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TVET SKILLS FOR RENEWABLE ENERGY AND GREEN HYDROGEN IN NAMIBIA

Annexure 2: Solar Equipment Installation and Maintenance

Implemented by

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On behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ)

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GFA CONSULTING GROUP

CONTENTS

ACRONYMS

AC	Alternating Current
DC	Direct Current
EVTC	Eenhana Vocational Training Centre
GH2	Green Hydrogen
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GVTC	Gobabis Vocational Training Centre
ISC	Industry Skills Committee
MEFT	Ministry of Environment, Forestry and Tourism
MIME	Ministry of Industries, Mines and Energy
MIRT	Ministry of International Relations and Trade
MEIYSAC	Ministry of Education, Innovation, Youth, Sports, Arts and Culture
NEI	Namibia Energy Institute
NCHE	National Council for Higher Education
NGH2P	Namibia Green Hydrogen Programme
NGHRI	Namibia Green Hydrogen Research Institute
NIPDB	Namibia Investment Promotion and Development Board
NQA	Namibia Qualifications Authority
NTA	Namibia Training Authority
NUST	Namibia University of Science and Technology
NVC	National Vocational Certificate
NYS	National Youth Service
OCC	Ondangwa Commercial College
PHC	Population Housing Census
PV	Photovoltaic
RVTC	Rundu Vocational Training Centre
SACC	Standards, Assessment and Certification Council
SEIM	Solar Equipment Installation and Maintenance
TVET	Technical and Vocational Education and Training
UNAM	University of Namibia
VVTC	Valombola Vocational Training Centre
VET	Vocational Education and Training
VTC	Vocational Training Centre
VTP	Vocational Training Provider
WIL	Work-integrated Learning
WVTC	Windhoek Vocational Training Centre

1 ANALYTICAL REPORT

1.1 Background

The production of green hydrogen (GH_2) is achieved through harnessing renewable energy (RE) sources, such as solar and wind, to generate electricity via photovoltaic (PV) and wind turbine technologies. Namibia has developed a Green Hydrogen and Derivatives Strategy with goals to supply 10-15 Mtpa hydrogen equivalent by 2050, constituting approximately 8% of global GH_2 production.

The country plans to export hydrogen products like ammonia, methanol, synthetic kerosene, and hot-briquetted iron. It is envisaged that the GH_2 sector will significantly contribute to the growth of the Namibian economy. The required expertise may not be available at the scale to achieve the targets set out in the GH_2 Strategy. Technical and Vocational Education and Training (TVET) in specific fields that contribute to the full development of the GH_2 value chain in Namibia has not been fully evaluated and there may be gaps that require addressing.

The aim of this study is to contribute to the development of an enhanced and skilled workforce for the RE and GH_2 sector, in compliance with international standards and required certificates thereof.

This report highlights specific and critical skills needs and gaps, including stakeholder mapping and analysis in the RE and GH_2 sectors. The Namibia Qualification Authority (NQA) registered the Solar Equipment Installation and Maintenance (SEIM) National Vocational Certificate Levels 1 to 5 on the National Qualifications Framework (NQF) in March 2018, and these were due for review in 2023. The review had not taken place by March 2025; however, a roll-over was granted.

Although all levels were registered on the NQF, none of the state-owned Vocational Training Centres (VTCs) offered Levels 4 and 5. Eenhana VTC (EVTC) has offered Levels 1-3 since 2022 but lacks the capacity to train at Levels 4 and 5. Windhoek VTC (WVTC) also offers up to Level 2, citing a lack of qualified trainers and insufficient equipment for practical training. Only Ondangwa Commercial College (Private) offers Level 4 in SEIM since 2024, and commenced implementation of Level 5 in 2025.

1.2 Methods

A comprehensive literature review on the stakeholders in Namibia's TVET sector was conducted. A survey was administered to various stakeholders to collect data on perceptions of the identified sector players regarding vocational training on SEIM. Discussions with stakeholders, in person, telephonically and online were validated to support the data collected from the questionnaires.

International benchmarking was conducted through literature reviews and by visiting the official websites of technical and vocational training centres in at least six countries, to compare required qualifications and certification processes.

1.3 Status quo - Overview of existing training measures and training providers

Important Stakeholders in the Renewable Energy and Training Sectors

The Namibian RE sector comprises mainly of RE suppliers, the Namibia Energy Institute (NEI), RE installers, Technical and Vocational Training Providers (VTPs), the Department of Technical and Vocational Education and Training (DTVET) at the Namibia University of Science and Technology (NUST), Namibia Green Hydrogen Research Institute (NGHRI), University of Namibia (UNAM), and other training providers offering courses on renewable energy as well as their graduates (employed and unemployed).

The Namibia Training Authority (NTA) is entrusted with regulating and funding the provision of TVET in Namibia.

The NTA is responsible for qualification development and review, working with the Mining and Quarrying, Construction, Electricity, Gas, Water Supply, and Sanitation Industry Skills Committee (ISC). It contributes to establishing an effective and sustainable system of skill formation aligned with the needs of the labour market. The NQA and NTA are also responsible for the quality of TVET programmes.

The NQA is specifically responsible for the accreditation of TVET programmes and providers, while the NTA is responsible for the quality of TVET programmes, trainers, and institutions. Specifically, the Standards, Assessment and Certification Council (SACC) is delegated by the Board of the NTA to oversee the registration and deregistration of Training Providers. The Council is also responsible for approving the registration of subject matter experts, like Assessors, Moderators and Assessment Instrument Designers.

Introduction to the Namibian Solar Equipment Installation and Maintenance Vocational Training Certificate Curriculum

Solar energy equipment comprises all the components of a solar system, which, when appropriately installed, enable harnessing the sun's energy and its conversion into electricity or heat to satisfy a predetermined demand. Photovoltaics (PVs) are the direct conversion of solar radiation into electricity.

In contrast, solar thermal applications are for the provision of heat. Still, superheated steam can also generate electricity through a steam turbine when solar radiation is concentrated to heat water. In the case of a GH_2 plant, the load will be the electrolyser, electric pumps for water abstraction and desalination, as well as distribution as needed, compressor pumps to hydrogen storage tanks, along with required pumps for Nitrogen extraction from air to make ammonia.

The nature of the energy input from the sun is variable and intermittent, and at night, it is zero. Still, electrolysers and other equipment need a constant power supply. Hence, a solar energy system must incorporate energy storage components like chemical batteries or hydrogen and oxygen tanks to convert to electricity via fuel cells at night. The structure of the Namibian National Vocational Certificate (NVC) in SEIM includes five progressive NQF levels, from foundational safety and technical skills (Levels 1–2) to advanced design, troubleshooting, and business management competencies (Levels 3–5). This report critically examines the Namibian qualifications and their associated unit standards to assess their comprehensiveness, practical applicability, and potential areas for enhancement.

The SEIM qualification was developed to advance people across the electrical industry. This qualification provides opportunities for (self-) employment to contribute to society by facilitating social and economic transformation and empowerment, as well as general upliftment of the electrical industry and Namibia.

Table 1: Compulsory Requirements for Award of National Vocational Certificate (NVC) in Solar Equipment Installation and Maintenance (SEIM)

Level	Qualification ID	Entry requirements	Compulsory credits	Compulsory Industrial/ job attachment
1	Q0920	NVC in SEIM (Level 1) or equivalent	40	3 months
2	Q0921	NVC in SEIM (Level 2) or equivalent	44	6 months
3	Q0922	NVC in SEIM (Level 3) or equivalent	66	6 months
4	Q0923	NVC in SEIM (Level 4) or equivalent	42	9 months
5 (Technician)	Q0924	NVC in SEIM (Level 5) or equivalent	45	10 months

All learning outcomes listed in Table 2 (below) are mandatory for an NQF certificate. In other words, there are no alternative routes to obtaining the national certificate at the relevant level. To be certified, one must meet all requirements: attain the full credits and complete the prescribed, monitored Workplace-Integrated Learning (WIL) or industrial attachment, as stipulated in the National Policy on WIL for the TVET sector.

Table 2: NQF - Accredited Solar Installation and Maintenance Vocational Education and Training Courses in Namibia

Level 1	**National Vocational Certificate in SEIM**	
Unit ID	**Unit Standard Title**	**Credits**
1641	Apply safety rules and regulations in a solar energy installation environment	3
1642	Demonstrate basic knowledge of electricity	2
1643	Demonstrate basic knowledge of environmental issues relating to solar energy installations	4
1644	Demonstrate correct use of basic measuring instruments	2
1645	Demonstrate knowledge of plumbing principles	5
1646	Demonstrate knowledge of solar energy technologies	4
1647	Draw and interpret basic technical drawings	5
1648	Install basic solar home systems	6
1649	Perform basic estimations, measurements and calculations	6
1650	Use and maintain electrical and mechanical tools for solar equipment installations	3
	Total Number of compulsory credits	**40**

Level 2	National Vocational Certificate in SEIM	
Unit ID	**Unit Standard Title**	**Credit**
1651	Demonstrate basic computer literacy	3
1652	Demonstrate correct use of advanced measuring instruments	3
1653	Demonstrate knowledge of photo-voltaic technology	3
1654	Demonstrate knowledge of Solar Water Heating principles and technologies	3
1655	Develop, interpret and apply intermediate technical drawings	5
1656	Install Photo Voltaic Pumps	4
1657	Install Solar Home Systems	10
1658	Install one collector Solar Water Heater	10
1659	Prepare mounting structures	3
	Total Number of compulsory credits	**44**

Level 3	National Vocational Certificate in SEIM	
Unit ID	**Unit Standard Title**	**Credit**
1660	Carry out basic administrative duties	3
1661	Commission basic Solar Home Systems and Photovoltaic Pumping systems	5
1662	Demonstrate advanced computer application skills	4
1663	Demonstrate advanced knowledge of environmental and sustainability issues	4
1664	Demonstrate knowledge of Alternating Current principles	4
1665	Demonstrate knowledge of energy storage technologies	4
1666	Design basic Solar Home System	3
1667	Design basic domestic Solar Water Heater	3
1668	Design Photovoltaic Pumping	3
1669	Develop and interpret advanced technical drawings	6
1670	Install Solar Home Systems (up to Distribution board and to load)	10
1671	Install Solar Water Heating (200 litres and above including preheating)	10
1672	Repair Solar Home Systems	3
1673	Manufacture mounting structures	4
	Total Number of compulsory credits	**66**

Level 4	National Vocational Certificate in SEIM	
Unit ID	**Unit Standard Title**	**Credits**
1674	Maintain and troubleshoot photovoltaic pumping systems	10
1675	Maintain and troubleshoot Solar Home System	3
1676	Design advanced Solar Home Systems	8
1677	Design advanced solar water heaters	8
1678	Perform advanced administrative duties	3
1679	Commission solar home systems and photovoltaic pump systems	10
	Total Number of compulsory credits	**42**

Level 5	National Vocational Certificate in SEIM (Technician)	
Unit ID	**Unit Standard Title**	**Credits**
1680	Demonstrate environmental awareness	5
1681	Demonstrate knowledge of thermodynamics	7
1682	Demonstrate special applications of hybrid and grid tied Photovoltaic systems	10
1683	Demonstrate knowledge of special Solar Thermal applications	10
1684	Manage business, financial and legal requirements for a solar energy business	6
1685	Utilise specialised computer applications	7
	Total Number of compulsory credits	**45**

The NQF-registered qualifications are offered by, and run at, NTA-registered Training Institutions, which include Vocational Training Centres (VTCs) and private training providers (VTPs) who meet the set criteria for registration as specified in the Government Gazette of the Republic of Namibia 5099 of 17 December 2012.

Table 3, below, (an extract from the Namibian institutions and their programmes accredited by the Namibia Qualifications Authority, 17 June 2024) indicates the nine state-owned VTCs, whether they offer training on SEIM, and contact details of each VTC.

Table 3: Namibian state-owned Vocational Training Centres Offering National Vocational Certificate (NVC) in SEIM

	National VTC	Offering SEIM?	Contact Details
1	Eenhana Vocational Training Centre, Ohangwena Region (visited by the consultants)	YES	Paulus Hamutenya Street, Eenhana Email: info@evtc.edu.na Website: www.evtc.edu.na/
2	Nakayale Vocational Training Centre, Omusati Region	NO	Oshakati- Ruacana Main Road, Outapi Email info@nvtc.edu.na website: www.nvtc.edu.na
3	Okakarara Vocational Training Centre, Otjozondjupa Region	NO	John Tjikuaa Street, Okakarara Email: info@ovtc.edu.na website: www.ovtc.edu.na

	National VTC	Offering SEIM?	Contact Details
4	Rundu Vocational Training Centre, Kavango-East Region	NO	Maria Mwengele Road, Rundu; Email: info@rvtc.edu.na website: www.rvtc.edu.na
5	Valombola Vocational Training Centre, Oshana Region (visited by the consultants)	NO	C/o Mandume Ndemufayo & Nandjebo Mengela Street, Ongwediva, Email: info@vvtc.edu.na website: www.vvtc.edu.na
6	Khorixas Vocational Training Centre, Kunene Region	NO	Chief Justus //Garoeb Str, Khorixas Email: info@khvtc.edu.na website: www.khvtc.edu.na
7	Windhoek Vocational Training Centre, Khomas Region	YES	Erf 4885, 11 Tsu-Khoe //Gaweses Street, Khomasdal, Windhoek Email: info@wvtc.edu.na website: www.wvtc.edu.na/
8	Zambezi Vocational Training Centre, Zambezi Region	NO	Wenela Road, Katima Mulilo Email: info@zvtc.edu.na website: www.zvtc.edu.na
9	Gobabis Vocational Training Centre, Omaheke Region	YES	Industrial Area, Free Market Street, Gobabis Email: info@gvtc.edu.na website: www.gvtc.edu.na

From Table 3, the NVC in SEIM, Levels 2-3, is offered at Gobabis VTC (GVTC) in the Omaheke region, and the NVC in SEIM Levels 1-3 is provided at Eenhana VTC (EVTC) in the Ohangwena Region.

During discussions with Windhoek VTC (WVTC), it emerged that they have started offering NVCs in SEIM at Levels 1-2. No other state-owned VTC is offering these courses, and no mention was made of expanding training to higher levels (levels 4 and 5) at state-owned VTCs. It therefore seems that although the unit standards for levels 4 and 5 were developed and registered in 2018, they have not been implemented by any state-owned VTC in Namibia.

NamVoc Vocational Institute (NamVoc), a private institute, also offers SEIM at Levels 1-3. The private Ondangwa Commercial College is the only provider offering SEIM Level 4 since 2024 and have started offering Level 5 in 2025.

1.4 Stakeholder mapping and analysis in the RE and GH_2 sector in Solar Equipment Installation and Maintenance

Renewable Energy and Green Hydrogen Stakeholders in Namibia

The role of government is to establish an environment conducive to doing business. It does so through various agencies like the Namibia Green Hydrogen Programme (NGH2P), Namibia Investment Promotion and Development Board (NIPDB), NQA, NTA, Ministries of: Industries, Mines and Energy (MIME); Enviroment, Forestry and Tourism (MEFT); International Relations and Trade (MIRT); as well as Education, Innovation, Youth, Sport, Arts and Culture (MEIYSAC). Universities and VTPs train the trainers, and these trainers, in turn, train the artisans and technicians, who also must undertake work-integrated learning in the industry before they can graduate and possibly become employees in the SEIM sector. Generally, trainers need one level higher than the training they are facilitating.

The GH_2 value chain, illustrated in Figure 1, begins with energy-intensive processes such as abstraction, desalination, deionisation of sea or borehole water, electrolysis, gas compression, and dispensing for distribution. This energy is primarily expected to come from large photovoltaic and wind systems located near the hydrogen production plant. The SEIM trade plays a crucial role in these renewable power plants, as shown in Block 1.

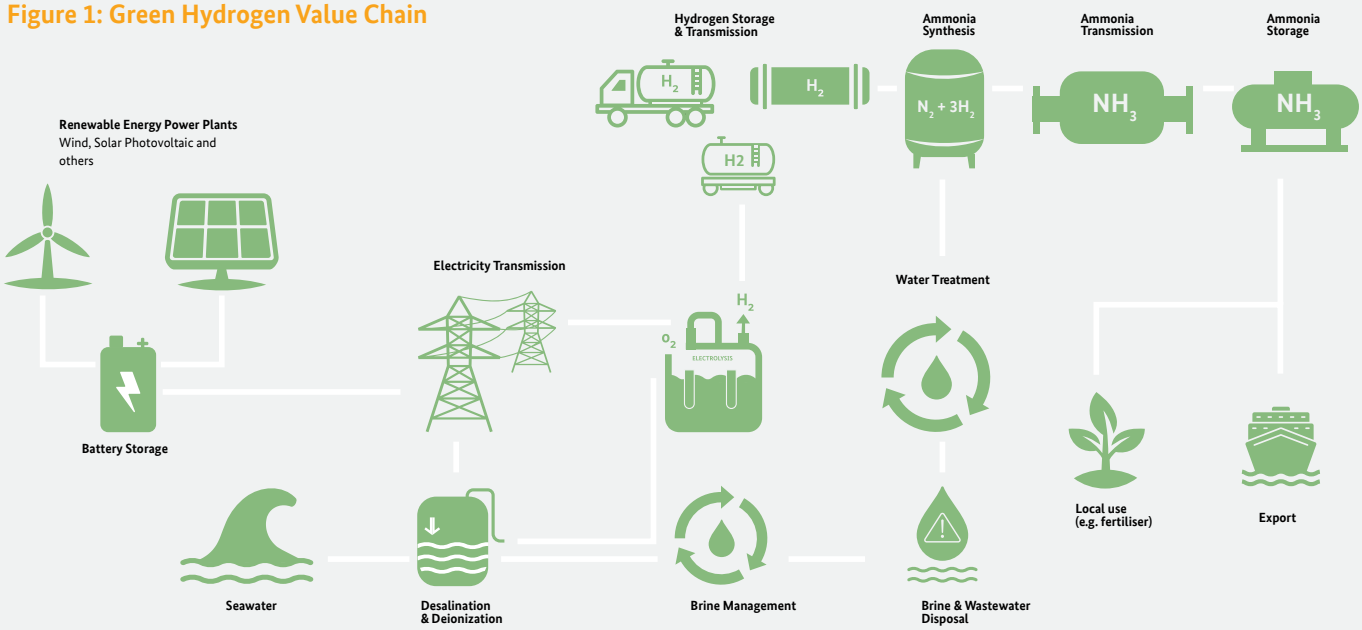
However, the management of SEIM in Block 1 should not be viewed in isolation. While each block in the figure could be managed separately, effective communication and integration between them remain essential.

Optimisation of solar radiation collection may require solar tracking mechanisms, which should be included in TVET programme offerings. The design of such systems is not expected at Technician level 5. Still, the Technicians should be able to interpret designs and drawings, operate under suitably qualified Engineers, supervise the installation, and participate in the commissioning of such systems.

The desert environment can cause soiling, reducing energy output from solar panels, and therefore requires periodic cleaning. The operation of automated cleaners is expected from artisans working under the supervision of a technician. Maintenance of the system is needed, including hot spot checks by infrared drone mapping, and the system-linked computer interface monitoring should be learned.

These are added to the standard construction of mounting structures, including foundations, installation of the modules, series and parallel strings and their connection through junction boxes, to the inverters, possible grid integration, as well as installation, setting up, and maintenance of batteries and/ or hydrogen fuel cells to store energy as needed.

Figure 1: Green Hydrogen Value Chain



1.5 International Benchmarking

The international benchmarking focused on identifying vocational training courses in SEIM relevant to the Namibian TVET sector across several countries. The aim was to collect information about course title, entry and exit levels, course summary, course duration, NQF levels and related occupational standards, as well as key competencies, to compare the Namibian standards against international levels, and to identify skills gaps with reference to international standards and requirements. The findings are summarised and can be viewed in Table 8 below.

- **The following points were prioritised while compiling the benchmarking information:**

- **The availability of international benchmarking information:** International benchmarking information remains fragmented due to differences among education systems in various countries considered while collecting data throughout the study period.

- **The suitability of information to act as a benchmarking indicator for occupational standards:** Occupational standards and key competencies were sometimes difficult to obtain; they were often fragmented and incomplete, therefore, unsuitable for benchmarking. Nevertheless, great care has been taken to align the available information in the best possible way. At the international level, usually the SEIM courses are divided into off-grid and on-grid (grid-tied) Solar Installation and Maintenance. Therefore, occupational standards are separated into off-grid and on-grid solar installation and maintenance standards, meaning that they vary.

- **Data comparability for evaluation of the same level:** The available data from different countries did not align well enough to compile and evaluate the same level and its training content in direct comparison.

- **The quality of information used in the validation process:** The overall quality of information used in the validation process is good and has been verified during a data pre-selection process.

- **Training and education in the GH_2 sector:** Pioneering Systemic Innovations for the emerging GH_2 economy remain in early development stages at the international level, and there are currently limited sources and job vacancies available. Therefore, this study cannot comprehensively express all associated training needs. The GH_2 economy has a great future with massive room for development in training and education.

The benchmarking assessed skills gaps regarding international training content, skills and technology standards, and requirements for obtaining international certifications.

The benchmarking study also informed the recommendations and priorities for further development.

Table 4: International Benchmarking on Vocational Training – SEIM

GERMANY							
Course Title, and Trade Name	**Description**	**Entry Level**	**Exit level**	**Course Duration**	**Occupational Standards and key Competencies**	**Additional Information**	**Web-links**
Solarteur - Cross-trade-course Trade Name: Solarteur	This cross-trade course is aimed at Technicians from the SHK and electrical trades. A corresponding professional qualification is required to carry out safety-relevant work independently.	People who successfully completed apprenticeship or trade certificates in related fields, such as electricians.	SEZ-Certificate	2-months	Solar energy installers are qualified to plan, install, and maintain photovoltaic systems, solar thermal systems for hot water production and heating integration, and heat pumps. They gain an overview of the household, roof, orientation of the PV system, photovoltaic mounting system, component placement, and possible subsidies. Based on electricity consumption, they determine the optimal system size and prepare detailed yield calculations and profitability forecasts.	The Solarteur® is a designation protected throughout Europe. Completing the training to become a Solarteur® enables the provision of competent advice to customers on the use of technologies "photovoltaics, solar thermal energy and heat pumps" professionally. After completing the course, trainees will be qualified to provide advice, installation, commissioning, and customer service in these technologies.	https://www.sez-stuttgart.de /Kursangebot/Technik / Solartechnik /SOLARTEUR%C2%AE.html# info@sez-stuttgart.de
Professional Solarteur Trade Name: Solarteur	Solar installers are qualified for the planning of PV systems, installation and maintenance of photovoltaic systems, solar thermal systems for hot water preparation and heating integration as well as heat pumps.	Tradespeople with completed vocational training, for example as electricians, roofers or in the field of plumbing, heating and air conditioning technology, can specialise in further training as " solar technicians".	Certified as a training provider by the Federal Employment Agency.	6-weeks	Photovoltaic Off-Grid Systems, setting up an Off-Grid System, Charge controllers, operating modes, AC/ DC systems, inverter options, hybrid systems, battery storage/types, charging/discharging processes; Design of Off-Grid Systems, Energy Requirements, Module Yields, Simulation Tools, Consumers; Standards, Grid-Connected Photovoltaic Systems. Why Grid-Connected PV Systems. Main components: Inverters/concepts, disconnection point, grid connection, planning of grid-connected PV systems, simulation tools, dimensioning, component selection, cables, metering, measurement technology, and visualisation, setting up a grid-connected PV system: commissioning and maintenance, fall protection, fault detection/correction, standards, regulations, and guidelines, recycling, surge/lightning protection, equipotential bonding, economic efficiency and funding tenant electricity model	A photovoltaic installer carries the entire process from consultation to maintenance. A solar installer is also the contact for maintenance and possible repairs. Training to become a solar installer is based on completed vocational training in a technical profession, followed by further training.	https://www.enpal.de/ photovoltaik/solarteur
Solar Energy - Basics of Solar Technology Trade Name: Expert in Solar Technology	Expert in solar energy as a renewable energy source (solar technology, solar thermal, photovoltaics).	A qualification with at least two years of professional experience is required; an apprentice degree is advantageous.	Internal certificate or certificate of participation.	6-weeks	This course provides trainees with the knowledge and skills to plan and install solar and photovoltaic systems. They receive a comprehensive theoretical foundation, incorporating many useful practical tips. Basic electrical engineering principles will also be covered.	General principles, perspectives, advantages, disadvantages, and limits of solar energy. Potential of solar energy. Funding programs, laws and regulations.	www.ibb.com kursinfo@ibb.com

KENYA							
Course Title, and Trade Name	**Description**	**Entry Level**	**Exit level**	**Course Duration**	**Occupational Standards and key Competencies**	**Additional Information**	**Web-links**
Installation and Maintenance Trade Name: Solar PV Installer	In Kenya, solar PV installation offers hope and opportunity for sustainable development. As the country and the world shift towards cleaner energy, solar PV systems play a key role in providing clean, renewable electricity, reducing reliance on fossil fuels, and protecting the environment.	QUALIFICATIONS At least a High School certificate. Extra professional or academic certificates and or field experience are not compulsory for admission. High passion and interest in sustainable energy and Solar installation	Solar PV installation certificate	Inceptor 6-month course, and short courses	Basics of solar PV electricity, Solar PV components (panels, batteries, charge controllers, inverters), Solar PV appliances (lights, refrigerators, tv, radio), solar water pumping, Site survey and solar system sizing, Installation and maintenance, Solar PV applications	University of Nairobi, TARGET GROUPS The training is ideal for groups or individuals from government, public or private institutions, electricians, technicians, teachers, technical institute tutors, NGO's outreach personnel & solar PV retailers.	https://physics.uonbi.ac.ke/basic-page/solar-academy, email: physics@uonbi.ac.ke
Installation and Maintenance Trade Name: Solar PV Installer	Description or Summary	(1) Attained Kenya Certificate of Primary Education (K.C.P.E) (For CDACC Certification	Solar PV installation certificate	Information not available	Information not available	Information not available	https://physics.uonbi.ac.ke/basic-page/solar-academy, email: physics@uonbi.ac.ke
Installation and Maintenance Trade Name: Solar PV Installer	In Kenya, solar PV installation offers hope and opportunity for sustainable development. As the country and the world shift towards cleaner energy, solar PV systems play a key role in providing clean, renewable electricity, reducing reliance on fossil fuels, and protecting the environment.	(2) OR hold equivalent qualifications in a related field, as determined by the Kenya National Qualifications Authority (KNQA)/	Solar PV installation certificate	Information not available	Information not available	Information not available	https://physics.uonbi.ac.ke/basic-page/solar-academy, email: physics@uonbi.ac.ke
Solar PV and Domestic Electrical Installation Trade Name: Solar PV Installer Trade Name: Solar Installer		(3) Must have a sound electrical installation background having served in the industry for at least 2 years	National certificate of competency is then issued by TVET CDACC	2 months (for trainees with an electrical background), 5 months (for trainees without an electrical background)	Installation Techniques: Master the practical skills and techniques to safely and effectively install solar PV systems, including mounting hardware, electrical wiring, and panel installation.	VITECH Training Institute, Green Energy Innovation Department	https://vti.ac.ke /

ETHIOPIA								
Course Title	**Description or Summary**	**Trade Name**	**Entry Level**	**Exit level**	**Course Duration**	**Occupational Standards and key Competencies**	**Additional Information**	**Web-links**
Solar PV System Installation and Maintenance	Solar PV System Installation and Maintenance NTQF Level 2 - 5	Solar Installer	Information not available	NTQF Levels 2 to 5	Information not available	Solar PV System Installation and Maintenance Level 3: This unit covers the knowledge, skills and attitude in installing an off-grid PV system.	Ministry of Science and Higher Education	n/a
Solar PV System Installation and Maintenance	The new paradigm in the outcome-based TVET system is the orientation at the current and anticipated future demand of the economy and the labour market.	Solar Installer	Information not available	NTQF Levels 2 to 5	Information not available	Solar PV System Installation and Maintenance Level 3. Determine the size of PV system components and wire/cable. This unit covers the skills, knowledge, and attitude to determine customer requirements, sizing of system components and wire/cable for institutional solar PV systems, up to 3kWp	Ministry of Science and Higher Education, Occupational Standard	n/a

SWITZERLAND								
Course Title	**Description or Summary**	**Trade Name**	**Entry Level**	**Exit level**	**Course Duration**	**Occupational Standards and key Competencies**	**Additional Information**	**Web-links**
Solar Installer course	Solar installers EFZ assemble and install solar systems on flat roofs, on pitched roofs and on facades, attached to buildings or free-standing. The focus is on the assembly and installation of solar systems for the generation of electrical energy from solar energy.	Solar Installer	Admission requirements: (1) manual skills, physical fitness, no fear of heights, good knowledge of German language (level B1). (2) at least 120 days of practical experience in solar installation before starting the apprenticeship	Certification: Course Certificate Educational Center Polybau	2 years full-time course	Assembly and installation of PV systems: On flat and pitched roofs, on the facade, attached, or freestanding, depending on the application. Creating and connecting cable routing Installing and connecting storage solutions. Commissioning, maintenance, repair, and dismantling: Maintaining PV systems, locate and resolve simple faults. Dismantling, disposal	Bildungszentrum Polybau Lindenstrasse 4, 9240 Uzwil, Switzerland	www.polybau.ch info@polybau.ch

SOUTH AFRICA							
Course Title and Trade Name	**Description or Summary**	**Entry Level**	**Exit level**	**Course Duration**	**Occupational Standards and key Competencies**	**Additional Information**	**Web-links**
(1) Solar Photovoltaic Installer course (Stand-alone Installation) Solar PV Installer **(2) Photovoltaic Service Technician course** (PV Farm) Photovoltaic Service Technician **(3) Photovoltaic Service Technician course** (Stand-Alone Installation) Photovoltaic Service Technician	The TVET sector in South Africa aims to train artisans and technicians for the emerging green hydrogen economy; therefore, it must transcend conventional models of skill development.	(1) NQF level 4 with mathematics OR (2) A qualified PV Technician with at least 2 years of experience, or a qualified electrician/millwright with PV-related training and/or 2 years of relevant experience working within a PV environment.	Information not available	Information not available	Information not available	The emergence of GH2 is a promising avenue in South Africa's energy transition, underscored by its prominent inclusion in pivotal government planning documents such as the Hydrogen Society Roadmap, Green Hydrogen Commercialisation Strategy, Green Hydrogen TVET Ecosystem Just Transition Strategic Framework, 2 South African Energy Skills Roadmap and the Just Transition Framework Implementation Plan.	https://saiia.org.za/wp-content/uploads/2024/10/SAIIA_PB_293_SkillsGovernanceTVET-corrected.pdf
Solar PV Service Technician Solar PV Service Technician	The Solar Photovoltaic Standalone Service Technician ensures the safe and efficient maintenance of standalone PV system installations, including domestic rooftops and off–grid setups in urban and rural areas.	Entry Requirements: NQF level 4 (Grade 12), mathematics	NQF level 5	12 months	Graduates are prepared for career progression. This qualification fosters upskilling in the industry, aiding South Africa's efforts to install quality, safe, and sustainable infrastructure. It aligns with national development goals and promotes environmental sustainability.	none	https://africaskills.co.za/qualification/trades/solar-pv-service-technician/
Solar Installer course Solar Installer	A Solar Installer is a specialist qualified or licensed plumber who installs and repairs solar water heating systems in homes and businesses.	This Designation may be awarded through Recognition of Prior Learning.	National Certificate: Solar Water Heater System Installation, NQF Level 2	Information not available	Reading, drawings, and figures to understand the water supply, waste, and venting systems layout. Planning and performing calculations for specific and unique projects. Thorough knowledge of solar plumbing regulation/codes and safety rules. Provide time and cost estimates of the work to be performed (labour and materials). Communicating effectively and confidently with consumers, colleagues, subcontractors, and management. Work with their hands. Hand and power tools and machines are used to measure, cut, bend, and thread pipes. Installing, repairing and maintaining various domestic solar heating systems and configurations. Being able to work in confined spaces or at height. Test pipes for leakages using water and air pressure gauges.	The course covers essential topics such as solar PV system design, installation, and safety, ensuring installers can work with solar systems that meet regulatory and technical standards. This training not only enhances participants' employability but also supports the solar industry's growth by fostering a skilled workforce.	https://pbdesig.saqa.org.za/viewProfessionalDesignation.php?id=416

SOUTH AFRICA							
Course Title and Trade Name	**Description or Summary**	**Entry Level**	**Exit level**	**Course Duration**	**Occupational Standards and key Competencies**	**Additional Information**	**Web-links**
Solar PV Service Technician Training Course Trade name: Solar PV Service Technician	A Solar Installer is a specialist qualified or licensed plumber who installs and repairs solar water heating systems in homes and businesses. Some vital knowledge and skills needed by a good Solar Installer are:	Without pre-qualifications	NQF level 5, 344 Credits	up to 3 years	Practical skill modules: Maintain Test, Diagnose, and Replace PV Panels. Maintain Test, Diagnose, Repair, and Replace Inverters in PV Systems. Maintain Test, Diagnose, Repair and/or Replace Transformers in PV Systems. Maintain Test, Diagnose, and Replace Batteries in PV Systems. Maintain, Test, Diagnose, and Replace Cables, Cable interconnections, Smart Boxes, PV Junction/String Boxes, String Diodes, Connectors, and Fuses in the PV System. Maintain, Test, Diagnose, Repair, or Replace Tracking Systems in PV Systems. Maintain, Test, Diagnose, Repair, Or Replace Charge Controllers in PV Systems. Maintain, Test, Diagnose, Repair and/or Replace Switchgear and Control Gear in PV Systems	The course is split between (1) Knowledge Modules, (2) Practical Skill Modules and (3) Workplace Experiences Modules	https://africaskills.co.za /campuses/georgetech/

AUSTRIA								
Course Title	**Description or Summary**	**Trade Name**	**Entry Level**	**Exit level**	**Course Duration**	**Occupational Standards and key Competencies**	**Additional Information**	**Web-links**
Photovoltaic Technician course	The certification is aimed at experts who have attended at least the Basic and Expert modules. By completing the final exam, you will also receive the certification carried out in cooperation with the WKÖ/WIFI certification body.	Photovoltaic Technician	Basic theoretical knowledge of electrical engineering (electrical engineering apprenticeship or higher) and/or practical knowledge in electrical engineering (e.g. installer, PV roofer or building technician, etc., with further electrical engineering training and practical experience). To be certified, you must provide evidence of completed school/vocational training and 6 months of professional experience.	Certified Photovoltaic Technician	9-day compact course	Basics and functionality of photovoltaic systems, project planning principles, coordination with grid operators and clients, system and operating modes, Inverter systems, PV generator (modules, parameters, etc.), Requirements for storage systems or battery systems, installation guidelines and standards, subsidies, costs and profitability.	WiFi Kärnten, 9021Klagenfurt, Europaplatz 1, Austria	https://www.wifikaernten.at / wifi@wifikaernten.at

Comparison of the Namibian and the Tanzanian Curricula

The structure and content of SEIM in Namibia are organised into a progressive system, with the national certificate divided into distinct levels.

Levels 1 and 2: Focus on fundamental safety, basic electrical knowledge, introductory solar technologies, and installing solar home systems.

Level 3: Introduces advanced technical drawings, commissioning of solar systems, and basic system design.

Level 4: Emphasises maintenance, troubleshooting, and advanced system design for photovoltaic pumping systems and solar home systems.

Level 5: Addresses specialised areas such as hybrid/grid-tied systems, solar water heating, thermodynamics, and business management.

While the foundational levels are well-articulated, the curriculum shows a narrowing focus at the upper levels. Advanced topics like grid-tied system design, solar water heating, and business aspects are more flex-integrated compared to the practical applications of the Tanzanian curriculum.

A comparison is made with the Masasi Folk Development College in Tanzania, highlighting key similarities and differences:

Safety and Basic Technical Skills: Both curricula emphasise safety protocols, proper tool usage, and foundational solar technology. Namibia's strong practical approach confirms that the NVC Levels 1–2 adequately cover these essentials.

Installation Practices: The Tanzanian curriculum is efficient, emphasising site layout, component mounting, wiring, and testing. Although the Namibian curriculum aligns with NVC Levels 2–3, more detailed practical methods similar to those in Masasi training could be incorporated.

Maintenance and Troubleshooting: The Masasi Folk Development College programme includes fundamental maintenance and troubleshooting components. The Namibian NVC Level 4 addresses these topics, yet the depth of diagnostic skills and advanced troubleshooting methods appears to be less comprehensive.

Advanced and Specialised Topics: The training of the Masasi Folk Development College primarily focuses on solar PV installation integrated with domestic electric installations. It does not extend into advanced topics such as solar water heating or sophisticated grid-tied system design. While the Namibian curriculum introduces these topics at NVC Levels 4–5, the coverage could benefit from greater depth, particularly in: Advanced system design (grid-tied/hybrid configurations); Detailed solar water heating technologies; Business, financial, and legal aspects essential for entrepreneurial success in the solar energy sector.

2 RESULTS AND DISCUSSION OF FINDINGS

2.1 Results

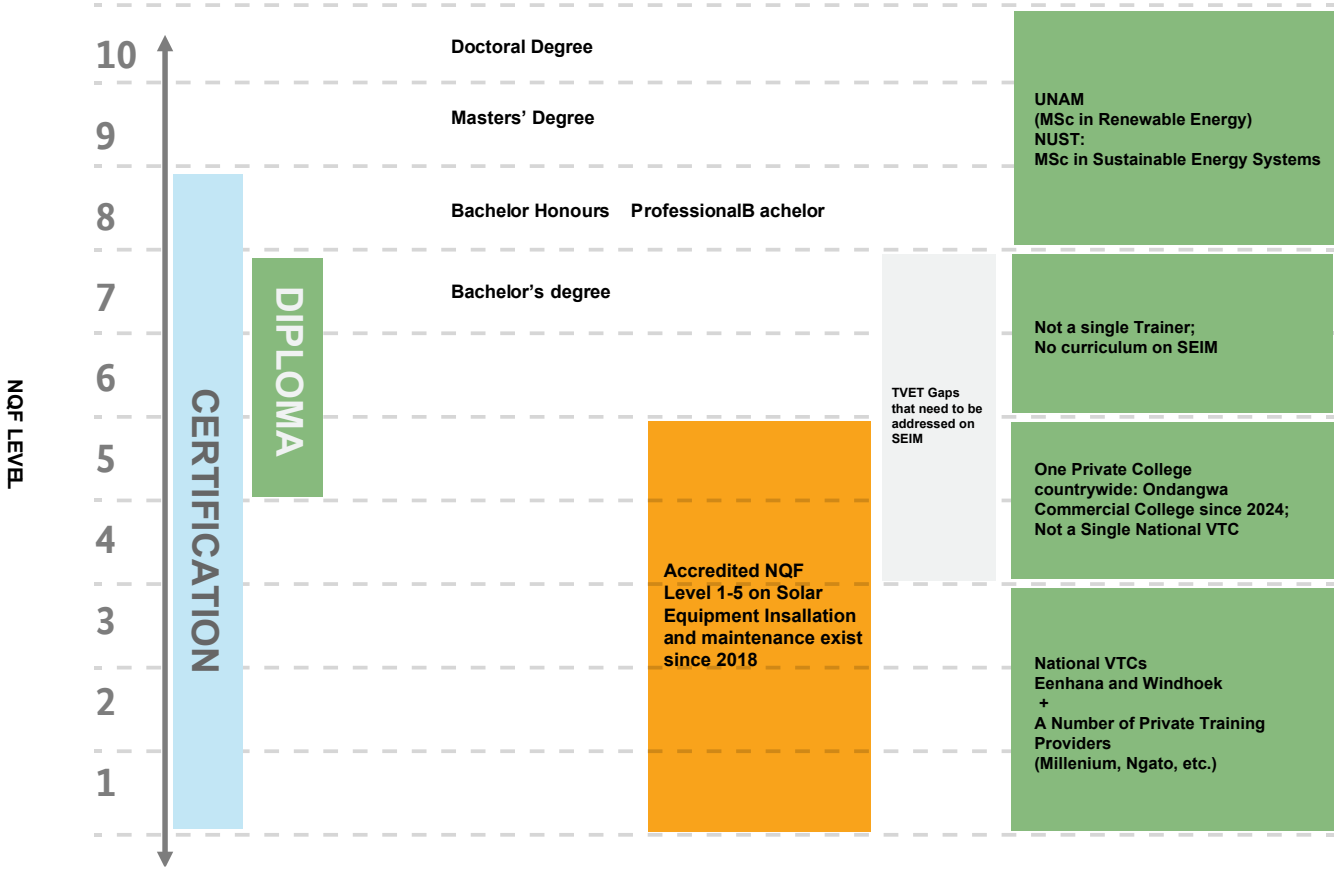
Analysis of Gaps in the Namibian TVET System with respect to SEIM

The NVCs in SEIM provide a solid foundation in safety and basic technical skills. However, notable areas require enhanced tuition, particularly advanced system design, solar water heating, and business-oriented training.

Addressing these gaps by incorporating enhanced practical exposure and deeper technical content will better equip graduates to meet the dynamic demands of the solar energy sector.

In Namibia's public education sector, there is a gap between vocational education training providers and universities in terms of levels, as illustrated in Figure 2:

Figure 2: Illustration of gaps in the curriculum levels offered by NTA on SEIM.



There is a gap in Namibia's educational system, specifically in polytechnic education. Most TVET courses are only implemented at NQF level 3, although qualifications exist up to level 5, meaning that graduates from VTPs cannot progress to higher levels on the NQF.

The lack of coverage of levels 4 and 5 is a key deficiency within the TVET system. Graduates from other public VTCs (such as Rundu VTC (RVTC), Windhoek VTC (WVTC), Eenhana VTC (EVTC), and Valombola VTC (VVTC), amongst others), have furthered their studies at colleges and universities in South Africa, pursuing qualifications such as N6 or degrees in engineering disciplines, including civil, electrical, or mechanical engineering.

NTA developed unit standards to bridge the gap for the SEIM course up to NQF Level 5, as illustrated in Figure 1, but as discussed earlier, they are not widely offered.

The vocational training courses under the custodianship of the NTA correspond to NQF levels 1 to 6. Universities start at level 7; however, there is a gap in the availability of level 6 programs at the TVET level. This is the regime where polytechnicals are needed. They would train at levels 5 and 6 and issue Diplomas – something the system needs for SEIM qualifications.

These levels would, for instance, train the VTC trainers so that they would be able to offer Levels 4 and 5. NUST has started training TVET trainers. However, a new problem emerges due to the entry requirement being above level 5, especially if one progressed through the levels without gaining the requisite science and mathematics grades at secondary school level.

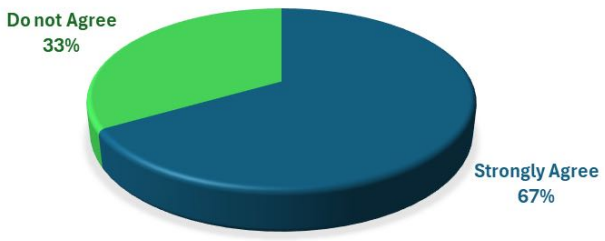
2.2 Training Needs Analysis of the TVET System withrespect to SEIM Stakeholder Responses

The questionnaire was distributed to more than 40 identified stakeholders, including all state-owned VTCs, selected private VTPs, industry representatives, the NTA, the Ministry of Industries, Mines and Energy, and others. The response rate was 34%. Stakeholders engaged through interviews or questionnaire responses included VTC trainers and management from EVTC, NVTC, VVTC, and WVTC, as well as representatives from NTA, NYS, and NEI. Additional discussions were held with NUST, NGH2P, OCC, Millenium Private College, UNAM, Daures GH_2 Village, Hyphen, among others.

The questionnaire results are presented in Figures 3 to 11, each followed by a brief analysis.

Figure 3: Perceptions on (a) adequacy of SEIM training programmes in Namibia; (b) adequacy of theoretical and practical training facilities at VTCs per Level

a) There are sufficient training programmes on solar equipments installation and maitence in Namibia



b) Theory and practical content, is well resourced at VTC/ Training Institution

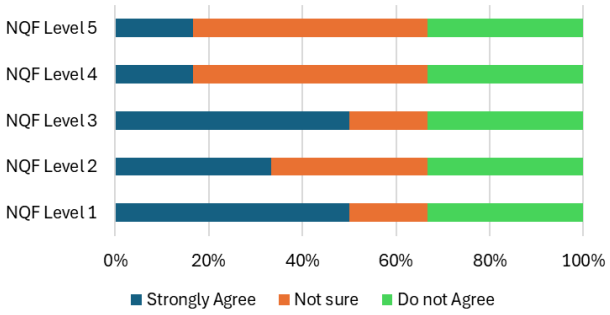
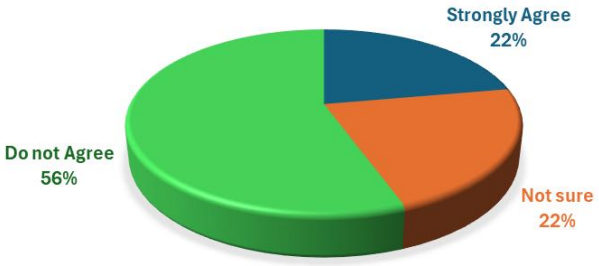


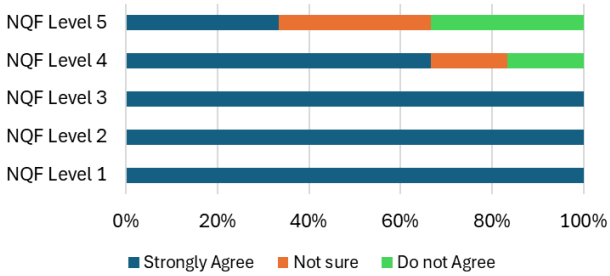
Figure 3 illustrates that most consulted stakeholders believe there are sufficient training programmes on SEIM in Namibia. However, (b) shows that NQF levels 1 to 3 are well-resourced, while Levels 4 and 5 are under-resourced.

Figure 4: Perceptions on (a) adequacy of SEIM trainers for NQF Levels 1 to 5 in Namibia; (b) adequacy of the training levels of the trainers at various NQF levels

a) There is sufficient knowledge o laboratory, workshop space, and training equipment, needed for NQF levels 1 to 5 on solar equipment installation and maintenance in Namibia



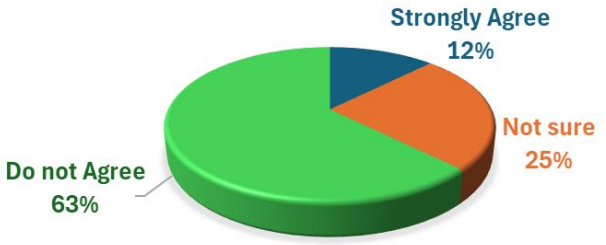
b) Trainers at VTC are sufficiently trained to teach SEIM at NQ Level



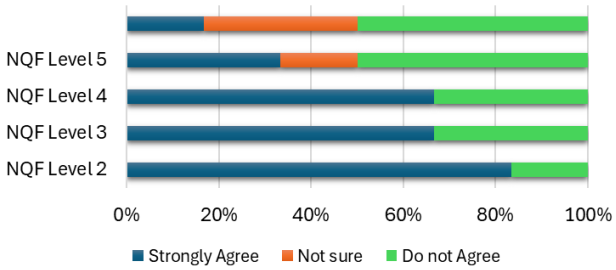
Most stakeholders either disagree, or are unsure, that Namibia has sufficient trainers for all 5 levels. At the VTCs, Levels 1 to 3 seem to have adequately trained trainers while for Levels 4 and 5 some responded that the trainers were insufficiently trained.

Figure 5: Perceptions on (a) adequacy of SEIM laboratory, workshops and training equipment for NQF Levels 1 to 5 in Namibia; (b) whether VTCs are well equipped for all NQF levels

a) There are sufficient laboratory, workshop space, and training equipment, for NQF level 1 top 5 on solar equipment installation and maintenance in Namibia.



b) VTC sufficiently equipped to train SEIM per NQF Level

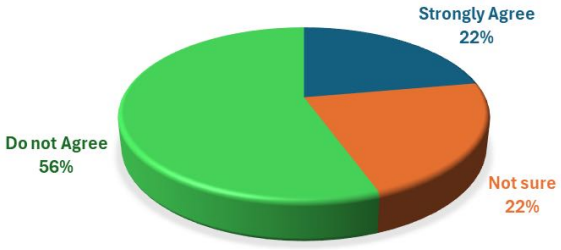


63% of all consulted stakeholders disagree, and 25% are unsure, that Namibia has sufficient SEIM trainers for all five levels.

More than 50% of consulted VTC stakeholders strongly agree that VTCs are sufficiently equipped to train SEIM at levels 1 to 3, while more than 60% either disagree or are unsure that level 4 is well catered for. Only about 15% indicate that the VTCs are well equipped for Level 5.

Figure 6: Perceptions on (a) adequacy of knowledge of needed SEIM laboratory, workshops and training equipment for NQF Levels 1 to 5 in Namibia; (b) whether VTCs are knowledgeable on needed SEIM training equipment for all NQF levels

a) There is sufficient knowlege on laboratory, workshop space, and training equipment needed for NQF level 1 to 5 on solar equipment installation and maintenance in Namibia

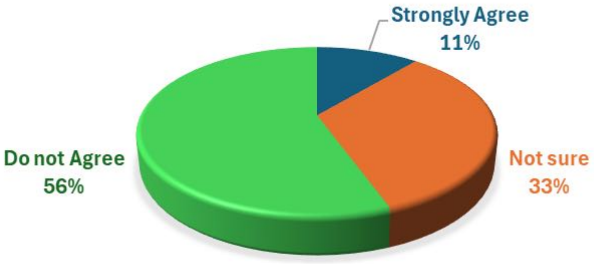


Most stakeholders either disagree or remain unsure that Namibia has sufficient knowledge of laboratory, workshop space, and training equipment needed for NQF levels 1 to 5 on SEIM in Namibia.

Seventy per cent of the respondents perceive VTCs as knowledgeable about equipment and facility needs for levels 1 to 3, but few agree for Levels 4 and 5.

Figure 7: Perceptions on (a) whether all VTC trainees receive sufficient practical training needed in SEIM for NQF Levels 1 to 5 in Namibia; (b) whether VTCs are offering hands-on training to their trainees as needed in SEIM for all NQF levels

a) All trainees recieve sufficient hands-on trainig needed for NQF level 1 to 5 on solar equipment installation and maintenance Namibia



b) VTC offering sufficient hands on training per NQF level

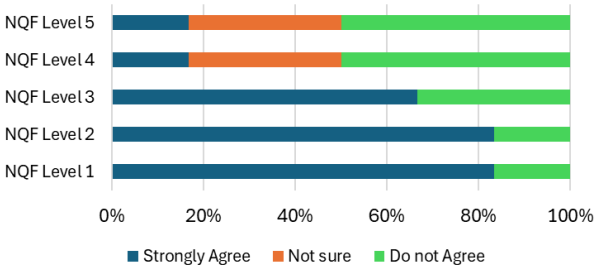
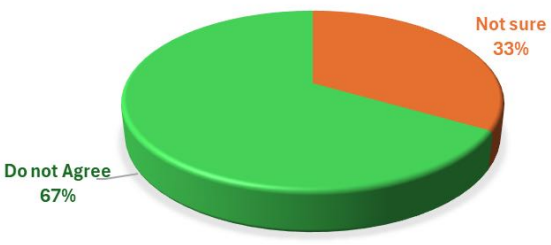


Figure 7 shows that just 11% of respondents believe Namibian TVET trainees on SEIM receive sufficient practical training. At the VTCs, Levels 1 to 3 seem to have some practical training, while Levels 4 and 5 are insufficiently catered for.

Figure 8: Perceptions on (a) whether all VTC trainees NQF Levels 1 to 5 receive sufficient work-integrated learning relevant SEIM industries in Namibia; (b) whether VTCs send and follows up on their trainees on industrial attachment/work-integrated learning at all NQF levels

a) All trainees recieve sufficient work intergrated learning in repective industries as needed for NQF levels 1 to 5 on solar equipment installation and maintenance in Namibia



b) VTC sends and follows up every trainee on work intergated learning at each NQF level

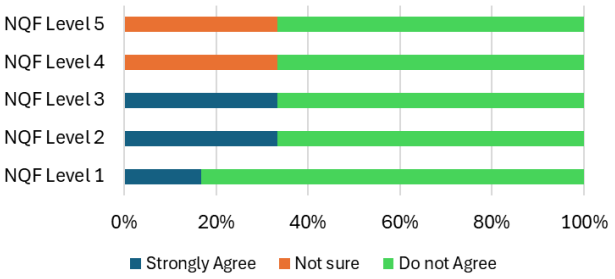


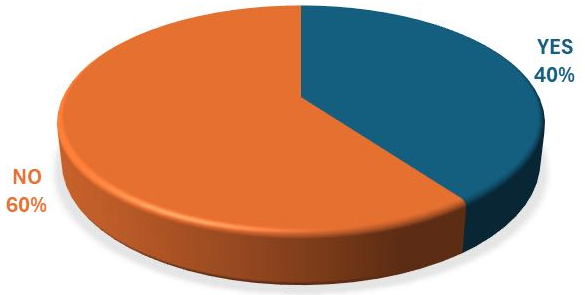
Figure 8 (a) shows that 67% of respondents disagreed that there are sufficient and properly monitored industrial attachments, also referred to as Work-Integrated Learning (WIL), for SEIM trainees in Namibia.

The remaining 33% were unsure whether this applied across all NQF Levels 1–5. Figure 8 (b) indicates that trainees may not receive adequate WIL even at Levels 1–3. Fewer than 40% of respondents confirmed that VTCs ensure placements and provide follow-up during attachments. More than 60% disagreed that this is done effectively.

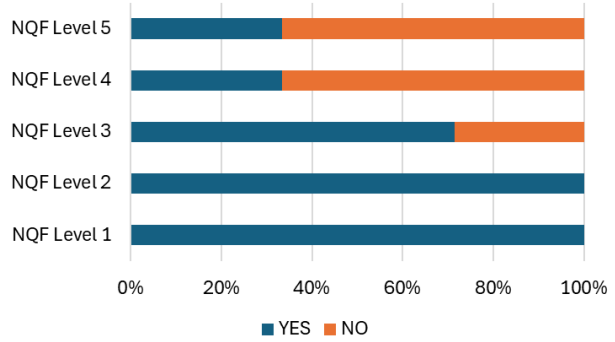
At NQF Levels 4 and 5, no VTC currently facilitates industrial attachments. Practical training, however, is compulsory for all NQF Levels 1–5 in SEIM.

Figure 9: Perceptions on (a) whether Namibia has experience in training SEIM at NQF Levels 1 to 5; (b) whether VTCs in Namibia have experience in training SEIM at NQF Levels 1 to 5

a) Namibia has experience in trainig eligible trainees at each of NQF level 1 to 5 on solar equipment installation and maintenance



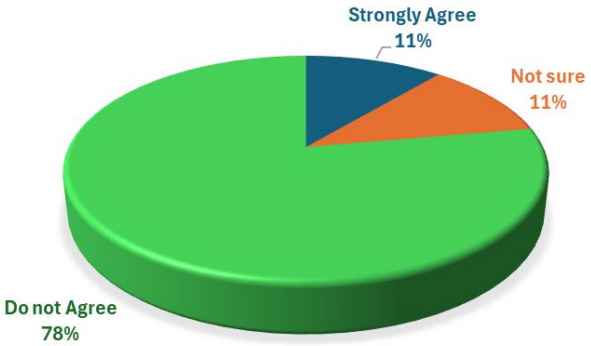
b) VTC has experience in training eligible trainees at these NQF level



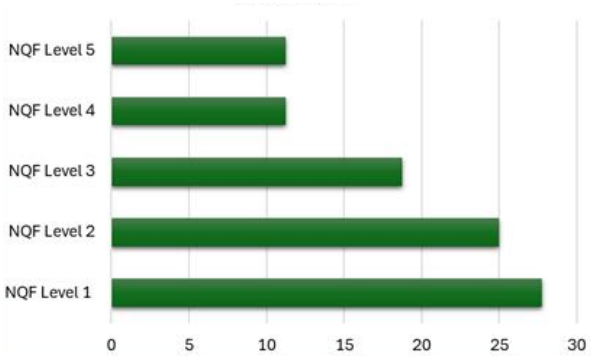
Sixty percent of consulted stakeholders either disagreed or were uncertain that Namibia has sufficient experience in training SEIM trainees at NQF Levels 1–5 or enough qualified trainers across all levels. VTCs currently offer training up to Levels 1–3, but not at Levels 4 and 5.

Figure 10: Perceptions on (a) whether there is sufficient capacity to host and train all eligible trainees at each of NQF levels 1 to 5 in Namibia; (b) whether VTCs in Namibia have experience in training SEIM at NQF Levels 1 to 5

a) There is sufficient capacity host an train all eligible trainees at each NQF level 1 to 5 on solora equipment installation and maintenance in Namibia



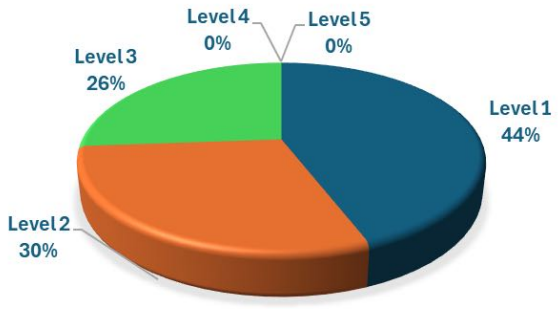
b) Average number of SEIM trainees a VTC can host and train per year



89% of consulted stakeholders either disagree or are uncertain that there is sufficient capacity to host and train all eligible trainees at each of NQF levels 1 to 5 in Namibia. The VTCs have experience in training from NQF Levels 1 up to 3, but not levels 4 and 5.

Figure 11: (a) Percentages of SEIM trainees per NQF level in 2024 in Namibia; (b) Actual number of trainees for NQF levels 1 to 5 at EVTC and WVTC in 2024

a) Average number of SEIM trainees at EVTC and WVTC in 2024



b) Number of SEIM Trainees in 2024

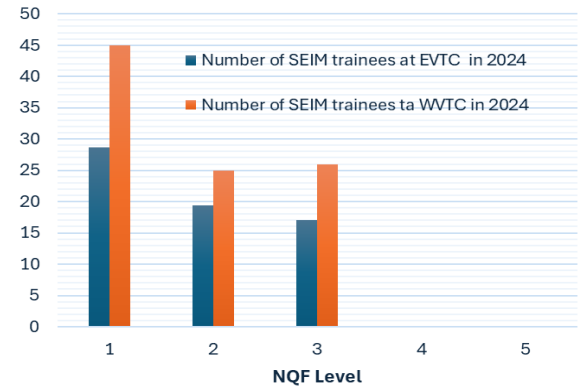


Figure 11 shows the proportion of SEIM trainees at Eenhana and Windhoek VTCs in 2024: 44% at level 1, 30% at level 2, and 26% at level 3. State-owned VTCs did not train any SEIM technicians at levels 4 and 5 in 2024.

Stakeholder perceptions Adequacy of the TVET in SEIM

A summary of the stakeholder perceptions on whether the technical and vocational training offered in Namibia is sufficient to install and maintain solar photovoltaic systems for large-scale GH_2 production indicated "NO" as the primary response, due to several reasons as follows:

- The current TVET sector has insufficient capacity to maintain and install large-scale PV systems for large GH_2 production, hence the need for upscaling the training programmes coupled with adequate investment in equipment and tools.
- The TVET sector needs greater capacity, including advanced training equipment such as mini grid-connected power plants and a range of solar technologies available on campus. More substantial support from industry is also essential. More knowledge, skills, and practical aptitude are required to install and maintain solar PV systems. When curricula cover key aspects of education, sustainability, and technology, trainees will be able to maintain large-scale solar PV systems effectively.
- Namibian sectors are largely unaware of the integration of solar energy technologies within GH_2 production. This is currently an opportunity in the market, and Namibia should enter this space and build capacity, especially at GH_2 pilot projects such as the Daures GH_2 Village and Cleanergy Solutions Namibia's H_2 Refuelling Station, which could provide industry experience.
- There is an urgent need to provide formalised, accredited training at higher levels than NQF Level 3. One or two national state-owned vocational training centres may need to specialise and start training SEIM programs up to NQF level 5. In specialised areas, qualifications may need to be developed and offered as short courses.
- More needs to be done to manufacture solar panels and other accessories in the country.

Stakeholder suggestions on improving SEIM training

Below are ten suggestions extracted from the responses to the question on how consulted stakeholders think TVET offerings in SEIM can be improved in Namibia.

- **Accredited Training Programmes for Trainers and for Trainees:** Clarity on the content and skills, definition of trainers' qualifications, and upgrading trainers with accredited qualifications are required. Accredited training programmes should be developed across vocational institutions to provide formalised training to trainees. These programmes should be designed in a way that equips trainees with practical skills and must conform to established standards.
- **Training hubs/ Specialist Centres:** Dedicate one or two VTCs as centres of specialisation in SEIM, equip these VTCs, and provide all required training support at all SEIM levels.
- **Local and International Collaboration:** Partner with established local or international institutions to collaborate on SEIM training. These may be either training institutions or industries that operate solar businesses. This will reduce the gap in solar training and enhance the development of required specialised short courses.
- **TVET Trainer Upskilling:** There is a need to upskill the TVET Trainer qualifications beyond level 3, coupled with intensive industrial attachment. The TVET trainers require substantial hands-on practical experience to enhance the existing capacity to meet the demands of the GH_2 sector. Not all TVET trainers in Namibia have the capacity to train at all Levels (1-5) of the NQF. Thus, capacity needs to be developed through Training of Trainers (ToT) initiatives to ensure they have higher-level qualifications to train at higher NQF Levels.
- **Accreditation of Trainer Courses:** Dedicated courses need to address the shortage of qualified trainers in the TVET discipline. Such ToT programmes need to be accredited to align with the targets set for the GH_2 industry.
- **Investment in Equipment and Tools up to Level 5:** There is a need for substantial investment to procure the necessary equipment and tools required for Levels 1 to 5 for various Training Providers in accordance with the unit standards/qualifications developed. The TVET unit standards are usually accompanied by a list of equipment and tools requirements for delivering such qualifications at a particular level.

Given the current developments concerning GH_2 , it is necessary to look beyond the existing lists. The TVET sector in Namibia needs significant capital investment inflow to ensure the training institutions have enough capacity to train trainees at NQF Levels (1-5).

- **Support of Accredited Private Training Providers:** The Private Training Providers, who are accredited and offer such qualifications, such as Ngato, NAMVOC, Millenium, Ondangwa Commercial College, and others, should also be considered for such assistance to enhance the necessary capacity in the country.

- **Additional content at TVET Level:** There is a need to add unit standards on SEIM to include different skill gaps, such as Monitoring systems (SCADA, IoT-based monitoring, drones), troubleshooting inverters, charger controllers, batteries, wiring, and power electronics.

Conduct awareness campaigns to educate the public on the importance of, and need for, green energy. Additional funding should be sourced and allocated to the SEIM space for programs to absorb and train students.

- **Work-integrated learning (WIL):** WIL is minimal for trainees in SEIM (SEIM) in Namibia, resulting in too many trainees passing without the compulsory on-the-job training experience or job attachment. This could be due to the small solar market compared to the traditional electrical industry. Increase job attachment to the industry; add frequent refresher training; add dedicated sessions on system sizing.

2.3 Summary

Five gaps were identified in the TVET sector in SEIM training in Namibia, and summarised in Table 5, together with recommended interventions.

Table 3: Namibian state-owned Vocational Training Centres Offering National Vocational Certificate (NVC) in SEIM

	Finding	Recommendation
a	NQF Levels 4 and 5 have not yet been offered by any state-owned VTC in Namibia despite all five levels being registered on the NQF since March 2018. The first five-year review period lapsed in 2023. VTCs have not been empowered to train SEIM Artisans and Technologists at Levels 4 and 5.	Introduce Levels 4 and 5 at training providers and review as soon as possible so SEIM training remains relevant to the industry's needs.
b	The VTCs are not empowered in terms of qualified trainers. Most of the Trainers are only qualified up to Level 3 and thus are not ready to train others at higher levels, even if some participated in organised short ToT courses.	Capacitate Trainers to offer levels 4 and 5. Structured ToT short courses are recommended for those with experience of training at Level 3.
c	All credits must be obtained before graduation. Work-Integrated Learning (WIL) is compulsory at all 5 NQF levels, but it seems to be insufficiently implemented. Placement, follow-ups, and monitoring mechanisms are not sufficiently organised, possibly because links between VTCs and industry are not well developed. The absence of WIL produces an inadequately trained Artisan, even at the levels 1 to 3 being offered currently.	VTCs must be encouraged to collaborate with industry so that adequate WIL placement, follow-up, and monitoring are done. NTA may have to withhold certification until all requirements are met and verified. NTA should support industrial attachment by paying an allowance to the industrial trainee as a loan to be paid back later.
d	There is limited capacity at VTCs, which can take in an average of less than 30 trainees per level per annum. Large-scale GH2 may require more technicians, who may also need to be highly trained in specialised SEIM skills. Only Eenhana VTC, Windhoek VTC, and a private provider offer SEIM at Levels 1 to 3.	Dedicate one or two state-owned VTCs as centres of specialisation in SEIM, equip these VTCs and provide all required training support at all SEIM levels.
e	No Diploma-Level SEIM training is offered in Namibia, neither at VTCs nor at the university level. NUST has started training TVET trainers, but the entry requirements are above level 5 and cannot be met by most applicants (TVET trainers).	For SEIM qualifications, NQF levels 5 and 6 should be offered and Diplomas issued. In the case of Level 6, the unit standards still need to be developed and registered on the NQF. Issues of articulation from certificate to Diploma, and to degree level must be addressed.

3 CONCLUSIONS AND RECOMMENDATIONS

3.1 Conclusions

Capacities and skills may be significant limitations in realising local inclusion in the workforce and supply chain. Skilled professionals will be in high demand in Namibia for ongoing large infrastructure projects, such as solar equipment installations for the GH_2 industry.

The key areas where skills are lacking include engineering and technical skills, construction workers, and higher education and training. There are gaps in vocational education and higher education, particularly in providing adequate training and qualified trainers for green solar photovoltaics and GH_2-related courses.

Furthermore, the report strongly identifies existing skills enhancements that include aspects of hydrogen appreciation.

Namibia requires a coordinated effort between the government, educational institutions, and the private sector to address these skills gaps. The crucial steps are to enhance the relevance of education and training programs, invest in skills development, and create incentives for skilled professionals to stay and work in Namibia.

3.2 General Recommendations

Based on our comparative analysis, we propose the following recommendations to enhance the Namibian National Vocational Certificates:

- **Enhance Practical Exposure:** Integrate additional hands-on practical modules that provide real-world installation and testing experiences through laboratory and workshop sessions, fieldwork, and simulated training environments.
- **Deepen Advanced Technical Content:** Expand NQF Levels 4 and 5 to include comprehensive training in: Advanced Design: Detailed modules on grid-tied and hybrid system design, system sizing, load analysis, and integration with existing infrastructure. Solar Water Heating: Dedicated content focusing on solar water heating principles, installation, and maintenance.
- **Introduce Business and Entrepreneurial Training:** Incorporate units covering business management, financial planning, and legal considerations, thereby preparing graduates for self-employment and leadership roles in the solar industry.
- **Expand Maintenance and Troubleshooting Skills:** Augment the curriculum with advanced diagnostic tools and techniques, including case studies, simulation-based training, and extended modules on inverter, controller, and battery management.
- **Consider Tiered Certification Levels:** Adopt clearly defined certification levels or pathways from basic installation to advanced system design and business management - to ensure a smooth progression that aligns with evolving industry standards.

3.3 Recommendations for Training Measures in Solar Equipment Installation and Maintenance

Any high level technician should be exposed to content that includes a short review of PV systems; fixed and tracking PV mounting systems, design, installation and maintenance; stand-alone DC PV System Design; stand-alone AC PV system design; storage systems and their maintenance; large stand-alone PV system design; stringing of solar panels in series and in parallel; combiner boxes; string inverter(s); cable sizing and connections; large battery storage systems (Li- ion batteries); interface with the grid (theory and practice); net metering; common faults – diagnosis and repair procedures.

The recommended short courses, particularly for Training-of-Trainer (ToT) initiatives, are designed to equip trainers to teach at NQF Levels 4 and 5.

Individual experts from UNAM, NUST, NamPower, and the private sector could deliver such training in partnership with organisations like GIZ. In 2022, GIZ, financed by the European Union and Germany, procured equipment, solar systems, and conducted ToT initiatives on PV systems at EVTC, enabling the introduction of SEIM at NQF Level 3.

Table 6 briefly describes the recommended courses based on the skills gaps. It is important to note:

- Each recommended short course should be formally developed and accredited to ensure trainers are motivated to participate.
- These courses are not for beginners, but for those with knowledge and experience at or above NQF Level 3, such as VTC trainers.
- Each course is expected to run for one week (five days of content plus one day of field visits) and is presented in order of priority.

Table 6: Recommended short courses for upskilling TVET Trainers on SEIM

	Short Course Working Title	Aim of Training Measure	Content
1	Grid connected photovoltaic systems	To upskill NQF Level 3 trainers so that they can train students at levels 4 and 5 on grid-connected PV systems.	Renewable Energy Systems; Stand-Alone DC, and AC PV Systems; Inverters; Series and parallel stringing; Necessary Conditions for Grid Interfacing; Fault Detection; Control and Maintenance.
2	Large pv electrical storage systems	To upskill NQF Level 3 trainers so that they can train students at levels 4 and 5 on large PV electrical storage systems.	Renewable Energy System Components; Intermittence and Remedies for Baseload Supply; Electrical Energy Storage Systems; Concepts of State of Charge, Depth of Discharge, Charge – Discharge Cycle, Lifetime; Connection in large storage Systems; Settings optimum operation; Lifecycle Analysis of PV Systems; Setting up; Fault detection and Maintenance of large storage systems.
3	Solar tracking	To upskill the NQF level 3 trainers to train students at levels 4 and 5 on SEIM, especially on large systems.	The solar energy resource; Mounting structures for optimum collection; Fixed, Single and Double Axis Tracking; Benefits; Control and Maintenance
4	Hybrid baseload green hydrogen – photovoltaic systems	To introduce trainees to baseload photovoltaic systems.	Hydrogen as a renewable energy storage medium; Production of green hydrogen; Retrieval of stored energy through fuel cells; Fault detection; Maintenance.
5	Solar thermal power systems	To introduce trainees to concentrated solar thermal power systems.	Solar tracking; Concentration of Solar Radiation; Parabolic concentrators; Parabolic troughs, Heliostats; Thermal power generation; System Maintenance.

All the proposed short courses could be integrated into potential NQF Levels 6, 7, and 8, helping to close the gap identified for diploma-level training in SEIM.

Training providers should involve local universities in every case, collaborating with relevant private sector partners and bodies. Experts from institutions such as UNAM, NUST, and NamPower could deliver pilot courses or be directly involved in their development.


THE EENHANA VTC SOLAR PHOTOVOLTAIC (PV) PLANT WAS OFFICIALLY INAUGURATED BY HON. DR. ITAH KANDJII-MURANGI, MINISTER OF HIGHER EDUCATION, TECHNOLOGY AND INNOVATION ON 16 AUGUST 2024.
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