

REPORT

Integrating Africa Energy: Progress, Challenges, and Policy Implications

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Abstract

Access to affordable, reliable and clean energy is crucial for Africa's development, yet 570 million people lack electricity and demand is set to rise 215% by 2030. Despite this, energy investments remain low and reliance on fossil fuels and biomass harms both economies and the environment.

Integrating Africa Energy systems in Africa presents significant opportunities to improve investments, enhance resilience, and close energy gaps in the continent However, challenges remain in the generation, transmission and distribution sectors.

Prior to now, opportunities and strategies has not been sufficiently researched in the Africa context, despite its enormous potential contributions. For this, we dedicate this policy brief to closing the existing knowledge gap. We will ask the following:

1) How do integrating Africa energy systems present opportunities to improve investments and resilience in sustainable energy systems as well as close energy access gaps?

2) Which progresses are currently ongoing in integrating Africa's energy systems across the value chain – generation, transmission and distribution?

3) Which challenges hinder progress in integrating Africa's energy systems?

4) Which policy ideology and frameworks will enhance the integrating Africa energy agenda. And which lesson can Africa learn from the European experiences?

Table of Contents

1. Background and Context

Sustainable development can only happen with access to reliable and affordable sustainable energy. Increasing sustainable energy services in Africa offers opportunities to progress in many dimensions of development, including alleviating poverty, enhancing food security, creating new jobs, and fostering education and gender equality. Clean energy solutions are also essential to reduce pollution and environmental degradation, provide access to water and sanitation, improve human health, and protect ecosystems while contributing to tackling climate change and enhancing resilience. Energy poverty contributes to deindustrialization, unemployment, economic livelihood declines, trigger conflict and drive people to leave their homes, contributing to rising urbanization and migration in places where infrastructure already struggles to cope to meet people's needs. Providing universal access to affordable, reliable, sustainable and modern energy for all is the seventh Sustainable Development Goal (SDG) of the United Nations (UN). A sustainable energy sector is also essential to address strategic interests of Africa and Europe and will contribute to the implementation of the UN Paris Agreement on Climate Change.

The population of Africa is expected to double by 2050, reaching nearly 2 billion. Meanwhile, access to affordable and reliable energy services remains a major challenge in large parts of the continent. Of the top 20 access-deficit countries in the world, 15 are in SSA, where over 570 million people lived without access to electricity in 2017. The SSA population without electricity is projected to stabilize at around 585 million people in 2030, following current electrification trends and accounting for population growth. Even those with access do not always receive quality supply, limiting the potential for electricity to improve quality of life and boost economic development. Africa currently has 80 GW of new electricity capacity under construction, compared to under 250 GW currently installed (of which only 80 GW in SSA, excluding South Africa) (World Bank 2021a). Yet demand is projected to increase by 215% from 2016 to 2030 (World Bank 2021b). The continent's primary energy needs (including electricity, transport, and industry) are overwhelmingly met with fossil fuels

(50%) and unsustainable biomass or waste for cooking (45%), with consequences for air pollution and climate change (AEP 2021). Dependence on imported fossil fuels also harms local economies due to fuel price volatility. Electricity only represents 10% of the continent's final energy consumption (AEP 2021). The total installed generating capacity in SSA remains low, about equivalent to that of Spain, whose population is about 95% smaller. South Africa alone accounts for nearly half of the generation capacity for all of sub-Saharan Africa. From 2015 to 2016, Africa-focused investments made up only 16% of total global commitments, and about 26% of power sector commitments in Africa were concentrated on just four countries (AfDB 2019).
By 2030, electricity supply across Africa must triple to meet the demand from modernizing economies, demographic growth, changing lifestyles and expectations, combined with projections for universal reliable, clean and affordable energy access under SDG 7. This calls for urgent steps to ensure that investments keep pace with energy infrastructure needs. Expanding and strengthening sustainable energy supply will help drive the industrialization process (SDG 9) to advance socioeconomic development while tackling the climate crisis (SDG 13). Therefore, we must tackle the problem at a scale that matches the challenge. This requires us to think big. Integrating Africa's energy systems is one way to do so.

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1) How do integrating Africa energy systems present opportunities to improve investments and resilience in sustainable energy systems as well as close energy access gaps?
2) Which progresses are currently ongoing in integrating Africa's energy systems across the value chain – generation, transmission and distribution?
3) Which challenges hinder progress in integrating Africa's energy systems?
4) Which policy ideology and frameworks will enhance the integrating Africa energy agenda. And which lesson can Africa learn from the European experiences?

2. Opportunities in integrating Africa's energy systems

Integrating energy systems in Africa presents significant opportunities to improve investments, enhance resilience, and close energy access gaps in the continent. These opportunities are further discussed below.

2.1 Increase electricity access, stimulate economic growth and reduce social inequality

Another benefit of integrating energy systems in Africa is that grid interconnections amongst the member states allows for the accelerated electrification of regions and areas that previously lacked electricity access, especially along the corridors of the borders between interconnected countries. The resulting improvement in electricity access creates new economic frontiers and boosts productivity in already existing economic clusters, leading to an overall growth in both local and regional economy. Increased electricity supply also enhances socio-economic productivity within the local economy by enhancing storage of farm produce, reducing the amount of hours expended on household tasks and reducing the cost of operating small businesses, among others. Further, new and/or better acChigozie Nweke-Eze,
Integrated Africa Power (IAP)cess to electricity for communities often means improved access to educational opportunities, health care services, sanitation and other social amenities which contributes to overall social-economic development and wellbeing. Furthermore, integrating Africa's energy system through large-scale energy systems can increase urban electrification with already established transmission line. Opportunities includes improving affordability, efficiency and reliability of electricity. This contributes to efforts to achieve universal energy access by 2030 and can help bridge the gap between those with and without electricity.

2.2 Improve Infrastructure investment and economies of scale

A major benefit of integrating Africa energy systems and cross border electricity pooling and trading is that it has created a framework, incentive and opportunity for investments from both public and private sector. Private sector investments and involvement in cross-border electricity projects will ease the financing constraints and will lead to better application of technical skills in project implementation and operation as well as in organizational and financial discipline. Further, integrating Africa's energy systems create opportunity for investors to benefit from economies of scale in energy development within countries. It also reduces risks of investment by spreading the risk of affordability and capacity-to-pay. Although, increasing regional electricity sector integration requires a solid investment in infrastructure, international and regional organizations, such as the United Nations Office for Project Services (UNOPS) and Sustainable Energy for All (SEforAll), as well as the African Development Bank (AfDB) can help mobilize technical and financial resources for such integrated systems. Unlocking these financing and investment, however, requires the development of clear strategies and policies to help attract climate finance and technology spillovers, making investments more attractive.

2.3 Maximize capacity through market balancing and enhancing security of supply

Cross-border electricity generation and trading within African countries holds the potential to improve the connection between supply and demand for electricity by expanding the geographical reach of the energy markets. It allows participating countries to reduce the cost of electricity generation through its offering of a robust energy supply mix from the different participating countries. The pooling of energy resources and the interconnection of isolated electric power systems allows for trading and utilization of electricity based on reduced cost as a result of the optimal use of available energy and fiscal resources. This integration of energy resources helps to enhance the security of supply through mutual balancing of supply and demand among the interconnected member countries.

2.4 Reduce inefficiencies and electricity costs

Through electricity generation pooling and trading, inefficiencies of the transmission system of individual countries can be circumvented through the import or export of generated electricity from or to near interconnection points. Such optimized electric power systems model improves reliability and quality of service, while allowing for lower and affordable electricity tariffs. The improved electric power systems, accessibility and reliability will foster an increase in quality of service and a reduction in power interruptions which often lead to productivity losses in the commercial and industrial sectors, affecting average regional manufacturing costs and the national gross domestic product (GDP). Energy integration through transmission energy system will further contribute to strengthening and modernizing the grid infrastructure which improve energy security and reduce the risk of blackouts.

2.5 Increase adoption of renewable energies and environmental sustainability

Integrating Africa energy systems provides opportunities for tapping into the vast renewable energies in the region, including hydropower, geothermal and wind, by increasing the viability for their development. Africa remains a veritable ground for investment in large-scale renewable energies, which has ample potentials to provide access to cheap and sustainable energy. To encourage large-scale investment in hydropower, potential offtake needs to be assured and cross-border electricity pooling and trade across the West African corridor provides ample opportunity to mitigate risks by accessing a wider market. Furthermore, given political will, increased financing and other supporting factors, the exploitation of hydropower and other renewable energy resources, has to potential to gradually lead to reduced consumption of non-renewable energy (fossil fuels), which will result in significant reductions of CO_2 and other air-borne emissions, thereby safeguarding the environment while furthering sustainable development.

2.6 Increase regional and inter-country economic and political cooperation, and trade-away conflict

A major benefit of integrating Africa energy systems is that it holds the potential to create continental and regional energy market that furthers inter-country and inter-regional cooperation. The experience establishing frameworks and legal apparatus for intra-regional electricity trading will also shape further and future inter-country and inter-regional exchanges in other sectors of the regional economy. Furthermore, the development of a regional markets through interconnected power systems and cooperation has the potential to contribute to reducing tendencies for political, economic or social conflicts and increase resilience particularly in fragile states, through regional cooperation.

3. Progress in integrating African energy systems

Over the years, Africa has made efforts to address issues relating to its averagely minimal energy access rates and to unlock the region's energy potential by creating several regional integrated energy initiatives to increase energy access, support energy transition, and accelerate growth. This is dated back to 1995, when the region's first power pool was created to enhance generation capacity and transmission facilities to allow for more cross-border energy trading. It is vital to highlight that the notion of regional integrated energy systems referred to in this context is the interconnection and coordination of energy infrastructure, resources, and markets across multiple countries within a region. This approach efficiently utilizes diverse energy sources, including renewable energy, and facilitates cross-border trade and cooperation. By pooling resources and infrastructure, regional integration can improve energy access, enhance reliability, and promote sustainable energy development. Presently, there are four regional power pools in SSA, with twelve member nations in the South Africa Power Pool, fifteen member nations in the West Africa Power Pool while the East Africa Power Pool and Central Africa Power Pool consist of eleven and ten member countries respectively. These initiatives aim to develop regional electricity markets, facilitate cross-border power exchanges, and promote the integration of renewable energy resources. We discuss these progresses in detail in the following sub-sections.

3.1 Generation: The case of the Grand Inga Dam

The Grand Inga Project is the largest, most powerful and possibly most controversial prospective hydroelectric dam development project ever imagined. It is located on the Congo River – the deepest in the world and second-longest in Africa. The Grand Inga dam is the flagship of the Democratic Republic of the Congo's (DRC) development strategy. Harnessing its full hydropower potential has been an ongoing development dream of the DRC and its more powerful regional allies. If completed, the Grand Inga complex near Kinshasa, the capital of the DRC, will be the largest dam project in the world. Its eight separate dams (Inga 1–8) are envisioned to be "lighting up and powering Africa" in an integrated system.

Despite receiving considerable support from leading financial institutions, however, it has, so far, not been built. In 2017, the Grand Inga project made the headlines when the World Bank declared it was going withdraw its support from the project, citing a lack of transparency and failure to observe international good practices as major causes. Despite the failure of the original Inga dams 1 and 2, a World Commission on Dams (WCD) report deeming mega-dams economically and environmentally unviable and left without its major investor, the Inga dream pushes on. Given a lack of funding, the Inga 3 project has involved several stakeholders over the years, including South Africa, the World Bank, and the African Development Bank (ADB). In October of 2018, the DRC signed off on a deal with two international private companies to outsource the construction in return for mining rights.

Opponents claim that the rewards will be outsourced to corporate mining interests rather than meeting the needs of the local population, and that the project is flawed economically, socially and environmentally. The planned construction of the Inga dams and associated infrastructure has been stuck in limbo since it was mooted in the 1960s, a fantasy rather than a reality. The project dam is confronted with political, geostrategic, and financial challenges, notably the suspension of the World Bank's funding in 2016. Policy recommendations suggest that further transparency in implementing the Grand Inga project is required for restoring donors' confidence; while the country strives for political stability and sustainable development. We look more into the progress and detail of the forestalling of the Grand Inga Dam project below.

3.1.1. Building the dam: first failed attempt at mobilizing donors

In 2004, the Western Power Corridor (Westcor) comprising the DR Congo, South Africa, Angola, Namibia, and Botswana set up a regional energy integration for implementing the Inga 3 hydropower project. . In the wake of then President Kabila's election, in 2006, the country embarked on the economic reconstruction, focusing on five development pillars (infrastructure, job creation, education, water, and electricity). Building the Inga 3 dam became a national priority. On June 26, 2006, BHP Billiton SA (the Australian mining giant) and the SNEL, concluded a PPP, after a tender process. BHP agreed to build the Inga 3 dam, estimated at USD 3.5 billion. As the principal off-taker of the electricity generated, it planned to obtain 1600MW out of 2000MW, for developing its aluminum project. Five years later, Westcor did not register progress on the Inga 3 project. Consequently, the DR Congo's withdrawal from Westcor ended the regional integration in 2009. Facing multiple challenges, BHP withdrew from the Inga 3 project by abandoning its aluminum plant's project in February 2012.

3.1.2. Rising interests of the bilateral and multilateral donors

Despite the failed partnerships, the country maintained its interest in developing the Grand Inga project, probably estimated at about USD 80 billion. The mega energy infrastructure consists of the Inga 3 hydropower scheme (the Inga 3 low chute and the Inga 3 high chute) and five other dams (the Inga 4 to the Inga 8). The country intended to become a major energy exporter in Africa by supplying electricity to five regional electrical networks, including the SAPP and the West African Power Pool (WAPP). Initially, the country planned to expand the West network by building the Inga 3dam with a projected capacity of 4800MW8: (i) 2500MW for South Africa; (ii) 1300MW for mining companies operating in the ex-Katanga; and (ii) 1000MW for the population. The Inga 3 project was valued at between USD 12 billion and USD 14 billion. It will be developed based on the PPP model, as public investments are limited due to debt capacity constraints. However, the donor coordination became more challenging than expected.

3.1.3. The key role of South Africa in developing the project

Given the energy crisis, South Africa was eager to secure the low-cost and clean energy that the Inga site could produce. Therefore, South Africa and the DR Congo progressively strengthened their cooperation in the energy sector. On November 12, 2011, they signed a memorandum of understanding on the Grand

Inga project. On October 29, 2013, former President Kabila and former President Zuma signed a 10-year treaty on the Inga 3. On September 9, 2014, a bilateral deal on energy was also signed. On November 21, 2014, the DRC authorized the ratification of the said treaty. South Africa demonstrated a vital interest in the Inga 3 project, which will contribute to reducing the national electricity gap. Through Eskom (the national utility company), it will also become the biggest importer of power produced at the Inga 3 dam (initially 2500 MW) to bolster the country's economic development. The Grand Inga project constitutes a powerful geostrategic tool.

3.1.4. The involvement of the multilateral donors

The donors expressed a real interest in developing the Inga 3 project. Firstly, in 2010, the ADB provided technical support of USD 15 million. In 2013, it awarded USD 33.4 million to create a structure in charge of the Grand Inga project and to assist the government in selecting the Inga 3 developers. Secondly, on March 20, 2014, the World Bank approved a Technical Assistance (TA) project on the Inga 3 and mid-size hydropower development, funded by an International Development Association (IDA) grant of USD 73.1 million. Funds were allocated to environmental and social impact studies, which were critical before building the Inga 3 dam. However, in April 2015, the World Bank voiced its concerns about the project's management.

3.2 Transmission and distribution: The African Power Pools

Power pools in Africa are established to foster cooperation between countries in power sectors. These power pools are founded by the regional economic communities (RECs) of the African Union. The RECs are institutions of African states that aim to facilitate regional economic integration between members of the individual regions under the auspices of the African Economic Community. The African Union recognizes eight RECs: the Arab Maghreb Union (UMA) in the North; the Common Market for Eastern and Southern Africa (COMESA) in the South East; the Community of Sahel–Saharan States (CEN-SAD) in the North; the East African Community (EAC) in the East; the Economic

Community of Central African States (ECCAS) in the centre; the Economic Community of West African States (ECOWAS) in the West; the Inter-Governmental Authority on Development (IGAD) in the East; and the Southern African Development Community (SADC) in the South. Figure 2 shows the REC membership map. These RECs serve as the foundation for the establishment of five power pools in Africa, namely the Maghreb Electricity Committee (COMELEC), the Southern African Power Pool (SAPP), the Western African Power Pool (WAPP), the Central African Power Pool (CAPP), and the Eastern African Power Pool (EAPP), in the order of their establishment. Figure 3 displays the geographic location of the five power pools.
It is important to note that the African RECs have varying institutional characteristics in terms of rules and authority, and they set the policy framework for the power pools. As a result, the power pools display different regulations, governance, and institutions [IEA, 2019]. However, a common feature among all the power pools is their mandate to perform the activities of the regional market operator and regional infrastructure planner [WAPP, 2019a, SAPP, 2019, EAPP, 2020]. While some power pools, such as WAPP, are designed to carry out the activities of the regional system operator, others, such as SAPP, delegate these responsibilities to control area transmission system operators and only facilitate the coordination between them. Table 1 shows the membership of the three selected power pools and their respective foundation year. In the subsequent sections, a concise overview of the foundation of each power pool, including the institutional characteristics of their RECs, key factors that led to their establishment and their regional institutions, will be presented.

Benefits to be expected from developing interconnections and operating power pools include the following:-

1) Reduction capital and operating costs through improved coordination among power utilities;-
2) Optimization of generation resources with large units;-
3) Improved power system reliability with reserve sharing;-
4) Enhanced security of supply through mutual assistance;-
5) Improved investment climate through pooling risks;-
6) Coordination of generation and transmission expansion;-

6) Increase in inter-country electricity exchanges; and-
7) Development of a regional market for electricity.

Major constraints/challenges to power pools development and operation include:-
1) Lack of trust and confidence among pool members;-
2) Underdeveloped transmission networks and tie lines; -
3) Inadequate generating capacity and reserve margin;-
4) Difficulties of mobilizing investment for power projects;-
5) Lack of legal framework for electricity trading;-
6) Lack of rules for access to the transmission grid, including setting wheeling charges; and-
7) Lack of regional regulation and appropriate mechanism for dispute resolution.

The different regional power pools in Africa are discussed below.

3.2.1 Eastern Africa Power Pool (EAPP)

The Eastern Africa Power Pool (EAPP) was established in 2005 with the signing of an Inter-Governmental Memorandum of Understanding (IGMOU). Its member countries include Burundi, Comoros, the Democratic Republic of Congo, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Libya, Madagascar, Malawi, Rwanda, the Seychelles, South Sudan, Sudan, Tanzania, Uganda, and Zambia. EAPP was initially founded by agreements between member countries and was then adopted by the Common Market for Eastern and Southern Africa (COMESA). COMESA is a platform aimed at the creation of a large trading area based on the Preferential Trade Area Treaty, which explicitly promotes regional integration by removing trade barriers. COMESA is the largest regional economic community in Africa, it includes countries from East and South Africa, yet it does not include all EAPP members (e.g., Tanzania). Therefore, EAPP is loosely tied to COMESA. The only important factor in the establishment and development of EAPP is the support from international institutions and the facilitation of funds through COMESA. EAPP has a more politically driven governance structure. Its highest decision-making authority is the Council of

Ministers, which includes countries' energy ministers. EAPP rejects IPPs in its membership and only allows national utilities. To enable regional trade, EAPP only established legal documents and agreements permitting regional trade, an Inter-Governmental Memorandum of Understanding and an Inter-Utility Memorandum of Understanding. Also, the power pool modestly contributes to regional infrastructure planning by delivering a regional master plan through its planning committee. On the other hand, the Council of Ministers decided to establish a regional regulator, the IRB, but it is yet to be operationalized. Thus, the region still lacks sufficient infrastructure and institutional capacity for establishing the regional market.

3.2.2 West African Power Pool (WAPP)

WAPP is a special institution of the Economic Community of West African States (ECOWAS) and was created by Decision A/DEC.5/12/99 of the 22nd summit of 1999 in Lomé, Togo [WAPP, 2018]. Its member countries include Benin, Burkina Faso, Ghana, Guinea, Guinea Bissau, Ivory Coast, Liberia, Mali, Niger, Nigeria, The Gambia, Togo, Senegal, and Sierra Leone. ECOWAS is a supranational entity with a commission authorized to issue legal demands through directives and regulations. ECOWAS strongly influences WAPP and manages it through its special regional institutions, e.g., the regional regulator ERERA. ECOWAS also adopts the master plans of WAPP and helps market creation by adopting policies and regulations on the national level. Although ECOWAS has the legal power to make binding decisions, it lacks the supranational power to enforce them. The following factors were important in the establishment and development of WAPP. The distribution of natural energy endowments in the region and having countries with limited sizes and resources created interdependence and a need for trade between countries, as occurred in SAPP. The presence of the ECOWAS Commission as a regional institution for promoting regional integration, foreign investments, and cooperation in the energy sector. WAPP approves IPPs and consumer representatives as official members. The general assembly is the highest decision-making authority and includes all members with equal voting rights. Hence, the governance model of WAPP is preferable as it is democratic and inclusive, which incentivizes agents to join the power pool. However, more than half of the votes belong to only two countries, Ghana and Nigeria (each with ten votes out of a total of 39 [WAPP, 2021]), making it possible for these two countries to block decisions if they nationally and jointly orchestrate.

3.2.3 Southern African Power Pool (SAPP)

The SAPP was created in August 1995 at the SADC summit held in Kempton Park, South Africa, when member governments of SADC (excluding Mauritius) signed an Inter-Governmental Memorandum of Understanding for the formation of an electricity power pool. Its member countries include Angola, Botswana, Democratic Republic of the Congo, Eswatini, Lesotho, Mozambique, Malawi, Namibia, South Africa, Tanzania, Zambia, and Zimbabwe. The Southern African Development Community (SADC), the REC of SAPP, is an intergovernmental institution and a secretariat for regional cooperation in specific sectors. It operates through regional protocols and agreements between member countries that are not binding. SAPP is an institute of SADC, but the latter does not interfere with its operation and gives it a degree of autonomy in deciding internal affairs. However, any change related to its policy or involving other external entities must go through the ministers of SADC. Historically, South Africa had leverage in the region due to its economy and military superiority [Vanheukelom, 2017]. Due to its interest in regional trade, it played an important role in pushing the power sector integration agenda in SADC. The following factors were important in the establishment and development of SAPP:

1. The establishment of the SADC.
2. The presence of sufficient regional infrastructure in the region (interconnections and generation).
3. The distribution of natural energy endowments in the region created interdependence and a need for trade between countries (thermal generation in South Africa and hydropower in the northern countries).
4. The presence of South Africa as a regional champion for pushing regional trade agendas in SADC.
5. The successful establishment of the coordination centre.
6. The technical support received from international institutions.

3.2.4 Central Africa Power Pool (CAPP)

The Pool Energetique De L'Afrique Centrale, also Central African Power Pool, is an association of ten Central African countries consisting of eleven (11) member countries of CAPP include Angola, Burundi, Cameroon, Congo, Gabon, Equatorial Guinea, Central African Republic (CAR), Democratic Republic of Congo (DRC), Rwanda, Sao Tome and Principe, and Chad.
The major aim of the association is to interconnect the electricity grids of the member countries in order to facilitate the trading of electric power between the members.

3.2.5 North African Power Pool (COMELEC)

COMELEC (Maghreb Electricity Committee) is a body created in June 1974, on the basis of a preliminary agreement between the General Directorates of STEG (Tunisia), SONELGAZ (Algeria) and ONE (Morocco) . Its extension to SONELEC (Mauritania) in 1975 and then to GECOL (Libya) in 1989 came after Mauritania joined the UMA (Arab Maghreb Union) and the extension of this body to Libya by virtue of the Treaty of Marrakech which enshrined the institutionalization of the AMU (Treaty of February 17, 1989). The permanent nature of COMELEC was enshrined by decision of the Ministers responsible for Energy of the AMU countries and of the Secretary General of this body, at the meeting of 13 and 14 February 1990 in Tunis. During this meeting, it was also decided to domicile the General Secretariat of COMELEC, under the aegis of the Minister in charge of energy of the host country, in this case the Algerian Minister in charge of Energy. COMELEC is interested in all questions relating to the electricity sector. Its concerns are those of companies responsible for the development of all electrical activities on a Maghreb scale. COMELEC's action is particularly aimed at the regular exchange of information between its members, the coordination of equipment and professional training resources, the monitoring of the interconnection of networks, the promotion of industrial integration of the Maghreb countries.

4. Challenges in integrating Africa's energy systems

Despite the opportunities and progress thus far, integrating Africa energy systems is not yet optimal because of several factors. They include market disparity, weak legal and institutional frameworks; regulatory, technical, network and interconnection deficiencies; overlapping functions and bureaucratic delays; insufficient capital and investments: and political risks and policy rehearsals. These factors are further discussed in the below sub-sections.

4.1 Market Disparity, weak regulatory and institutional frameworks

The creation of a regional market consisting of countries with varying and wide differences in the status of their national markets has been a major challenge in the setting up of an integrated Africa energy market. African countries in the southern, northern, western, central and eastern regions, range from very small countries with vertically integrated state-owned utilities (unbundled systems), partially unbundled systems, and fully unbundled and privatized systems. Whereas some of the power sectors in some African countries are fully unbundled and privatized, there are other countries that do not have any form of private sector participation. This disparity in the various national markets with regards to the reform and operations of the individual domestic markets similarly creates a mismatch of policies that lead to different reactions of the different participants to market stimuli within a broader integrated system. Furthermore, although the harmonisation of technical specifications (known as 'grid codes'), operating procedures and standards, and legal and regulatory frameworks are key requirements for safe and reliable operation of grids in integrated systems, most of the countries in the region do not have these grid codes yet. This challenge makes it difficult to harmonize standards for electricity trading under an integrated system framework. For integrated energy systems to work out, most countries will have to consider liberalization of the sector

Where state utility monopolies still exist, it can be difficult to set up a system of generation licenses for private sector participants. This makes liberalisation a prerequisite for creating a workable renewables market for C&I customers. Experience shows that once liberalisation commences, the high demand for renewable energy from industries such as mining creates strong incentives for government to continue the process, freeing the market to take off at speed, as happened in South Africa.

4.2 Insufficient capital and investments

CInvestments in generation and transmission infrastructure continue to be a challenge in all aspects of integrating energy systems in Africa. One of the biggest challenges in cross-border electricity pooling and trading in the region remain the inadequate mobilisation of affordable financing for inter-connection infrastructure projects, which are often perceived as a high-risk investment due to identified technical, commercial and collection losses. This is true for regional interconnections and internal lines as well as for the development of large-scale electricity projects. Even in already interconnected systems, congestion and disturbances remain obstacles to regional trade. Similarly, most countries have inadequate investments in generation capacity and suffer from unavailable capacity. All these impede the power pools from reaching the desired capacity of trade. It is also challenging to attract investments in the generation and transmission infrastructures due to both real and perceived risks. In Nigeria and other countries where the generation segment of the electricity value chain has been privatized, there has been a notable rise in the level of investment in electricity generation. However, this rise in investment in the generation sub-sector is often met with a corresponding lack of investment in transmission and distribution sub-sectors, which remains mainly controlled by the government in most countries. As a result, most integrated generation and transmission projects continue to rely on external and foreign investments to develop projects and run activities. Although this may be necessary in the short term to a certain degree, it is not sustainable in the long term, as excessive reliance on foreign investments could create a lack of local ownership.

4.3 Technical deficiencies

Inadequate transmission capacities and domestic infrastructure issues hinder the leveraging of opportunities in integrated energy systems and electricity trade among African countries. Across several African countries, it is observed that many countries encounter voltage problems on their grid. This observation is especially true in the north of the coastal countries like Ghana, Côte d'Ivoire, Togo, Benin. In these countries, most of the generation and large load centres are located along the coast while few generators exist inland to control the voltage profiles.

Furthermore, many countries currently experience load shedding due to insufficient generation capacities especially at peak demand times. Other causes of load shedding include problems such as the lack of reserves, frequency, and voltage deviations. The distribution grids of many African countries are also relatively old and need to be maintained. The development and maintenance of these distribution grids are of importance in order to reduce the high losses on the distribution network.

4.4 Network and interconnection deficiencies

The networking and interconnection of grids for integrated energy systems, electricity pooling and trading face many difficulties, including weakness of network codes, absence or weakness of the rotating reserve, and manual dispatching of electricity. These weaknesses result in frequent and long interruptions since the reenergization must be done manually in most cases. This factor also limits the possibility of integrating of intermittent renewables to the grid. Furthermore, many countries in the region lack the technical skills required to optimally and effectively dispatch electricity at the national level. These inefficiencies in dispatching as well as in the monitoring of national flow of electricity in dispatch centres hamper the process of gathering data and modelling electricity distribution for cross-border trading forecasting.

4.5 Stakeholder role management and bureaucratic delays

Integrating African energy systems involves several sectoral stakeholders in the different countries, which are often difficult to manage. The roles and responsibilities of various actors and stakeholders in the various regions are sometimes unclear and, in some cases, overlaps. Countries like Ghana, where 2 different regulators (PURC and Energy Commission) exist with similar roles and responsibilities in monitoring of contracts in the power pool, is an example of such complexities. Furthermore, in countries like Nigeria and Ghana where there are many actors and stakeholders involved in the electricity sector, there are often bureaucratic delays and difficulties in reaching agreements and financial close for the development of new integrated energy system projects and for cross-border electricity exchanges.

4.6 Political risks and policy rehearsals

Another challenge that has traditionally dogged investments in Africa (and other emerging markets) – and not just in renewable generation – is how investors and lenders seek to mitigate political and policy rehearsal risk. This will never be completely removed, since private Power Purchase Agreements (PPAs) and novel infrastructure projects is increasingly positioned to involve the private sector taking over and developing historically public asset and function. But, in addition to investment treaty protections that may be available for international private investors, these deals also seek to practically mitigate against political risk. One way to mitigate such risk is through the provision of a consistent and reliable electrical supply to a broad range of consumers, ultimately support further economic development and growth, not just for the private sector participants, but also for the local communities and host economies and governments.

5. Lessons from European Experiences

The integration of the EU electricity market over the last decade has brought enormous benefits for the EU, including lower wholesale prices, greater security of supply and enabling the large-scale integration of renewable energy. The EU chooses to assess its electricity market reform against its contribution to the following three key aims. It should support a transition to a decarbonized system at the lowest possible cost to our societies and ensure that security of supply is always safeguarded while transitioning to a highly efficient renewable based energy system. That will bring benefits to consumers, while at the same time protecting them against price peaks. This system enabled the EU to stand the severe challenges due to an extraordinary combination of three exceptional crises in 2022: The Russian energy war on Europe as well as the low availability of nuclear and hydropower generation. These have led to a period of reduced gas supply and subsequently very high electricity prices and exceptional fluctuations, which have set European households and companies under severe pressure and created distributive challenges. However, the internal market has proven to be resilient and able to ensure security of supply across Europe, through an efficient allocation of demand and supply, and by fully leveraging the benefits of interconnection, cross-border trade and European solidarity even in times of crisis.

Changes to the EU electricity market design has been guided by the following key principles:

5.1 Retaining the benefits of European electricity market integration.

By continuing to integrate EU electricity markets, through interconnection capacity, free formation of wholesale electricity prices and removing barriers to integration, the EU safeguards the benefits of electricity market integration for all Member States. This includes ensuring that the electricity generation units with the lowest costs available in Europe can be used to cover the specific demand, ensuring that electricity flows to where prices are highest, and ensuring security of supply. In this respect it is important to recall that the current EU market design, according to ACER estimates, has yielded a yearly EUR 34 bn in benefits over the last decade compared to a situation with no cross-border flows.

5.2 Safeguarding and improving incentives to invest in the green transition.

To achieve climate targets, the EU needs EUR 487 bn investments in renewables annually from 2021-2030 according to REPowerEU estimates. And similar investments are needed to ensure that the roll out of renewables towards 2050. To realize those investments, the EU aims to further work on obtaining a reliable, predictable and robust market framework that ensures investors' confidence, and which addresses both renewable and secure capacity. Geopolitical challenges have made the relevance of a competitive investment environment in the EU even clearer. Therefore, the EU are also skeptical about making general revenue limitations as introduced by the temporary emergency framework a permanent function of the regular market as that could compromise investors' confidence in the needed investments.

5.3 Ensuring efficiency of short-term markets and optimizing functioning of forward-markets.

Efficient short-term markets based on marginal pricing provide a solid foundation to achieve efficient prices that provide adequate dispatch and investment incentives for a decarbonized power sector in the EU. Inframarginal rents in normal times provide important incentives to invest in cost-efficient technologies and, therefore, contribute to minimum system costs of power generation. These short-term market signals are complemented by well-functioning forward markets that incentivize investments in renewables, but also let consumers profit sooner from the low renewable energy prices. A reform of the market design should support liquidity in forward markets. A thorough analysis of existing barriers to forward market participation and complementary financial instruments, such as financial PPAs, are carried out and promoted.

5.4 Maintaining market incentives and a level playing field.

To pass on low costs of power generation from renewable energy sources to consumers, the relevance of market-based power purchase agreements in the EU has been increasingly strengthened, barriers to PPAs has increasingly been removed and explorations on how the uptake of PPAs can be incentivized has been done. Depending on national circumstances private and government backed Contracts for Difference (CfD's) play a role in long-term markets if they benefit the renewable energy transition. For the EU case, it has been, however, important that the CfD's it is important that they keep the market functioning, do not impair the much-needed investor's confidence, and that they are designed so that reactions to current market circumstances are retained. However, the EU have concerns applying them to dispatchable generation because producer incentives to optimise CfD revenue could then counteract system needs. Therefore, CfD's is designed to be voluntary, imposed retroactively, focus on new renewable investments, and that prices be determined via competitive auctions or tenders in accordance with State aid guidelines, and not on regulated prices or cost-plus approaches. CfDs are also cleverly designed so that reactions to current market circumstances are retained. In this context, the EU is also exploring options to improve conditions for industry to access electricity at a competitive price.

5.5 Strengthening protection of consumers and empowering them to participate in and reap the benefits of the energy transition.

The current crisis in the EU has shown that certain consumer groups such as private households deserve better protection against unexpected electricity bill increases. This is achieved by limiting the exposure of consumers to potential shocks, on especially the wholesale market, e.g. by limiting the amount of risk in portfolios of suppliers and improving hedging opportunities for them. At the same time, the financial burden imposed on suppliers is balanced, the concentration of market power is avoided, and competitive pricing are ensured. For consumers it is possible to choose the level of exposure to short-term market volatility that suits their preferences. Therefore, both variable (or even dynamic) price contracts and fixed price contracts are available. The EU also works to strengthen consumer protection in cases of insolvency of electricity suppliers and against unfair practices. Additionally, the EU looks at those solutions which enable consumers to be protected against unexpected electricity bill increases, whilst at the same time enable and incentivize them to contribute to the green transition. Finally, the EU also reduce barriers for the entry of new market participants, such as prosumers and energy communities, facilitate the sharing of energy and better exploit system services from distributed small-scale installation, thereby contributing to reducing consumers' energy bills as well as grid/system operation.

5.6 Improving resilience to external shocks.

The EU works in the reality that external shocks causing high or low prices may occur again in the future. As such, the electricity market is better prepared for such external shocks. This better protects consumers, creates trust in the market and supports a stable investment environment. This includes improved financial instruments and forward markets to better handle risk exposure and increased focus on market integration. Also, the relevance of market-based power Purchasing Agreements (PPAs) are increasingly strengthened in the region.

5.7 Every EU market reform makes the market fitter for renewable energy and ensures effective price signals for flexibility to develop.

As the EU continues to integrate more renewable energy in the regional power system, flexibility sources such as energy storage and demand side response are increasingly important to maintain security of supply. For these sources of flexibility to develop in sufficient amounts, the electricity market is designed to efficient price signals that reflect the fluctuating demand for flexibility. The EU also makes better use of demand response in the intraday and day-ahead markets, as this is underutilized in its current market design.

5.8 Ensuring effective cross border trade as one important element for security of supply.

An open and competitive EU-internal energy market is an important element to ensure security of supply, especially by cross-border trade and cross-border physical flows at all times and under all circumstances as far as technically feasible. Efforts are therefore continued in the direction of building upon the solid foundations of short-term markets in the EU. With those principles in mind, the EU aims to continue discussions on how to improve the functioning of the EU's electricity market design in a targeted approach to ensure an efficient, well interconnected and integrated internal electricity market for the future. Reforms going beyond targeted adjustments to the existing framework are underpinned by an in-depth impact assessment and should not be adopted in crisis mode.

From the above, Africa integrated systems efforts can learn several lessons from Europe's energy integration experiences:

1. Political will and leadership: Strong political commitment and leadership are crucial for successful energy integration. Europe's integration was driven by political will, which helped overcome various challenges.
2. Public support: Engaging and bringing the public along is essential. Europe's integration efforts were supported by public understanding and desire for regional cooperation.
3. Tailored policy instruments: Policies should be tailored to the specific conditions of the market, supply, and demand volumes. Europe's success in renewable energy was partly due to customized policy instruments.
4. Institutional frameworks: Establishing institutions focused on renewable

energy development can drive progress. Europe's regional institutions played a key role in its energy transition.

5. Private sector participation: Encouraging private sector participation is vital for attracting investments and fostering innovation. Europe's energy sector benefited from strong private sector involvement

6. Conclusion, policy recommendations, and way forward

Several countries and regions in Africa have recognized the benefits of integrated energy systems and have taken steps in that direction, by developing large-scale renewable energy projects and attempting to form an integrated continental grid. Notable examples include the Grand Inga Dam project and the Africa regional power pools. Despite these positive efforts, the potential of these integrating projects and initiative have yet to bear maximum fruit. It is therefore unsurprising that electricity access in SSA continues to lag behind other geographies. Given the fundamental importance of reliable power to many other development outcomes – from economic growth and job creation to health and education – the power agenda has steadily crept to the forefront of national priorities in many countries.

Bringing the integrated Africa energy systems intentions into reality requires concerted efforts from member states, regional institutions, and relevant stakeholders. Member states must demonstrate strong political commitment to the objectives. This includes prioritizing regional power sector cooperation, supporting infrastructure development, and allocating necessary resources for implementation. There has to be an established and robust institutional framework to govern and coordinate activities in the integrated systems. This entails creating a central body with the authority to oversee project implementation, facilitate regional power trade, and harmonize technical and regulatory standards. Harmonizing policies, regulations, and technical standards across member states for creating an enabling environment for regional power trade will involve aligning licensing procedures, tariff structures, grid codes, and safety standards. Promoting knowledge sharing and learning should be promoted among member states by organizing workshops, conferences, and study visits. Facilitating the exchange of best practices, experiences, and lessons learned in power sector development and regional integration is also important in this context. It is also beneficial to collaborate with member countries and other regional institutions to develop capacity-building programs and technical assistance initiatives.

These programs can enhance the technical skills of energy professionals, strengthen regulatory frameworks, and promote knowledge sharing on renewable energy technologies and best practices. Establishing robust monitoring and evaluation mechanisms to track the progress of initiatives, measure the impact of regional integration efforts, and identify areas for improvement is important for the sustainability of an integrated Africa energy system. Regular assessment and reporting ensure transparency and accountability.

Further, there should be concerted efforts by member states to mobilize financial resources from national public funds, regional institutions, and external sources to fund regional power projects. This includes attracting private sector investments through supportive policies and regulations. It is also important to explore financing mechanisms and options for renewable energy projects within an integrated Africa system framework. This may involve accessing international climate funds, development finance institutions, private sector investments, and public-private partnerships. Work closely with financial institutions to structure suitable financing mechanisms that attract investment in renewable energy projects. Planning and financial structuring of such projects requires clear identification of renewable energy potential and their viability by conducting comprehensive assessment studies, feasibility studies, resource assessments, and financial analyses to develop bankable projects This could include plans for utility-scale renewable power plants, distributed generation systems, mini-grids, and energy storage projects. Integrating renewable energy resources into the regional power system can be achieved by adopting supportive policies, incentives for renewable energy investments, and establishing a framework for renewable energy trade.

Furthermore, managing an efficient integrated Africa system will require fostering collaboration and engagement with various stakeholders, including power companies, regulatory agencies, civil society organisations, and the private sector, and encourage their active participation and involvement in the decision-making processes. Collaborations and engagment should also be extended to other relevant stakeholders, including broader government agencies and international development organizations in order to foster partnerships and engage in dialogue to understand the priorities, challenges, and opportunities for integrating energy systems specific African contexts. These collaborations will further feed into better and more effective policies and regulatory framework relating to regional energy generation, particularly large-scale renewable energies. It will also help identify any barriers or gaps that need to be addressed to promote large-scale cross-border energy development.

Transmission planning is also essential in integrating Africa energy systems, since adequate transmission capacity is necessary to allow cross-border trade and regional generation plants. The bulk power system continues to supply most of the energy being distributed, so distribution planning must also continue to be coordinated with transmission and large generation planning, and even with regional or multinational power sector planning. However, no existing models are capable of addressing the distribution and bulk power system segments together in sufficient detail. Coordinating the distribution power supply needs with investments in transmission and large generation infrastructure requires an iterative, procedural approach. Efforts are underway to strengthen and modernize grid infrastructure to improve energy security and reduce the risk of blackouts. Regional power pools, such as the Southern African Power Pool (SAPP) and the West African Power Pool (WAPP), are working to enhance cross-border electricity trade and improve regional energy security.

To harness the opportunities offered by regional power integration, the governance of power pools must be reinforced, notably by empowering:

1) the regional regulator to establish regional market rules and enforce regional transmission planning
2) the regional system operator to dispatch generation efficiently, keep security at regional level, and make transmission plans
3) Pan-African institutions to develop a common approach on transmission planning between regions.

Power pools design must make use of best international practice in several respects:

i) in dealing with physical bilateral contracts;
ii) in allocating the cost of regional transmission network investments;
iii) in providing regional security of supply; and
iv) in providing capacity building at all levels, from technical to political and managerial.

In addition, the chief obstacles to successful implementation of multi-national power pools must be addressed, especially countries' reluctance to trust their neighbouring countries to honour supply commitments, and countries' fears of losing sovereignty over their electricity supply.

For the AfCFTA agreement to be successful, and for the successful development of the power pools in particular, African leaders must play their part, keeping the bigger picture in mind. Long-term economic growth and Africa's betterment must be prioritised above short-run political agendas. Capacity building, opinion-shaping and political nudging can go a great distance to overcome this low-hanging fruit barrier at minimum cost. The European Union's rich experience in garnering the political will for regional integration, as well as in developing the guiding market frameworks and infrastructure, can provide valuable experiences to inform African regions' steps towards integration.

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About IAP

Integrated Africa Power (IAP) is a multi-unit enterprise specialized in energy and infrastructure development on the African continent. We seek to solve Africa's energy deficits, through integrated systems solutions, resource pooling and cross-border cooperation. Our approach is based on our philosophies of tailored suitability, cost-effectiveness, sustainability and energy-development linkages.

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