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Challenges and Drivers of Green Vocational Education and Training in Africa's Solar Sector

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1. Introduction

Energy and electricity access are a priority for Africa. At present, 43% of its population (amounting to about 600 million people) have no access to electricity, most of them in sub-Sahara Africa (1). Africa owns 40% of the global potential for solar power. In 2022, Africa produced a total 12,641MW of electricity from solar energy amounting to 1.2% of the global production of solar electricity. Within the same year, 11,516MW of the solar electricity produced in Africa was from solar photovoltaic (PV) cells (2). These points to the essential role of solar photovoltaic systems in addressing Africa's energy crises and the need to develop associated technical skills to address the growing need for decentralized electricity. The adoption of Green Vocational Education and Training (VET) programmes in solar energy across Africa plays a pivotal role in addressing the continent's energy needs while promoting sustainability and economic growth. This factsheet aims to provide a brief overview of the current status, key drivers, challenges, regional differences, and best practices for Green VET programmes in solar energy in Africa.

2. Key drivers of Green VET trainings in solar energy

There are key initiatives driving increased demand for skills in the solar sector in Africa. Some of them include:

a. **Africa 2063 agenda:** Africa 2063 agenda revolves around four main themes of: economic development; political integration; improvements in democracy and justice; and establishment of security and peace on the entire African continent. It aims to birth the ideals of African growth underpinned by science, technology, and a hub for opportunities, and the requisition of the African Renaissance (3). At the heart of the Africa 2063 agenda is promoting the energy transition in Africa. This would require building a skill-base to support this transition.

b. **Solar energy potential:** Africa is home to 60% of the best solar resources globally (1). It boasts of abundant solar resources, making solar energy a workable and sustainable solution for meeting the continent's energy needs. Green VET programmes capitalise on this potential by preparing a skilled workforce to harness solar energy efficiently.

c. **Job creation and economic development:** Investing in Green VET programmes creates employment opportunities and stimulates economic growth. Solar energy projects require skilled technicians, engineers, and installers, driving the demand for trained professionals in the renewable energy sector. In Africa, between 8 million and 14 million energy transition jobs could be created through to 2030, driven primarily by government spending and investment in energy transition technologies (4).

d. **Climate Change Mitigation:** Solar energy contributes to reducing greenhouse gas emissions and mitigating climate change impacts. Green VET programmes focus on building a workforce equipped with the knowledge and skills to deploy solar technologies effectively, thereby supporting Africa's commitment to climate action.

e. International support and partnerships: Various international organisations, governments, and NGOs recognize the importance of promoting renewable energy education and training in Africa. The African Development Bank, through an initiative organized at the COP27, were able to attract the sum of $35 million to the Sustainable Energy Fund for Africa to catalyse private sector investments in renewable energy in Africa (5). Power Africa have also established relationship with key stakeholders and development partners in Africa's energy sector (including technical agencies, development finance, governments and multilateral organizations) to address its energy needs (6).

3. Key challenges

Some key challenges impacting the development of solar training in Africa include:

a. Skills shortage and poor training quality: There is a gap between the skills acquired through traditional education systems and the needs of the renewable energy industry. Green VET programmes must align their curricula with industry requirements and ensure the quality and relevance of training to produce competent professionals. Africa currently lacks over 4.3 million engineers and technicians to aid its development agenda (7).

b. Inconsistencies in regulatory and policy frameworks: Inconsistent regulatory frameworks and policy environments across African countries create uncertainty for investors and educators in the renewable energy sector. Harmonising policies, streamlining regulations, and providing incentives can foster a conducive environment for Green VET programmes.

c. Access to funding and financing: Sustainable funding mechanisms are essential for the sustainability and scalability of Green VET programmes. Securing adequate funding for infrastructure development, curriculum development, faculty training, and student scholarships remains a significant challenge.

d. Poor awareness and perception of solar energy: Limited awareness about the benefits of solar energy and misconceptions about renewable energy careers hinder the uptake of Green VET programmes. For example, there are narratives that solar energy cannot power commercial and industrial facilities. There are also ideas that certain solar installations are for the rich due to its high initial installation cost Addressing misconceptions and raising awareness about the opportunities in the solar energy sector is essential to attract more students to these programmes.

e. Limited training infrastructure and resources: Many African countries face infrastructure gaps and resource constraints, hindering the establishment and expansion of Green VET programmes in solar energy. Insufficient funding, inadequate training facilities, and a lack of modern equipment pose significant challenges.

4. Key regional differences

There are key regional peculiarities within the African continent that affects demand and the eventual supply of skilled manpower within Africa's solar energy sector. Some key regional differences impacting the different sub-regions of Africa are highlighted below.

a. North Africa: Countries like Egypt and Morocco have made significant progress in renewable energy addition to their energy mix. Between 2015 and 2019, Egypt added 25.5GW of new electricity generation capacity, which also includes 1GW of solar PV and 840MW of wind capacity. This took Egypt out of energy shortage to having a 25% energy surplus (8). Mega-projects like Egypt's Benban and Morocco's Noor are poised to address the regions energy and export needs, thus showcasing the immense potential of the region's solar resources.

b. East Africa: About 140 million people in East Africa lack access to electricity. In 2021, Kenya and Ethiopia accounted for 30% of global solar home systems and solar appliance sales (9). Recognizing the immense potential of solar energy for development, East Africa is witnessing significant progress. Initiatives like the East African Renewable Energy Training Centre (EARETC) are fostering education and training in the region.

c. West Africa: Mirroring North Africa's sunny disposition, West Africa prioritizes solar power due to its abundant sunshine and rising energy demand due to its high population. Regional collaboration through ECOWAS tackles shared challenges, paving the way for a sustainable energy future. Leading countries like Nigeria and Ghana showcase the region's potential, inspiring a collective journey towards a brighter, solar-powered future.

d. Central Africa: While boasting rich renewable energy resources, Central Africa faces infrastructure limitations. Building capacity and securing funding access are crucial for the region's progress. In Central Africa, over 109 million people in central Africa lack access to electricity (10). This will necessitate increased need for more off-grid solar solutions and more skilled manpower in the solar industry.

5. Best practices to enable skills scale-up

Best practices in solar training in Africa can be better understood through three main dimensions.

- Solar trainings offered by universities and research institutes.
- Solar trainings offered by TVET institutions.
- Solar trainings offered by non-formal training academies.

5.1. Solar trainings offered by universities and research institutes

In Southern Africa, South Africa leads with a robust presence in vocational solar training, where about 50% of its 26 institutions offer solar programmes at both undergraduate and postgraduate levels. Institutions like Nelson Mandela University, University of Johannesburg, and University of Cape Town provide specialized courses in photovoltaic engineering, energy storage, and techno-economic modelling. These trainings typically last between one to two years. Furthermore, the University of Cape Town's Energy Research Centre (ERC), funded by the African Climate & Development Initiative, carries out research and short course trainings to help enhance skills via a multi-disciplinary approach. However, the need for more advanced research facilities often drives students abroad for further studies.

Northern Africa, particularly Egypt, boasts of a strong TVET solar training sector. Graduate programs, spanning one to three years, covering topics like solar cell materials and energy storage. Cairo University and the German University in Cairo collaborate with German institutions to offer a dual-degree Master's in Renewable Energy and Energy Efficiency.

In West Africa, Nigeria and Ghana are at the forefront of solar training. Nigerian institutions like the University of Nigeria, Nsukka, and Usman Danfodiyo University offer advanced degrees in renewable energy, focusing on solar power generation. Ghana's Kwame Nkrumah University of Science and Technology (KNUST) and Ghana Technology University College are key players. The KNUST's MSc programme in Renewable Energy Technologies is a notable example. Both countries offer programs ranging from 18 to 24 months, with KNUST also providing short courses through its Brew-Hammond Energy Centre.

In East Africa, Kenya and Uganda are leading the way in solar training. Kenya's Kenyatta University and Moi University, in partnership with Kibabii University, offer postgraduate programs in sustainable energy, supported by international partnerships and lasting up to three years. Uganda's Uganda Martyrs University and Uganda Christian University (UCU) are also advancing in this field, with UCU launching a postgraduate diploma in Sustainable Business and Renewable Energy, supported by the EU's DALILA project. Makerere University's Centre for Research in Energy and Energy Conservation (CREEC) in Kampala further contributes through research and solar training workshops.

Overall, Africa's solar education landscape is thriving, with institutions across the continent increasingly offering specialized programs and training to meet the growing demand for renewable energy expertise.

5.2. Solar trainings offered by TVET institutions

There has been significant progress in Africa's TVET landscape in solar training with significant focus on enhancing the skills of technicians across the continent. In North Africa, Tunisia leads with numerous vocational institutions. The Sfax Vocational Training Centre, managed by the Tunisian Agency for Vocational Training, now features a solar photovoltaic training lab funded by the Turkish Cooperation and Coordination Agency (TIKA). Egypt's Don Bosco Technical Institute offers renewable energy training, with courses certified by both the Italian Embassy and the Egyptian Ministry of Foreign Affairs.

In East Africa, Kenya's solar PV regulations require compliance across the solar industry. Nairobi Technical Institute, in collaboration with the Kenya Renewable Energy Association (KEREA), offers Class T1 and T2 licenses for solar PV installation, with courses lasting from 3 weeks to 6 months. Uganda's Nakawa Vocational Training Institute, in partnership with the German Agency for International Cooperation (GIZ), provides solar PV short courses and electrician courses, spanning 6 to 8 months.

South Africa's Nkangala Technical Vocational Education and Training (TVET) College offers solar-specific courses with six-month internships through partnerships with companies like Enel Green Power South Africa. False Bay College also offers advanced solar technician training, including diploma programmes.

In West Africa, Nigeria's TVET sector integrates solar energy training into broader programmes. The Institute for Industrial Technology and John Bosco Institute of Technology (JOBITECH) include renewable systems in their curricula. Specialized solar training is offered by institutions like Asteven Academy, Renewable Energy Technology Training Institute (RETTI), and Wavetra Energy Academy. In Ghana, institutions like Accra Technical Training Centre (ATTC) and Koforidua Technical University provide comprehensive solar training, while programmes like Green People's Energy for Africa, organized by the German Agency for International Cooperation (GIZ), further support this initiative.

5.3. Solar trainings offered by non-formal training academies

South Africa boasts of numerous non-formal training academies due to its thriving solar industry, offering short courses to quickly upskill the labour force in the solar sector. Notable institutions include the Green Building Council for South Africa, Terrafirma Academy, South African Energy Efficiency Confederation (SAEEC), Ashrae, and Green Solar Academy. These courses, ranging from 1 week to 3 months, focus on practical, hands-on training in solar PV technology, system design, and installation, although they are outside the formal educational framework.

In Northern Africa, the Global Horizon Center in Sharm El-Sheikh offers two-week non-formal solar training courses. Additionally, Infinity's Women in Renewable Energy (I-WIRE) Committee provides vocational training programmes to increase female participation in renewable energy, particularly in rural areas.

West Africa's approach differs, with Ghana emphasizing collaboration with TVET institutions and government plans to certify artisans and technicians, reducing industry-driven training needs. Conversely, in Nigeria, companies like Gennex Academy, Green Academy Africa, Ecowatt Nigeria, and Rubitec Academy offer short courses, ranging from 1 week to 6 months, for recruitment and corporate social responsibility purposes.

In Eastern Africa, the Toolkit Hub in Kikuyu, Kenya, partners with over 50 TVET centres to provide short, dedicated solar PV courses. Initiatives like those at Sigalaga National Polytechnic (SNP) in Kakamega, Kenya, in partnership with Strathmore University, focus on equipping trainers with the skills needed to teach solar PV system design, installation, and maintenance.

6. Conclusions and key takeaways

The following are key takeaways from the evaluation of the solar TVET landscape in Africa:

- 43% of Africa's population (amounting to about 600 million people) have no access to electricity, most of them in sub-Sahara Africa.
- Africa owns 40% of the global potential for solar power.
- Africa produced a total 12,641MW of electricity in 2022 from solar energy amounting to 1.2% of the global production of solar electricity.
- 11,516MW of the solar electricity produced in 2022 in Africa was from solar photovoltaic (PV) cells.
- Africa 2062 agenda, huge solar energy potential, job creation and economic development are the key drivers of increased demand for solar trainings in Africa.
- In Africa, between 8 million and 14 million energy transition jobs could be created through to 2030, driven primarily by government spending and investment in energy transition technologies.
- Regional differences and sub-continental energy priorities within the African continent plays a major role in solar systems deployment and the corresponding sector skills needs.