



REGISTERED NATIONAL STANDARD

UNIT OF COMPETENCY

Title:	Apply basic concepts in <i>Solar photovoltaic (PV)</i> for energy generation and consumption		
	Notes: <ol style="list-style-type: none"> 1. Due to safety issues inherent in working with electricity and combustible substances, all training and assessment activities must be in accordance with local industry and regulatory requirements; 2. This unit of competency has been adapted from the Pacific regional unit standard <i>SE3302(B), Apply Basic Concepts Renewable Energy for Energy Generation and Consumption</i> 		
TQF Level:	3	Credits:	6
Version:	1		
National standard code:	NS088-03		
Associated qualification (and code):	National Certificate in Sustainable Energy (Solar) Level 3 (QR-03-NQ-018-05-0504-23-01)		
Approval date:	31 August 2023	Review date:	31 August 2028
Purpose:	<p>This unit standard is for people who work, or intend to work in Energy and Energy related fields.</p> <p>Persons credited with this unit standard are able to:</p> <ol style="list-style-type: none"> 1. Identify and describe the importance of social inclusion in energy and electrification; 2. Identify and describe basic processes of solar PV systems and their applications in renewable energy generation; 3. Calculate the energy demand and resource requirements for a solar PV system; 4. Identify the environmental and <i>socio-economic</i> impacts of using solar energy. 		

Learning Outcome 1 (LO1)	Identify and describe the importance of <i>social inclusion</i> in energy and electrification
Performance standards	<p>1.1 Describe what <i>social inclusion</i> means;</p> <p>1.2 Identify different social groups in Tongan society whose lives are affected by the availability of energy;</p> <p>1.3 Explain why <i>gender issues</i> are relevant and important in solar energy development in Tonga (or any other Pacific Island you know a lot about);</p> <p>1.4 Describe the differences in the ways men and women use domestic energy;</p> <p>1.5 Identify two barriers to the participation of women in decisions related to domestic energy choices;</p> <p>1.6 Identify factors that could determine the success of any solar PV system at the household or community level in Tonga;</p> <p>1.7 Explain how social inclusivity could improve the chances of success of any small solar PV system at the household or community level in Tonga</p>
Learning Outcome 2 (LO2)	Explain the basic processes in a solar PV system
Performance Standards	<p>2.1. Identify the main components of a solar PV system (both 'on-grid' and 'off-grid'); <i>[Range include but not restricted to: solar panels, inverter, battery bank, charge-controller, cabling, racking or mounting]</i></p> <p>2.2. Identify the main differences between <i>On-grid</i> and <i>Off-grid</i> PV systems;</p> <p>2.3. Describe, orally or in writing, the functions of the main parts or components of a solar PV system;</p> <p>2.4. Identify the main energy conversion processes involved in the solar PV system studied in this unit;</p> <p>2.5. Describe the effects of one of the components in PS 2.2 not functioning properly on the overall function of a solar PV system;</p> <p>2.6. Draw a simple process flow diagram detailing the functions of the components of the Solar PV system studied in this unit as well as the key processes that take place in each component;</p> <p>2.7. Explain the advantages of a solar PV system as a preferred energy generating method for Tonga (or any other Pacific Island);</p> <p>2.8. Explain the challenges of a solar PV system as the preferred energy generating method for Tonga (or any other Pacific Island).</p>
Learning Outcome 3 (LO3)	Estimate the power available from a solar PV system throughout the seasons of the year in the Tonga
Performance standards	<p>3.1 Obtain and describe local <i>solar insolation</i> data;</p> <p>3.2 Describe the effects of various environmental factors on the power potential</p>

	<p>of a solar PV system; <i>[Range of factors include but not restricted to solar insolation, cloud cover, cyclone seasons, obstructions at a local site, etc.]</i></p> <p>3.3 Determine the average weekly, monthly and annual solar insolation based on local data;</p> <p>3.4 Estimate the power potential of a solar PV system based on local solar insolation data and available PV panel surface area at a specific site throughout the seasons in Tonga;</p> <p>3.5 Estimate the power available from the solar PV system considering the system efficiency.</p>
Learning Outcome 4 (LO4)	Calculate the <i>electrical power demand</i> from a solar PV system for a community over various timeframes
Performance standards	<p>4.1 Describe orally or in writing what it means by <i>electrical power demand</i>;</p> <p>4.2 Explain the significance of determining the electrical power demand of a community over different periods [day and night time, months etc.];</p> <p>4.3 Calculate the average weekly, monthly and annual electrical power demand for a home or organization based on the power utilizing systems available;</p> <p>4.4 Assess the electrical power demand for a community and identify the variation in power demand over various timeframes;</p> <p>4.5 Discuss key advantages and disadvantages of utilizing a solar PV system to meet the electrical power demand of the community over different timeframes.</p>
Learning Outcome 5 (LO5)	Perform a simple economic and environmental assessment of solar PV system technologies in the Tongan context.
Performance standards	<p>5.1 Identify relevant information from relevant reports and literature on the economic benefits and risks associated with solar PV systems;</p> <p>5.2 Describe, orally or in writing, the potential economic benefits as well as the risks involved in implementing a solar PV system in Tonga;;</p> <p>5.3 Estimate the potential environmental growth and risks involved in implementing a solar PV system in Tonga using baseline reports and literature;</p> <p>5.4 Perform simple cost benefit analysis of the solar PV system.</p>
Learning Outcome 6 (LO6)	Conduct a public consultation to disseminate information and seek public opinions on the potential economic and environmental impact of using solar PV in Tonga.
Performance standards	<p>6.1 Describe, orally or in writing, the key processes involved in successfully carrying out a public consultation;</p> <p>6.2 Identify a consultation topic on the economic and environmental impact of using solar PVs in one's own community;</p>

	<p>6.3 Research a relevant consultation topic and collect data and information, prepare notes and visuals;</p> <p>6.4 Plan a consultation on the economic and environmental impact of using solar PVs in Tonga;</p> <p>6.5 Present in a public gathering, on the economic and environmental impact of using solar PVs in Tonga, and answer queries</p>
Learning Outcome 7 (LO7)	Understand the environmental and social impacts of energy generation using solar PV systems
Performance standards	<p>7.1 Perform a simple <i>cost benefit analysis</i> of a solar PV system;</p> <p>7.2 Outline the advantages of solar PV systems over other stand-alone energy generating systems;</p> <p>7.3 Identify social, cultural, and governance issues that limit the use of small-scale solar PV systems in Tonga;</p> <p>7.4 Explain how the limitations identified in 7.3 above could be addressed.</p>
Pre-requisites	N/A
Co-requisites	N/A
Underpinning skills and knowledge	<p>1) Knowledge of:</p> <ul style="list-style-type: none"> a) the basic geography of the Pacific region and local cultural norms and values b) social inclusion in society (importance, types) c) basic gender equity and decision making in development initiatives d) Sun and solar energy e) solar radiation (direct, diffused, reflected) f) solar insolation <ul style="list-style-type: none"> i. global insolation data ii. local (Tonga/Pacific) insolation data g) photovoltaic effect h) solar cells i) basic operation of a solar PV system: <ul style="list-style-type: none"> i. <i>On-grid</i> and <i>off-grid</i> ii. Components iii. Costs of components and operation; iv. Power potential; v. Efficiency j) Components of solar PV system; processes and functions k) Advantages and challenges of solar PV systems in Tonga

	<p>2) Skills including:</p> <ol style="list-style-type: none"> a) Estimating the power available from a solar PV system; b) Calculate the electrical power demand from a solar PV system c) Carrying out a cost-benefit analysis of a solar PV system d) Doing a simple economic and environmental assessment of a solar PV system
<p>Assessment requirements</p>	<p><u>Methods of assessment:</u></p> <p>A range of assessment methods should be used to assess students' knowledge and application of skills, include but not restricted to the following:</p> <ol style="list-style-type: none"> i. Direct observation of students performing certain tasks such as those described in context of assessment ii. Oral questions to test relevant skills and knowledge during observation and interviews; iii. Written assessment such as: <ol style="list-style-type: none"> a. Written theory tests on basic solar PV concepts b. Student portfolios c. Reports – such as work placement reports (by work place supervisor); reviews <p><u>Context of assessment:</u></p> <p>To support student assessment and to ensure they are valid, reliable, flexible, and fair, provider institutions are encouraged to make the necessary arrangements to involve the relevant key industry organisations such as <i>Tonga Electricity Commission (TEC)</i>, <i>Tonga Power Limited (TPL)</i> and other trusted licensed private energy and electricity entrepreneurs in the assessment of the required standards and competencies. Such collaboration between provider institutions and the industry may include but not restricted to the following:</p> <ul style="list-style-type: none"> • Experts from the industry have input to the design and implementation of the curriculum and assessment activities; • Experts from the industry are engaged as trainers, assessors, or assessment moderators; • Students are placed in relevant industry organisations for workplace attachment; • Industry experts act as supervisors of students on workplace attachment • Etc. <p>To show that learner has the required level of competency they will need to demonstrate and apply their knowledge in the workplace (or in an environment that closely resembles the workplace) in relation to the Learning outcomes of the unit:</p>

	<ol style="list-style-type: none"> 1) LO1: Identify and describe the importance of social inclusion in energy and electrification; 2) LO2: Explain the basic processes in a solar PV system; 3) LO3: Estimate the power available from a solar PV system throughout the seasons of the year in the Tonga; 4) LO4: Calculate the electrical power demand from a solar PV system for a community over various timeframes; 5) LO5: Perform a simple economic and environmental assessment of solar PV system technologies in the Tongan context; 6) LO6: Conduct a public consultation to disseminate information and seek public opinions on the potential economic and environmental impact of using solar PV in Tonga. 7) LO7: Understand the environmental and social impacts of energy generation using solar PV systems. <p><u>Re-assessment</u></p> <p>Candidates of assessment are eligible to three (3) attempts to achieve the required competency within 14 days of their first attempt:</p> <ol style="list-style-type: none"> 1. Feedback must be provided to the candidate and sufficient time provided to prepare for re-assessment. 2. The trainer/assessor has the discretion to vary the assessment tasks used in each assessment attempt as long as the: <ol style="list-style-type: none"> a. same competencies are being assessed; b. principles of assessment are adhered to. <p>Failure to achieve the required competency after three (3) attempts on the exam or specific part of the</p>
<p>Moderation arrangements</p>	<ol style="list-style-type: none"> 1) Training providers must have their own moderation system approved by TNQAB before accreditation is granted: <ol style="list-style-type: none"> a. Relevant internal moderation processes are documented; b. Assessment is planned for each unit, and moderation processes are integrated into such plan 2) External moderation is conducted by the national qualifications unit of TNQAB for all unit components of a national qualification: <ol style="list-style-type: none"> a. Samples of assessed activities are submitted to TNQAB for (external) moderation; b. Moderation (external) forms are available from TNQAB on request.
<p>Resource requirements</p>	<ol style="list-style-type: none"> 1) Solar PV system consisting of at least the following components: <ol style="list-style-type: none"> i. Solar panels ii. Charge-controller

	<ul style="list-style-type: none"> iii. Storage batteries iv. Cables v. Mounting <ol style="list-style-type: none"> 2) Text books (or printed resources) on Solar PV systems at the discretion of the course/unit coordinator or trainer, 3) Student computers, Printer, Internet Access 4) Student calculators 5) Conventional classroom furniture and resources: White/blackboard, tables or benches, chairs, student notice boards
<p>Requirements to complete this unit</p>	<p>There are seven (7) Learning outcomes and thirty-eight (38) Performance Standards to measure competence.</p> <p>To demonstrate competence, the person studying this unit is:</p> <ol style="list-style-type: none"> 1. required to demonstrate all LOs to the expected standards; 2. required to attain a <i>Achieved</i> Grade (Competent) to fulfil the requirements of the Unit standard; 3. eligible to three (3) attempts to achieve the required competency within 14 days of the first attempt. <p>Failure to achieve the required competency level after three (3) attempts of the exam or specific part of the assessment will require the person studying this Unit to re-enrol for the same Unit.</p>
<p>Important notes and definitions</p>	<p><u>Notes:</u></p> <ol style="list-style-type: none"> 1. Due to safety issues inherent in working with electricity and combustible substances, all training and assessment activities must be in accordance with local industry and regulatory requirements; 2. In the event that local laws and regulations are not available, relevant laws of New Zealand or Australia should be used for training. 3. This unit of competency has been adapted the Pacific regional unit standard SE3302 (B) <i>Apply Basic Concepts in Renewable Energy for Energy Generation and Consumption</i> <p><u>Definitions:</u></p> <ol style="list-style-type: none"> 1. <i>Cost Benefit Analysis</i> - refers to a procedure used to estimate costs and profits to be made from a business opportunity 2. <i>Electrical power demand</i> is simply the demand for electricity and is defined by how much is being used at any given time 3. <i>Gender</i> refers to a range of characteristics pertaining to the state of being male or female (typically used with reference to social and cultural differences rather than biological ones).

4. *Grid (or electrical grid)* refers to the main interconnected network of electrical power lines in which electricity is delivered from producers to consumers.
5. *Social inclusion* refers to the process of improving the terms on which individuals and groups participate in society thus promoting fair access to opportunities and resources.
6. *Off-grid PV system* refers to a solar PV system that is not connected to the electricity grid. This means that all the energy produced is stored and used on site. Essentially, off-grid PV systems operate from the energy stored in a battery bank.
7. *On-grid PV system* refers to a solar PV system that is connected to the local interconnected electrical network (or 'grid'). In on-grid systems, the main 'grid' acts as the battery space when the system under or over-produces in regard to the use's varying energy needs.
8. *Socio-economic* refers to people's social status and financial situation;
9. *Solar insolation* refers to the amount of electromagnetic radiation (solar energy) incident on the surface of the earth;
10. *Solar photovoltaic (PV) system* (also known as a *solar power system*, is an electric power system that uses photovoltaics (PVs) to generate electricity. It is made up of several components, including:
 - a. *solar panels* to absorb and convert sunlight into electricity,
 - b. *solar inverter* to convert the output from direct to alternating current,
 - c. *battery bank* to store the converted energy;
 - d. *charge-controller* to protect the storage batteries from overcharging;
 - e. *cabling* for electricity to flow
 - f. *mounting* to provide support
 - g. other electrical accessories may be added to complete the system.
11. *Sustainable Energy Development* refers to the utilization of sustainable energy for economic development.

Public comments on unit

Please contact TNQAB National Qualifications Unit (email EnquireNQ@tnqab.to or Telephone 28136) if you like to discuss or suggest changes to the details of this unit.