

What drives Green Technical Vocational Education and Training in Nigeria's Solar Sector?

Norbert Edomah

School of Science and Technology, Pan-Atlantic University, Lagos Nigeria
Email: nedomah@pau.edu.ng

1. Introduction

Nigeria is the most populous country and the largest economy in Africa. With a population of over 200 million people and an installed electricity generation capacity of about 15,000MW [1, 2], there exists a clear energy deficit that needs to be addressed to unlock greater economic potential and job opportunities particularly for the youth, with positive effect on the climate [3–5]. Only about 60% of Nigeria's population has access to electricity, meaning there are over 85 million Nigerians who do not have that access [6, 7]. Nigeria has tried to address this challenge through the promotion of renewable energy development projects, particularly solar energy.

Indeed, the growing emphasis on solar energy deployment to address the dire energy needs also provokes a growing concern and emphasis on renewable energy education and training, particularly in the fields of solar energy [8–11]. Understanding the regulatory and governance frameworks [12, 13], challenges in greening solar Technical Vocational Education and Training (TVET) [14], and some best practices in solar technical education delivery is paramount in ensuring a steady stream of skilled manpower preparation for the sector. In this factsheet, we present some of these salient issues that can serve as a basis for addressing the identified challenges.

2. TVET in the Nigerian educational system

TVET forms part of the formal education system in Nigeria and it is clearly incorporated into the three tiers of education system (primary, secondary and tertiary). In Nigeria, education is compulsory up to lower secondary level. Afterwards, there are two possible pathways that can be followed; either one proceeds to the upper secondary level or to an equivalent TVET institution that offers the National Technical Certificate in a chosen discipline. While the universities offer the pathway for further general education leading to the award of a bachelor's degree, monotechnics, Innovative Enterprise Institutions (IEIs) and polytechnics offer a TVET pathway that leads to the progressive award of National Diploma, National Innovative Diploma and Higher National Diploma. Figure 1 provides a snapshot of the available pathways in the Nigerian educational system and where TVET lies within the system.

Within the Nigerian educational system, there are no clearly defined qualifications on solar energy. Most solar energy courses are embedded as modules within a broader renewable energy programme. At the TVET level, there is no clearly defined programme that is focused exclusively on solar technologies. At university level, the Nigerian Universities Commission (NUC) recently released the Core Curriculum Minimum Academic Standard (CCMAS) in 2023 that now includes a compulsory course on Renewable Energy Systems and Technologies for all engineering disciplines. Within that course, solar technology is only treated as a module among other technologies. The same pattern also exists for postgraduate programmes in renewable energy.

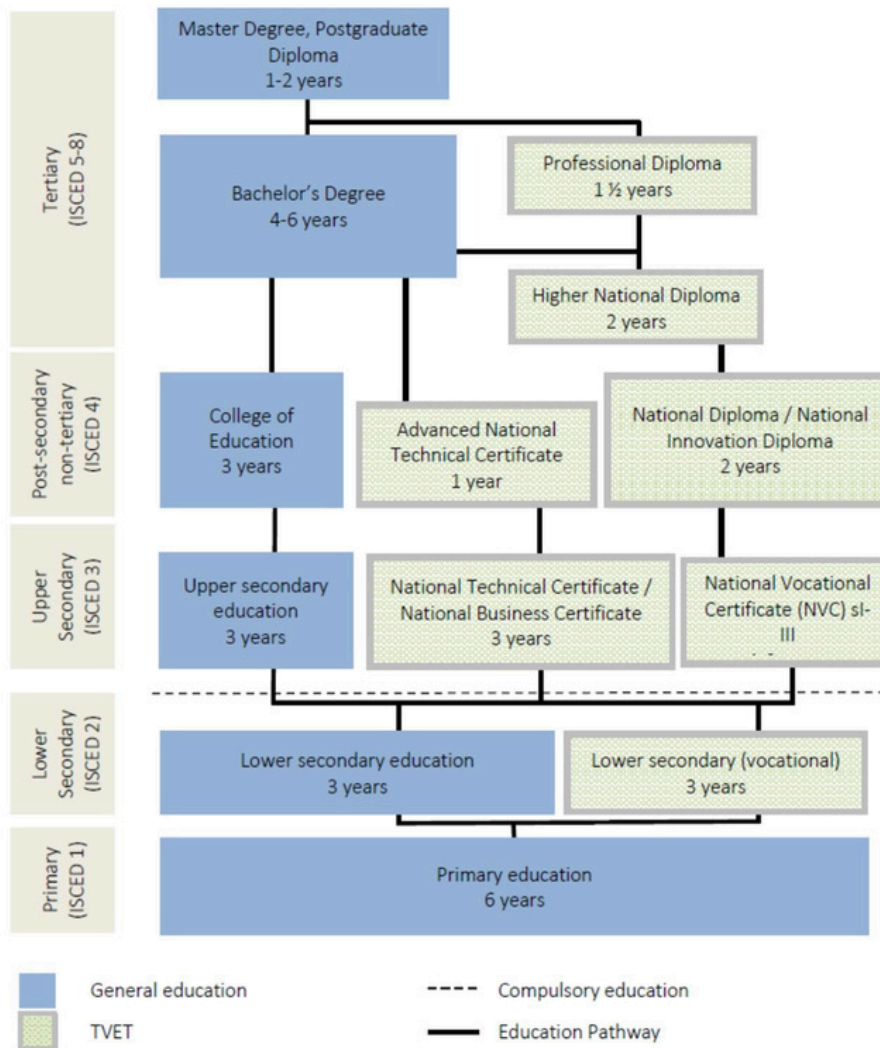


Figure 1: TVET in the Nigerian education system (Source [15])

3. Governance frameworks driving TVET training in Nigeria

Three agencies of the Nigerian government have played vital roles in the development of Technical Vocational Education and Training (TVET) and related policies. These are: the **Federal Ministry of Education**, the **Federal Ministry of Science and Technology** and the **Federal Ministry of Labour and Productivity**. The governance system for TVET in Nigeria follows a decentralized structure with different actors playing different roles. However, there are two important actors involved in the governance of TVET in Nigeria:

- a. **National Board for Technical Education (NBTE)**, responsible for supervision and regulation of TVET institutions in Nigeria, as well as providing the minimum guidelines for the curricula for different TVET programmes in the country. The NBTE was established in 1977 with the aim to develop critical manpower base to execute the National Development Plans initiated in the 1970s. NBTE regulates activities of Monotechnics, Polytechnics, Colleges of Education and Innovative Enterprise Institutions (IEIs). There are a few Innovative Enterprise Institutions approved by the NBTE that have National Innovative Diploma programmes in Renewable energy with an extensive focus on solar technologies. An example is the Asteven Energy Institute that offers diploma in solar technology.
- b. **National Business and Technical Examinations Board (NABTEB)**, an examination board that issues and validates certificates, and conducts examinations in the technical and business disciplines.

There is currently no defined examination and certification on solar systems installation and maintenance from the NABTEB.

NABTEB offers a Modular Trade Certificate in solar systems installation for short flexible programmes (ranging from a few weeks to months). This is a stand-alone certificate that is awarded to successful candidates that have passed a written and practical assessment offered by NABTEB. However, many informal training providers in solar technology are not aware of the possibility of a national certification in solar technology offered by NABTEB.

While the aforementioned institutions play critical roles in fulfilling their mandate, there are salient challenges that are confronted by the different stakeholders they regulate:

- **Pre-defined curricula that gives very little or no room for innovation in curriculum assessment and delivery.** The NBTE have provided a minimum benchmark document that defines the courses and modules within each programme. Even though this is defined as a minimum benchmark, it has become overly prescriptive over time, such that additional course modules (aimed at addressing industry needs) become burdensome to the students of the programmes. This also affects the quality of solar training delivery.
- **Rigid curriculum structure that does not address industry needs.** The existence of a minimum benchmark document that defines the curriculum at every point for every programme makes it excessively rigid. To respond to industry needs, some TVET institutions (by choice) decided to add some training courses/modules to their existing programmes as a way to address industry needs. The Don Bosco Institute of Technology and the Institute for Industrial Technology are examples of technical institutions that have incorporated solar systems training into their existing electrical installations curriculum.
- **Exclusive focus on technical skills with little emphasis on digital, entrepreneurial and soft skills.** Indeed, there is a claim that entrepreneurial skills have been added to many programmes. However, they are mostly taught as theoretical courses with very little practical appreciation. There is an urgent need to incorporate entrepreneurial skills in solar training delivery.

Some relevant policies and governance frameworks aimed at developing the TVET landscape in Nigeria include:

- The development of the **Nigerian Skills Qualification Framework (NSQF)**, which is a system for the development, classification and recognition of skills, knowledge, understanding and competencies acquired by individuals, irrespective of where and how the training or skill was acquired. This framework recognizes the skills acquired by individuals either through a formal means in classroom, on-the-job or informally [16]. With this new framework, solar trainings offered in non-formal and informal settings can be formalized through the modular assessment and certification system offered by NABTEB.
- Introduction of **digital literacy competency** for TVET teachers aimed at providing practical applications of digital tools and strategies to enhance teaching and learning in vocational education. This also includes the development of online tools and e-learning pathways for TVET training. Digital competencies provides additional opportunities for online and hybrid solar skills training for teachers and students.

4. Key drivers and barriers impacting solar systems adoption and use in Nigeria

The key barriers and drivers of solar trainings in Nigeria are summarized in table 1.

Table 1: drivers and barriers impacting solar systems adoption and use in Nigeria

s/n	Drivers/barriers	Description
1	Addressing the energy access challenge	<ul style="list-style-type: none"> • There is a huge energy need in Nigeria necessitating alternatives in electricity generation which includes solar technology. • Solar PV technology is viewed primarily as a way to address energy access and not just as a means to address the energy transition challenge. • Only 60.2% of Nigerian having access to electricity, meaning there are still over 85 million Nigerian without electricity access [17]. • These challenges points to the need for increased skilled manpower in the solar sector for provision and maintenance of solar electricity infrastructure.
2	Governance challenges	<ul style="list-style-type: none"> • Lack of long-term vision for the solar industry pose a challenge to achieving the full industry potential • Different stakeholders in the industry are working in silos which create a challenge around addressing the specific interests of diverse stakeholders regarding manpower needs in the solar sector.
3	Financial constraints	<ul style="list-style-type: none"> • Financial constraints are limiting solar systems adoption. • Limited funding available to support teacher training and manpower development in the solar sector.
4	Solar skills and training deficit	<ul style="list-style-type: none"> • Solar training is viewed as a way of addressing the existing multi-dimensional poverty in Nigeria.
5	Insufficient technical knowledge	<ul style="list-style-type: none"> • There is a lack of knowledge on how to integrate solar infrastructure to existing systems in an economic way. This is primarily due to a lack of knowledge which (unfortunately) is contributing to the bad image of solar as an unreliable energy infrastructure. • Safety trainings must be incorporated into solar training to reduce installation and maintenance safety risks. • Skills and competencies of trainers must be enhanced for greater impact
6	Lack of defined technical standards	<ul style="list-style-type: none"> • Lack of defined design, installation and operational standards pose a challenge in the Nigerian solar market. • There is a need for enhanced and good maintenance culture to ensure optimal efficiency of solar installations
7	Market risks	<ul style="list-style-type: none"> • There is a need for users and installers to be more risk aware. Security of the physical solar infrastructure is important to avoid the case of infrastructure sabotage. • There is less supply of labour than the actual demand in the solar market
8	Behavioural challenges	<ul style="list-style-type: none"> • There is a need for behavioural change since solar pays in the long run. • There is a need for a change of commercial strategy for those involved in the solar value-chain to help users see the benefits both now and in the future.

5. Key challenges and best practices in greening TVET training in Nigeria's solar sector

Best practices in solar training in Nigeria 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

Several universities in Nigeria have introduced **specialized postgraduate programs** to equip students with the skills needed for the national energy transition. Examples of these universities include the University of Nigeria, Nsukka, which offers advanced degrees in Renewable Energy Systems through its Renewable and Alternative Energy Research Group, focusing on solar drying, heating, and power generation. Other examples include the Obafemi Awolowo University and the Usman Danfodiyo University in Sokoto offering masters in Energy Systems and Renewable Energy Program. The Federal University of Technology Akure, Bayero University Kano, the University of Ibadan, and the University of Port Harcourt, have also embraced renewable energy studies. These programs, typically lasting 18 to 24 months, require candidates to have a Bachelor's degree in Engineering or Physical Sciences. The curriculum covers essential topics such as Renewable Energy Studies and Environmental Sustainability, preparing students to contribute to Nigeria's sustainable energy goals.

In Nigeria, only a few universities run **short courses** in solar systems installation and maintenance. Some of them include the School of Science and Technology of the Pan-Atlantic University, and the Open and Distance Learning and Research Centre of the Lagos State University. These programmes, ranging from one to four weeks, provide practical skills for professionals and individuals seeking hands-on experience in solar energy without committing to full-time studies. These educational initiatives underscore Nigeria's commitment to advancing renewable energy, making it more accessible and practical for a broader audience.

5.2. Solar trainings offered by TVET institutions

The TVET sector in Nigeria is characterized by institutions that offer both diploma certificates and Certificates of Proficiency. These institutions prioritize practical skills over theoretical knowledge, with program durations ranging from 3 to 24 months. Within this framework, some institutions have incorporated solar energy training into their existing curriculum. For example, the Institute for Industrial Technology offers robust programmes in Electromechanics and Electrotechnics, with solar renewable systems as one of the modules offered in both programmes. Similarly, the John Bosco Institute of Technology (JOBITECH), have included solar systems training as a module in the 3-year electrical installation programme.

Indeed, there are also institutions that provide specialized solar training programs as standalone courses, with durations ranging from 1 week to 3 months. Notable examples include the Asteven Academy, Renewable Energy Technology Training Institute (RETTI), Wavetra Energy Academy, and Green Academy Africa. These programs focus on equipping individuals with the specific skills needed for careers in the solar energy industry.

5.3. Solar trainings offered by non-formal training academies.

Several companies in Nigeria are actively involved in providing solar training programs to enhance the skills of the labour force in the solar energy sector. These programs, which serve both recruitment needs and corporate social responsibility drive, range from 1 week to 6 months depending on the company's objectives. Notable among these companies are Gennex Academy, Green Academy Africa, Ecowatt Nigeria, and Rubitec Academy.

Rubitec Academy is a pioneer in renewable energy training since 2004, specializing in the design, installation, and maintenance of off-grid solar systems. To foster future leadership in the sector, Rubitec Africa partners with Nigerian universities and polytechnics in delivering solar training by selecting ten top graduates in the electrical and electronic engineering, environmental sciences and related fields for the training. This initiative is part of Rubitec Africa's broader mission to collaborate with academic institutions both in Nigeria and abroad to develop leaders in Renewable Energy and Environmental Sciences.

6. Concluding thoughts and key takeaways

The following are key takeaways from this work:

- There is a huge energy need in Nigeria necessitating alternatives in electricity generation which includes solar technology.
- Solar PV technology is viewed primarily as a way to address energy access and not just as a means to address the energy transition challenge.
- Only 60.2% of Nigerian having access to electricity, meaning there are still over 85 million Nigerian without electricity access.
- Lack of long-term vision for the solar industry pose a challenge to achieving the full industry potential.
- There is a lack of knowledge on how to integrate solar infrastructure to existing systems in an economic way. This is primarily due to a lack of knowledge which (unfortunately) is contributing to the bad image of solar as an unreliable energy infrastructure.
- Lack of defined design, installation and operational standards pose a challenge in the Nigerian solar market.
- Many solar trainings in universities and TVET institutions are implemented either as short courses targeted at addressing specific skill needs, or as modules embedded in a broader programme.
- The National Business and Technical Examinations Board (NABTEB) have developed a Modular Trade Certificate In solar installation as a means to assess and certify those trained through short courses in the non-formal and informal sectors.

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