dominance as a supplier of battery minerals to build domestic capacity in the development and deployment of storage systems and electric vehicles. To build a domestic supply chain, the countries of the subregion must scale up investment in infrastructure; develop the policies and regulatory frameworks that are

2 For more information, see Copper Development Association Inc, Factsheet. Available at www.copper.org/ publications/pub_list/pdf/A6191-ElectricVehicles-Factsheet .pdf.

required to attract foreign direct investment and private investment; and help the workforce to acquire the skills that are needed to develop technologies and businesses in the industry. Better integration of African battery mineral producers into global value chains will not only contribute to the achievement of the Sustainable Development Goals and enlarge the share of wealth that is retained locally, but also strengthen the competitiveness of small and medium-sized enterprises at the local level and facilitate the creation of decent jobs in the subregion.

IV. Barriers to and potential of renewable energy

A. Barriers to the deployment of renewable energy for industrialization

The World Bank's Regulatory Indicators for Sustainable Energy (RISE) scorecard, a key element of the Sustainable Energy for All Knowledge Hub, helps to assess countries' policies and regulatory support under each of the three pillars of sustainable energy – access to modern energy, energy efficiency, and renewable energy. Most Central African countries have a relatively low overall score.3 Some of the key issues are: the lack of evidence-based energy planning and scenarios; a deficit of clear and sustainable national energy action plans, road maps, supporting policies and legislation; the need to update or refine current policies; the need to improve coherence and alignment with other sectors; insufficient policies to enable private sector investment; the lack of a supply-side orientation on the part of renewable energy and energy efficiency policies, standards and incentives (which would facilitate energy entrepreneurship and innovation in manufacturing, assembling and servicing); and a lack of policies to promote renewable energy and energy efficiency in rural and urban industrial sectors.

Additional barriers that countries have faced while promoting the deployment of renewable energy for industrialization in Central Africa include an absence of compatible skills, inadequate infrastructure and a poor business climate.

B. Strategies for the development of renewable energy

Given the abundance of renewable energy resources in Central Africa, the subregion can meet the electricity needs of its population while promoting industrialization and economic diversification. To foster renewable energy deployment and sustainable industrial development, Central African Governments should work closely with national and international institutions, the private sector and development agencies, by engaging in public-private partnerships to design sound national and regional policies, implementing initiatives to tackle financial constraints, and building local capacity.

1. Capacity-building and skills development

Building local capacity is fundamental to deploying renewable technologies, attracting investment and fostering structural transformation. Capacity-building should be broadened to include governments, public institutions and policymakers.

Enhancing government capacity is critical to the successful development and implementation of innovative projects and to gain access to international financing. Training for public procurement officers is also fundamental to

3 For more information on Regulatory Indicators for Sustainable Energy, see https://rise.esmap.org/.

implementing efficient and sustainable public procurement. Public institutions need to have the proper tools to facilitate the growth of the private sector and efficiently mobilize investment. Policymakers need to be aware of best practices being applied internationally to design more effective policies, which can be tailored to each country's context.

Another important area to focus on is planning. Several Governments around the world have developed energy master plans, which has helped to provide a stable and predictable investment environment that has been crucial for engaging the private sector. To undertake this exercise in the African context is very challenging, however, because of the lack of appropriate data, models and skills.

Human capital should also be strengthened to fill the gap between the level of skills among the populace and market demand for skills. Vocational training can be used as a way to equip the local workforce with the skills needed to implement an energy transition. Universities should take part by designing curricula that focus on renewable energy and its application for productive uses. Universities not only support the creation of a skilled workforce, but they are also major contributors to research and development, which is essential for economic development and diversification.

2. Technology development and transfer and innovative capacity development

Capacity-building should be complemented by technology transfer to foster sustainable and long-term economic and industrial development in Central Africa. It is also important to develop the capacity of the subregion to innovate and adapt technologies to local realities rather than copying without modifying the solutions put in place in other contexts. This will enable the receiving countries to build technological know-how, which is key for the development of local value chains.

3. Sharing knowledge, raising awareness and building regional and global partnerships

The dissemination of knowledge and information is also indispensable to efficiently foster the uptake of environmental technologies and promote research and development. In Central Africa, the lack of information dissemination affects public institutions, the private sector and consumers.

Policymakers are increasingly urged to use evidence-based research to inform development policy. Their doing so is often hampered by the lack of both rigorous data collection and a coordinated system to disseminate data. Central African Governments should consider adopting policies that are aimed at fostering strong data systems through digitalization.

Governments in subregion are often missing information on the success stories and best practices of neighbouring countries. One way to remedy that situation is through institutional partnerships at the regional and international levels, which can catalyse knowledge- and technology-sharing, thereby allowing countries to learn from each other and expand the spillover effects of technological breakthroughs. Such platforms as the Centre for Renewable Energy and Energy Efficiency for Central Africa, created under a partnership between the United Nations Industrial Development Organization and the Economic Community of Central African States, offer a great opportunity for knowledge-sharing and subregional coordination.

Regional trade integration in Africa is key to connecting local renewable energy markets and small and medium-sized enterprises to intraregional value chains and global value chains. It also facilitates the flow of locally produced

renewable energy technology components and enhances the cost-effectiveness of producing environmental goods by shortening value chains. In this context, the African Continental Free Trade Area has become a new pillar of continental cooperation by creating a channel for inbound foreign direct investment and enhancing intra-African trade (Hai, 2020). According to the Economic Commission for Africa (2018), the value of intra-African trade is projected to increase by $50 to $70 billion (an increase of 15-25 per cent) by 2040. Removing tariffs on commodities lowers the price of components for digital technology and renewable energy, thereby allowing easier access to advanced technology (International Energy Agency, 2019).

In addition, intraregional technical cooperation is imperative to increasing resilience to energy poverty in Central Africa. Sound grid-interconnectivity throughout the subregion can catalyse the affordable and reliable provision of power, while hedging against intermittent disruptions of the power that is generated using renewable energy. The Cameroon-Chad Power Interconnection project, which is sponsored by the World Bank, manifests the key role of international partnership in executing regional collaborative projects (World Bank, 2020). The project facilitates the implementation of adequate infrastructure and provides technical support to countries in negotiating power-trading contracts. This can be a steppingstone to extending grid interconnectivity in the subregion.

4. Enhancing the investment and business climate

Traditional financing mechanisms are typically not well suited to renewable energy projects, in particular decentralized systems, because of their high transaction costs and the low incomes of the rural communities and individuals that are their potential beneficiaries. Investor interest is usually focused more on large centralized systems, as small-scale investment in rural areas is thought to be riskier and more costly. Government support and funding mechanisms for users and small businesses are thus needed to overcome the initial capital barriers, in order to promote the widespread dissemination of decentralized systems.

The scale of investment needed to meet the growing demand for energy in Central Africa is huge and far greater than the funds that are available from public sources. Political will on the part of Central African Governments and substantial and targeted support from development partners in creating stable, predictable and conducive frameworks, identifying viable project pipelines and utilizing de-risking instruments will help to attract the private-sector capital that will be required to bridge the gaps.

De-risking renewable energy projects is key in scaling up renewable energy capacity to accelerate the transition to a net-zero future. De-risking entails the provision of debt guarantees by governments or development finance institutions, insurance coverage, and the facilitation of blended financing, including financing using local currency to reduce currency risk. It also includes putting in place policies and regulations that will favour investment in the renewable energy sector; for example, policies that will inspire confidence among investors and financiers that governments will continue to honour contractual obligations such as power-purchase agreements, even if administrations change.

Governments can reduce the perception of risk through regulatory reform and the adoption of policies that increase government accountability and effectiveness, combat corruption and promote the rule of law (Schwerhoff and Sy, 2017). Policymakers can create an enabling policy and regulatory framework by adopting an integrated approach to policymaking and

by standardizing the institutional processes of regulatory authorities to reduce license approval and issuance delays (Aliyu, Modu and Tan, 2018). In addition, deregulation of the energy sector can facilitate market competition and increase efficiency by providing a favourable environment for private investment and by reducing or removing controls on energy pricing, fuel use and fuel imports. It can also enhance capacity and promote small-scale renewable energy production, which would increase the availability of electricity and reduce the cost of energy. Independent and transparent regulatory frameworks and reporting bodies would also reinforce the liquidity of financial markets (Ouedraogo, 2019).

V. Conclusion and recommendations

Notwithstanding its vast potential for renewable energy, the distribution of that potential among the countries of the subregion remains highly uneven, specifically in the case of hydropower. Moreover, Central Africa remains one of the least developed subregions on the continent in terms of renewable energy output and final renewable energy use in the industrial sector. This is partly due to several barriers to the development of the energy sector that can be grouped in three main categories: laws and regulations; financing and investment; and knowledge and information.

Central African countries should develop and implement policies to break these barriers and harness their considerable renewable energy resources for industrialization, economic diversification and sustainable development. The appropriate allocation of available resources through sound energy management and energy planning policies is crucial for economic development and environmental security in Africa. Equally, improving the production and dissemination of quantitative data and qualitative information on energy, along with sound and accurate energy forecasting models are of prime importance in the deployment of renewable energy in Central Africa.

Supply-side measures should be implemented to finance the upgrading of electricity grids to ensure that they can carry large flows of renewable energy. Transmission and distribution lines should also be upgraded to reduce technical losses, given that high power transmission and distribution losses affect electricity availability and system reliability in the subregion.

Demand-side policies should also be implemented. Necessary actions to be carried out include the design of measures and programmes aimed at reducing electricity demand and use. Such policies can help to limit energy demand by promoting the use of energy-efficient appliances and equipment, along with changing negative consumer behaviour in Central Africa.

Significant increases to financing in the energy sector are a prerequisite for the implementation of these policies, which would trigger the deployment of renewable energy in the subregion for economic development through sustainable industrialization.

International support for decarbonization programmes can be a key leverage point for investment. International climate financing, in the form of bilateral and multilateral official development assistance, can be used efficiently and effectively to support renewable energy development. Industrialized countries have pledged significant resources to support

developing and emerging economies in adaptation and mitigation through bilateral and multilateral mechanisms. In addition, a growing number of beneficiary countries have set up national climate change funds that receive funding from multiple developed nations.

Central African countries continue to have limited access to financing for renewable projects, which necessarily impedes their development. This requires the subregion to prioritize renewable energy projects, which will lead to improved coordination and pooling of efforts to ensure the best possible use of resources at the national and subregional levels. Micro- and small-scale renewable energy projects in particular should be prioritized.

Financial resources can also be mobilized through international carbon markets, especially through the Clean Development Mechanism and other crediting mechanisms under international law. Reducing the large inefficiencies in the generation and distribution of electricity would also mobilize significant additional domestic financing.

Central African countries should consider adopting policies to harmonize standards and procedures, to enforce equitable commercial terms, and to cooperate at the power-pool level. Such policies are crucial to broadening the sources of financing to support expansion in capacity, transmission, and distribution infrastructure through regional cooperation; and to expanding regional grid integration and power trade through regional planning.

Overall, energy policies should be aligned with development plans that are focused on economic diversification and the structural transformation of the economies of Central Africa. Deploying renewable energy requires a policy mix tailored to countries' specific socioeconomic conditions and the maturity level of various sectors, and be aimed at strengthening firm-level capabilities, building a domestic industry, promoting education and research, and facilitating investment and technology transfers.

The following key catalysts for enabling an energy transition in Central African countries should to be considered:

- Strong policy and regulatory frameworks
- A conducive environment for private sector investment in renewable energy
- Technologies and schemes that facilitate energy efficiency and power system flexibility
- Innovative business models that increase access to affordable and clean energy
- Cost-reflective tariffs and financially viable service delivery
- Reliable networks coupled with improved skills in operation and maintenance
- Dismantlement of current fossil-fuel-based generation capacity

VI. References

African Development Bank (n.d.). Energy utilities database. Available at

https://www.infrastructureafrica.org/dataquery/.

Aliyu, Abubakar Kabir, Babanigida Modu and Chee Wei Tan (2018). A review of renewable energy development in Africa: a focus in South Africa, Egypt and Nigeria. *Renewable and Sustainable Energy Reviews*, vol. 81, No. 2 (January), pp. 2502–2518.

Australian Mining (2019). AVZ confirms Manono as world's largest lithium resource, 8 May.

Beck, Chantal, and others (2020). *The future is now: how oil and gas companies can decarbonize*. New York: McKinsey and Company.

Bloomberg Finance L.P. (2021). "The cost of producing battery precursors in the DRC", November 2021. Available at .

Bridle, Richard, and others (2021). *Driving Demand: Assessing the impacts and opportunities of the electric vehicle revolution on cobalt and lithium raw material production and trade. IISD Report*. Winnipeg, Canada: International Institute for Sustainable Development.

Chen, Angela (2019). Where will the materials for our clean energy future come from? *The Verge*, 15 February.

Copper Development Association Inc. (n.d.). *Copper Drives Electric Vehicle*. Available at www.copper.org/publications/pub_list/pdf/A6191-ElectricVehicles-Factsheet.pdf.

Economic Commission for Africa (2018). *An empirical assessment of the African Continental Free Trade Area modalities on goods*. Addis Ababa.

_____(2022). Harnessing renewable energy for industrialization, economic diversification in Central Africa. Working Paper, forthcoming. Addis Ababa.

Enerdata (2021). Global Energy and CO2 Data. Available at at https://www.enerdata.net/.

Hai, Helen (2020). Making industrialization in Africa sustainable. *United Nations Chronicle*, 1 December.

Igogo, Tsisilile, and others (2020). Integrating clean energy in mining operations: opportunities, challenges, and enabling approaches. Technical Report, No. NREL/TP-6A50-76156. Golden, Colorado, United States of America: Joint Institute for Strategic Energy Analysis.

International Energy Agency (2019). *Africa Energy Outlook 2019. World Energy Outlook special report*. Paris.

Karekezi, Stephen, and others (2012). Energy, poverty and development. In *Global Energy Assessment. Toward a Sustainable Future,* Nora Lustig, ed. New York: Cambridge University Press.

Ouedraogo, Nadia S. (2019). Opportunities, barriers and issues with renewable energy development in Africa: a comprehensible review. *Current Sustainable/Renewable Energy Reports*, vol. 6, No. 2, pp. 52–60.

Regulatory Indicators for Sustainable Energy (n.d.). Home page. Available at https://rise.esmap.org/.

Schwerhoff, Gregor, and Mouhamadou Sy (2017). Financing renewable energy in Africa – key challenge of the sustainable development goals. *Renewable and Sustainable Energy Reviews*, vol. 75, issue C, pp. 393-401.

te Velde, Dirk Willem, and others (2018). Five new ways to promote African industrialization. Available at https: //odi.org/en/insights/five-new-ways-to-promote-african-industrialisation/; or https://odi.org/en/profile/dirk-willem-te-velde /?page=3.

United Nations Industrial Development Organization (2020). *How Industrial Development Matters to the Well-being of the Population. Some Statistical Evidence*. Vienna.

Watson Farley and Williams (2020). Mining and renewable energy – a green way forward, 23 November.

World Bank (2020). Cameroon – Chad Power Interconnection Project (P168185). Washington, D.C.

_____(n.d.). World Bank enterprise surveys database. Available at _____

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