

BQA NCQF QUALIFICATION TEMPLATE

SECTION A: QUALIFICATION DETAILS													
QUALIFICATION DEVELOPER (S)				<i>Department of Teacher Training & Technical Education</i>									
TITLE		<i>Diploma in Renewable Energy Engineering</i>						NCQF LEVEL		6			
STRANDS (where applicable)		1. 2. 3. 4.											
FIELD		<i>Manufacturing, Engineering and Technology</i>						CREDIT VALUE		370			
SUB FIELD		Engineering and Engineering Trades											
New Qualification		✓		Legacy Qualification				Renewal Qualification					
								Registration Code					
SUB-FRAMEWORK		General Education				TVET		✓		Higher Education			
QUALIFICATION TYPE		Certificate	I	II	III	IV	V	Diploma	✓	Bachelor or			
		Bachelor Honours				Post Graduate Certificate				Post Graduate Diploma			
		Masters						Doctorate/ PhD					
Qualifications Authority													
RATIONALE AND PURPOSE OF THE QUALIFICATION													
RATIONALE: Renewable Energy has been identified as one of the occupations in high demand in Botswana and beyond (HRDC Occupations pg 20). The occupations or the skills are needed by mining, agriculture, construction, tourism and public. This is based on the Labour Market Analysis conducted by the HRDC. The qualification Diploma in Renewable Energy Engineering is developed as a response to the need established by Human Resource Development Council Report (HRDC 2019): Top Occupations in Demand, which identified Renewable Energy Technicians as one of the occupations in high demand in Botswana.													

Furthermore, qualification has been developed in line with Botswana Government's Vision 2036 which acknowledges Technical and Vocational Education Training (TVET) as one of the key contributors to economic growth and employment creation (page 17) and NDP11 (page 71) The Vision further emphasizes implementation of curriculum which is aligned to the needs of the economy

Renewable energy is a form of sustainable and green energy. Botswana is one of the countries in the world that has an abundance of renewable energy sources such as sunshine almost throughout the year. NDP 11 emphasizes that through the up scaling of renewable energy sources the Government will not only address its energy insecurity concerns but will meet its climate change protocol targets.

Renewable energy has an important role to play in Botswana as it will meet future energy needs in both rural and urban areas as well as uplifting the livelihood of the people. The country will reduce the cost and dependency on power imports and will renewable energy will augment the existing national power supply. It is a form of clean energy that at the same time mitigate climate change and it is reliable Renewable energy comes from the natural flow of sunlight, wind, or water around the earth therefore Botswana can capture some of the energy and use it for domestic and commercial purposes.

Botswana has the potential to generate power or electricity which will be also sustainable and cost effective as reported by IRENA –RRA Botswana (Renewables Readiness Assessment Botswana) on pg 48 that Botswana presents considerable opportunities, particularly for solar energy but also from biomass sources. The report continue to emphasize that if the resources are utilized to their full capacity. The untapped referable resources have the potential to reduce the country's dependency on fossil-based energy tremendously, enhancing energy security, addressing issues of climate, increasing access to modern energy services and local economic development.

This qualification has been developed in line with Botswana Government's Vision 2036 which acknowledges Technical and Vocational Education Training (TVET) as one of the key contributors to economic growth and employment creation (page 17) and NDP11 (page 71). The Vision further emphasizes implementation of a curriculum which is aligned to the needs of the economy, business, science, mathematics and technology (page 20).

Furthermore, the Continental Education Strategy for Africa 2016 – 2025 stipulates that there is a need to expand TVET opportunities at both secondary and tertiary levels and strengthen linkage between the world of work and education and training systems.

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PURPOSE: (itemise exit level outcomes)

The purpose of this qualification is to produce graduates with advanced knowledge, skills and competencies to:

- implement relevant health and safety environment and quality regulations in engineering discipline
- Apply renewable energy principles to develop innovative technological solutions for renewable energy challenges
- Design energy storage systems in both renewable and non-renewable energy supply system
- Design, develop and implement renewable energy systems and technologies to create a more sustainable environment.

MINIMUM ENTRY REQUIREMENTS (including access and inclusion)

Minimum entry requirement for this qualification is as follows:

- Certificate IV, NCQF Level 4 (General Education or TVET Intermediate Certificate)
- Applicants who do not meet minimum entry will be absorbed through RPL and CAT according to the ETP's policies aligned to National RPL and CAT policies

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SECTION B QUALIFICATION SPECIFICATION	
GRADUATE PROFILE (LEARNING OUTCOMES)	ASSESSMENT CRITERIA
1. Apply mechanical, electrical & electronics engineering principles to solve engineering problems	1.1 Measure mechanical, electrical, and electronic quantities using appropriate measuring and testing equipment 1.2 Analyse measurements of mechanical, electrical & electronics quantities using graphs and charts 1.3 Implement mechanical, electrical & electronics practices and standards 1.4 Analyse the principles of biogas, wind energy, solar (thermal & PV) systems. 1.5 Simulate engineering scenarios using Engineering applications software

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	1.6 Calculate thermodynamic parameters for renewable energy systems 1.7 Implement and monitor environmentally friendly and energy efficient practices and standards
2. Design engineering drawings used in Renewable Energy engineering industry	2.2 Analyse types of Renewable Energy engineering diagrams and associated documentation 2.3 Draw and develop Renewable Energy engineering diagrams using application software 2.4 Implement the engineering drawings as per the set standards
3. Apply professional skills(ethics) for installation of renewable energy systems	3.1 Plan and carry out installation of renewable energy system 3.2 Test and commission an installed renewable energy system according to set standards. 3.3 Monitor the performance of a renewable energy system 3.4 Evaluate an installation project of a renewable energy system
4. Carryout maintenance and repairs procedures for renewable energy systems according to the required standards	4.1 Interpret constructional arrangements, functions and operations of systems and components 4.2 Plan and carry out maintenance of systems and components. 4.3 Repair components and systems using relevant service equipment, tools and techniques. 4.4 Disassemble and assemble systems and components in accordance with manufacturer's specifications.
5. Apply engineering mathematical skills to analyse systems in renewable energy discipline	5.1 Perform calculations to solve renewable energy problems 5.2 Employ engineering mathematical concepts and principles within renewable energy field in

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	accordance with repair and maintenance procedures 5.3 Perform engineering mathematics skills to analyse circuits and systems in electrical and electronics engineering
6. Execute professional skills (generic) applicable in renewable energy discipline.	6.1 Employ ICT skills in renewable energy engineering to execute the assigned tasks 6.2 Use applicable skills to communicate effectively, and efficiently (oral and written,) in renewable energy field 6.3 Apply entrepreneurship practical skills in a business set up of renewable energy industry 6.4 Perform administrative duties within renewable energy discipline 6.5 Employ professional skills to carry out research in renewable energy discipline 6.6 engage in critical thinking by analyzing situations, constructing and selecting viable solutions to solve problems
7. Execute health and safety measures to ensure a health and safety compliant environment	7.1 Adhere to health and safety regulations in the workplace to minimize risks and accidents 7.2 Apply and monitor occupational, health and safety regulations, codes and practices in the work place to ensure best safety practices 7.3 Report injuries and accidents in the work place to comply with health and safety reporting procedures
8. Generate renewable energy in a sustainable manner	8.1 Evaluate the operation and maintenance tasks required for operation of renewable energy installations 8.2 Generate energy in a cost effective and sustainable manner or practice 8.3 Analyse the energy system from electricity generation, consumption and production factor in the economic system and the functioning of the various energy markets

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	8.4 Apply strategies addressing environmental and sustainable issues in the energy sector 8.5 Implement and monitor energy sector environmental and sustainable policies and procedures 8.6 Analyse impact of engineering activity on society and the environment. 8.7 Implement and commission renewable energy project
9. Employ the skill to work as an individual, team, and as multidisciplinary in the workplace	9.1 Adhere to development personal competency plan as per set standards 9.2 Work effectively and efficiently as a team member by contributing towards workplace set goals and objectives 9.2 Build and sustain an innovative work environment to enhance working relationship among different disciplines 9.3 Apply engineering code of ethics in the work environment
10 Apply engineering management skills in the workplace	10.1 Adhere to continuous professional development schedule in the workplace 10.2 Use information management system according to workplace standards 10.3 Employ knowledge and understanding of engineering management principles and economic decision-making in Renewable Energy Discipline 10.4 Implement , monitor, policies and procedures for environmentally sustainable work practices

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SECTION C	QUALIFICATION STRUCTURE				
COMPONENT	TITLE	Credits Per Relevant NCQF Level			Total Credits
		Level [3]	Level [5]	Level [6]	
FUNDAMENTAL COMPONENT Subjects/ Courses/ Modules/Units	Occupational Health & Safety		6		6
	Introduction to Computing		8		8
	Entrepreneurship		8		8
	Communication Skills		8		8
	Introduction to Research Methods			8	8
	Engineering Ethics			8	8
CORE COMPONENT Subjects/Courses/ Modules/Units	Engineering Mathematics		18	18	36
	Electrical Workshop Practice		15		15
	Electrical Engineering		23		23
	Electrical Engineering Drawing		10		10
	Electronics		14	14	28
	Measurement and Instrumentation		12		12
	Electrical Computer Aided Drawing			10	10

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	Electrical Machines			14	14
	Foundations of Renewable energy			13	13
	Wind Energy			11	11
	Grid connected renewable Power Technology			13	13
	Bio Energy			11	11
	Solar Photovoltaic Systems			12	12
	Alternative Energy Systems			14	14
	Integrated Research Project			30	30
	Work placement			60	60
STRANDS/ SPECIALIZATION	Subjects/ Courses/ Modules/Units	Credits Per Relevant NCQF Level			Total Credits
		Level []	Level [5]	Level [6]	
1.	N/A				
2.					

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Electives	Microprocessor Based Systems			12	12
	Power Electronics			12	12
	Programmable Logic Controllers			12	12
SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL					
TOTAL CREDITS PER NCQF LEVEL					
NCQF Level			Credit Value		
Level 5			122		
Level 6			248		
TOTAL CREDITS			370		
Rules of Combination: (Please Indicate combinations for the different constituent components of the qualification)					
Fundamentals NCQF 5= 30 Fundamental NCQF 6 = 16 Core NCQF 5 = 92 Core NCQF 6=220 Electives Level 6= 12 Total Credits 370 There are three electives at level 6 and the candidate chooses 1 The candidate has to pass all the fundamental, core and chosen elective module(s)					

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BOTSWANA
Qualifications Authority

ASSESSMENT ARRANGEMENTS

Documentation

All necessary documents including: qualification document, alignment matrices, assessment instruments and Assessment criteria/rubrics should be available.

Formative (60%)

The contribution of formative assessment to the final grading shall be 60%

Summative Assessment (40%)

The contribution of summative assessment to the final grade shall be 40%

Assessment shall be carried out by BQA registered and accredited Assessors

MODERATION ARRANGEMENTS

Internal and external moderators to be engaged will be BQA accredited subject specialists in relevant fields with relevant industry experience and academic qualification.

RECOGNITION OF PRIOR LEARNING

Recognition of Prior Learning (RPL) will be considered for the award of the credits according to applicable RPL policies

CREDIT ACCUMULATION AND TRANSFER

Credit Accumulation and Transfer will be considered for the award of the credits according to applicable RPL policies

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Horizontal Articulation(related qualifications of similar level that graduates may consider)

- Diploma in Electrical & Electronics Engineering
- Diploma in Control & Instrumentation Engineering
- Diploma in Mechanical Engineering
- Diploma in Industrial Engineering
- Diploma in Refrigeration Engineering
- Diploma in Solar Energy Engineering

Vertical Articulation(qualifications to which the holder may progress to)

- BSC Degree in Renewable Energy Engineering
- BSC Degree in in Control & Instrumentation Engineering
- BSC Degree in Electrical & Electronics Engineering
- BSC Degree in Industrial Engineering
- BSC Degree in Solar Energy Engineering

Bachelor of Technology in Renewable Energy Technologies

Employment Pathways

On successful completion of this qualification the holder may be absorbed in the job market as:

- Renewable Energy Technician
- Solar Energy Technician
- Electrical/ Electronics Technician
- Instrument Mechanic
- Assistant Maintenance Engineering Technologist
- Assistant Service Engineering Technologist
- Assistant Field Service Engineering Technologist
- Assistant Solar Technologist
- Assistant Wind-farm Technologist
- Assistant Wind-turbine Technologist

QUALIFICATION AWARD AND CERTIFICATION

Qualification Award

- Candidate meeting the required minimum of 370 credits will be awarded Diploma in Renewable Energy Engineering in accordance with the qualification composition rules and applicable policies.

Certification

There will be certification upon awarding of Diploma in Renewable Energy Engineering qualification.

SUMMARY OF REGIONAL AND INTERNATIONAL COMPARABILITY

Introduction

. Diploma in Renewable Energy Engineering is a three year qualification which aims to produce Renewable Energy Technician graduate, with knowledge and skill that meets the needs of the industry. The developed qualification has two entry levels which are for holders of NCQF Level IV (BGSCE) and NCQF level V (Artisans).

The qualification has been benchmarked with other qualifications from Namibia (National Institute of Technology: NIT) and Australia (TAFE NSW). NIT qualification is at NQF level 5 and Level 6 (standalone diploma qualifications with exit point at each level: Level 5 is pre-requisite for level 6). TAFE South Australia is at NQF Level 5 which is for holders of NQF Level 4 (Artisans). The developed qualification NCQF maximum level is ten (10), NIT NQF maximum level is also ten (10) while for TAFE Queensland is level 12, but the content and the depth is equivalent.

Title of Qualifications

The title for the developed qualification is Diploma in Renewable Energy Engineering whereas for TAFE- NSW is Diploma of Renewable Energy Engineering while for NIT is Diploma in Renewable Energy Technologies. The naming of the developed and benchmarked qualification(s) are similar names of the benchmarked qualifications and all produce a Technician with similar competencies.

Duration and Level

NIT has two diplomas which are at NQF Level 5 (with exit point) and NQF level 6 and level 5 it's a pre-requisite for level 6. The duration for NIT qualification is one (year) for each level and enrollment is for candidates with Recognition of Prior Learning. TAFE NSW is at NQF level 5 duration running from one (1) to two (2) years whereas the developed qualification is at NCQF level

6 with three (3) years duration. Australia NQF ends at level 12 and Namibia NQF and the developed qualification ends at level 10 but the content and depth is equivalent. The developed qualification has two entry levels which is for the holders of NCQF Level 4 qualification and NCQF Level 5 qualification.

Main Exit outcomes

The benchmarked qualifications and the proposed qualification have similar competencies such as (in summary) impacts of renewable energy on the environment and society, to apply code of ethics, installation and commissioning of the project and others.

Modules

The developed and the benchmarked qualification share some similar modules that covers content of Electrical Engineering(Electrical Engineering Principles), Work Placement, ICT, Grid Connected Photovoltaic Power Technology/ Grid connected renewable Power Technology, Programmable Logic Controllers, Foundation of Studies in Renewable Energy and Sustainability, Entrepreneurship, CAD and others

Assessment strategies and Weightings

Assessment strategies for the developed and benchmarked qualifications are formative and summative assessments.

The developed qualification and the benchmarked have stated that the candidate has to certify all the set minimum standards (such as all the modules should be passed including electives where applicable) of the qualification in order to be awarded a diploma. NIT candidates for level 5 have to pass all the modules and for Level 6 they should have Continuous Professional Development (CPD). The candidate of TAFE NSW is required to achieve a minimum of 760 weighting points whereas for the developed qualification a minimum of 364 credits should be achieved in order to be awarded a full qualification.

Qualification rules and minimum Standards for the award of the qualification

The proposed and the benchmarked qualifications have stated that the candidate has to satisfy all the minimum set standards in order to be awarded the diploma.

Differences

The minor difference is the naming of qualifications and modules but still in terms of content meaning the same thing

Comparability and Articulation

The students of the developed qualification can articulate horizontally (NQF Level 6) or transfer to institutions offering similar qualifications. Horizontal articulation qualifications include but not limited to: Diploma in Electrical and Electronics Engineering, Diploma in Mechanical Engineering, Diploma in Electrical Engineering and Diploma in Control and Instrumentation Engineering

Students can articulate vertically to NQF Level 7(Bachelor's Degree) since the benchmarked institutions offers a degree qualification of Bachelor's Degree in Renewable Energy Engineering. Other vertical articulation qualifications include: Bachelor's Degree in Solar and Renewable Energy Engineering, Bachelor's Degree in Control & Instrumentation Engineering, Bachelor's Degree in Mechanical Engineering, Bachelor's Degree in Electrical and Electronics Engineering, Bachelor's

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Degree in Electronics Engineering, BSC Degree in Solar Energy Engineering and Bachelor of Technology in Renewable Energy Technologies.

Graduates of Diploma in Renewable Energy Engineering can be employed locally and internationally as Renewable Energy Technician
Solar Energy Technician, Electrical/ Electronics Technician, Instrument Mechanic, Assistant Maintenance Engineering Technologist, Assistant Service Engineering Technologist, Assistant Field Service Engineering Technologist, Assistant Solar Technologist, Assistant Wind-farm Technologist and Assistant Wind-turbine Technologist

Employers for Renewable Energy Technicians include Engineering consultancies, mining, agriculture, construction, tourism, public, Power Stations.

In conclusion, the developed qualification and the benchmarked qualifications shares similar names, competencies and modules. The depth and the content is the same and the graduates can employed locally, regionally and internationally. The competencies of the skill that enables graduates to be entrepreneurs.

REVIEW PERIOD

The qualification will be reviewed every five (5) years or as and when required depending on the changing needs of the market.

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For Official Use Only:

CODE (ID)	REGISTRATION STATUS	BQA DECISION NO.	REGISTRATION START DATE	REGISTRATION END DATE
LAST DATE FOR ENROLMENT			LAST DATE FOR ACHIEVEMENT	