



ECOWAS Certification for Sustainable Energy Skills (ECSES)

REGIONAL CERTIFICATION GUIDELINES
For
OFF-GRID SOLAR PHOTOVOLTAIC TECHNICIANS

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ECOWAS CENTRE FOR RENEWABLE ENERGY AND ENERGY EFFICIENCY

CENTRO PARA AS ENERGIAS RENOVÁVEIS E EFICIÊNCIA ENERGÉTICA DA CEDEAD

CENTRE POUR LES ENERGIES RENOUVELABLES ET L'EFFICACITÉ ENERGÉTIQUE DE LA CEDEAD

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Foreword

This document presents the rules and procedures for the regional certification scheme for off-grid solar photovoltaic (PV) technicians in the ECOWAS region.

The certification of technicians is a way to promote the quality and safety of PV installations. Cognizant of this need for the West Africa region, ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) and the International Renewable Energy Agency (IRENA) with support from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and other partners such as the West African Economic and Monetary Union (UEMOA), LuxDevelopment and Renewable Energy Cooperation Programme (RECP) decided to put in place a voluntary regional certification scheme for solar photovoltaic (PV) technicians that is recognized in all ECOWAS Member States to support the development of the solar energy market. ECREEE will align all structures and procedures of the certification scheme to the requirements of the standard ISO/IEC 17024:2012 “Conformity assessment — General requirements for bodies operating certification of persons”.

The regional certification scheme is based on a Job Task Analysis (JTA) for off-grid solar photovoltaic technicians that were developed with inputs from stakeholders from all ECOWAS member states. It is also based on lesson learnt from other operating certification schemes in various countries.¹

¹ The following certification schemes in the United Kingdom (Microgeneration Certification), Denmark (KSO Quality Assurance Scheme), Spain (Professional Qualification for Installers), Austria (Austrian Institute of Technology training and certification scheme), New Zealand (Sustainable Electricity Association New Zealand), Belgium (Quality Centre Sustainable Energy), USA (North American Board of Certified Energy Practitioners), the Netherlands (Kwaliteit voor Installaties Nederland), and France (Qualification des professionnels de l'électricité photovoltaïque) were taken into account.

EXECUTIVE SUMMARY

The ECOWAS Renewable Energy Policy (EREP) seeks to harmonize common standards, regional quality labelling for equipment as well as the certification of skills in order to improve the quality of renewable energy (RE) and Energy Efficiency (EE) installations within the region. For successful solar photovoltaic (PV) installations and projects, there is a need for quality assurance at various levels. This includes quality assurance of equipment e.g. through the establishment and enforcement of product standards. However, high-quality products will only provide the desired services if renewable energy systems are designed, installed and maintained by highly qualified individuals. Cognizant of this need for the West Africa region, the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) and the International Renewable Energy Agency (IRENA) with support from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and other partners decided to support the development of the regional market for RE and EE services by establishing a Regional Certification Scheme (RCS) for sustainable energy skills. The certification of solar PV technicians is a way to promote the quality and safety of PV installations within the region. This certification scheme is currently designed to cover only technicians of off-grid solar PV systems, but will gradually be extended to technicians of more complex off-grid and on-grid PV systems as well as other RE and EE professionals.

The core objective is to support the ECOWAS region in increasing the quality of solar PV professionals through a regional certification system, which is voluntary and based on unified and harmonized technical guidelines, the job task analysis (JTA). This will provide the possibility for solar PV technicians and other clean energy professionals to obtain a quality certification that is recognized in all ECOWAS member states. Also, an added value of this voluntary regional certification scheme as compared to the national certification schemes that are under establishment in some countries is that the Regional Certification Body is planning to seek ISO accreditation in the medium term, thereby strengthening the reputation of the ECOWAS Certification for Sustainable Energy Skills (ECSES) Scheme.

The regional certification scheme is designed to provide credentials for those PV technicians who demonstrate the requisite skills, abilities, and knowledge typically required to install and maintain off-grid solar PV systems. The fundamental document upon which the regional certification scheme is based is the JTA. The paramount process for getting certified is illustrated in Exhibit ES. 1.

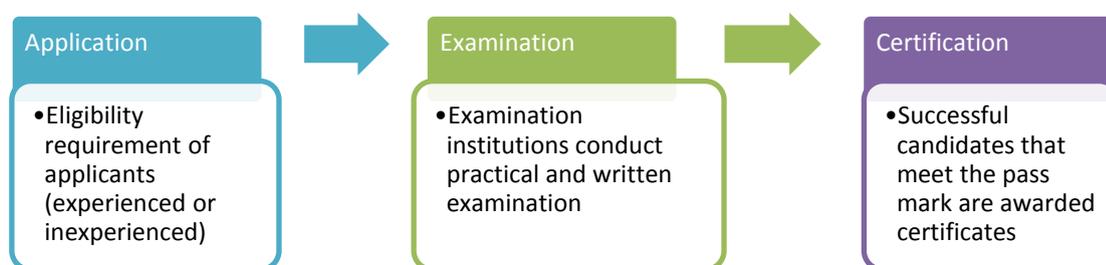


Exhibit ES.1: Process to certification

After an assessment whether the applicant meets the eligibility requirements of the scheme, the Examination Institutions will register candidates for the regional examination. Successful candidates that pass the regional examination shall be awarded a certificate that is recognized by member states. This process will ensure that barriers to the development and enhancement of the solar PV market related to poor installation are minimized in the region. It will also encourage mobility of skilled technicians across the ECOWAS region. The default modalities of the scheme as illustrated in Exhibit ES.2 will be as lean as possible, which will allow the RCB to cover wider part of the ECOWAS region.

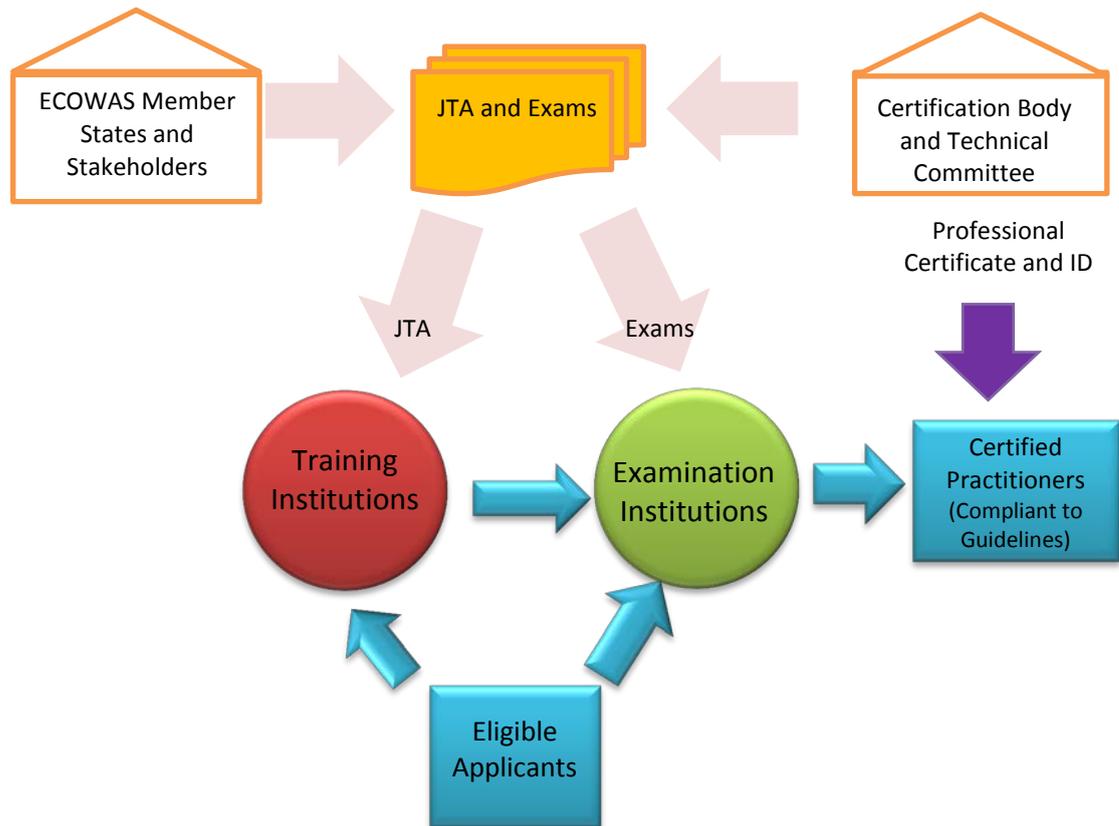


Exhibit ES.2: Default certification model



List of Abbreviations

ECOWAS	Economic Community of West African States
ECREEE	ECOWAS Centre for Renewable Energy and Energy Efficiency
ECSES	ECOWAS Certification for Sustainable Energy Skills
EE	Energy Efficiency
EI	Examination Institutions
EoI	Expression of Interest
EREP	ECOWAS Renewable Energy Policy
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HND	High National Diploma
IRENA	International Renewable Energy Agency
JTA	Job Task Analysis
NREAPs	National Renewable Energy Action Plans
PV	Photovoltaic
RCB	Regional Certification Body
RCS	Regional Certification Scheme
RE	Renewable Energy
TA	Technical Assistance
TC	Technical Committee
TI	Training Institutions
UEMOA	West Africa Economic and Monetary Union



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1. INTRODUCTION

1.1. Background

In fulfilment of the ECOWAS Renewable Energy Policy (ERP) and National Renewable Energy Action Plans (NREAPs) of Member States, the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) and West African Economic and Monetary Union (UEMOA) with support from International Renewable Energy Agency (IRENA), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and other partners initiated the Regional Certification Scheme (RCS) as a first response to promote quality installations by technicians of quality Renewable Energy (RE) and Energy Efficiency (EE) equipment within the region. This RCS is a voluntary scheme that is initially focusing on certifying the competencies and skills of off-grid PV systems technicians/installers but will gradually cover other RE and EE professions.

For successful renewable energy installations and projects, there is a need for quality assurance at various levels. This includes quality assurance of equipment e.g. through the establishment and enforcement of product standards. However, high-quality products will only provide the desired services if renewable energy systems are designed, installed and maintained by highly qualified individuals. More specifically, certification is a way to promote the quality and safety of RE and EE systems and by certification there is a reassurance that technicians/professionals have the competencies and capacities required to complete an installation or a job safely and effectively.

The RCS will provide the possibility for the technicians and professionals to obtain a quality credentialing and certificate that is recognized in all ECOWAS Member States. The added value of this voluntary regional certification scheme as compared to the national schemes that are being established in some countries is that the Regional Certification Body (RCB) will align all structures and procedures to the requirements of the standard ISO/IEC 17024:2012 “Conformity assessment — General requirements for bodies operating certification of persons” and may seek ISO accreditation in the medium to long term.

The first phase of the program started with the development of the Job Task Analysis² (JTA) for technicians of off-grid solar PV systems. The JTA was presented to stakeholders from seven UEMOA member states³ in a workshop organized in Ouagadougou, Burkina Faso by IRENA and the UEMOA in April 2015. A second workshop was organized in July 2015 to present the draft JTA to representatives of the remaining ECOWAS member states⁴ and to gain their commitment for the regional program. These two workshops marked the start of national consultation processes with solar PV experts from all ECOWAS member states to review the content of the JTA. The results of these consultations were then integrated into the final French and English versions of the JTA for off-grid solar PV systems which were validated at a regional workshop with all 15 ECOWAS member states held in Praia, Cabo Verde in December 2015 and later translated into Portuguese. During this workshop, ECREEE confirmed its willingness to serve as the RCB. The participants from the ECOWAS

² JTA defines core knowledge areas, critical work functions, and/or skills for solar photovoltaic installers.

³ The countries represented at the workshop in April 2015: Benin, Burkina Faso, Guinea Bissau, Mali, Niger, Senegal and Togo.

⁴ The countries at the workshop in July 2015: Cape Verde, Côte d’Ivoire, Ghana, Guinea, Liberia, Nigeria, Sierra Leone and the Gambia.

member states also discussed the structure of the regional certification scheme and suggested Technical Committee (TC) candidates to support ECREEE in establishing and operating the certification scheme.

1.2. Objective

The overall project aim is to support the ECOWAS region in increasing the quality of solar PV professionals through the establishment of a self-sustaining and voluntary certification scheme, based on unified and harmonized technical guidelines to ensure quality, the safety of systems and professionals. Technicians seeking these proficiencies must meet all requirements established by the scheme.

1.3. Regional Certification

This scheme is currently covering only technicians of off-grid solar PV systems, but will gradually be extended to technicians of more complex off-grid and on-grid PV systems as well as other RE and EE professionals.

The regional certification will assure (potential) clients that a certified off-grid solar PV technician has the skills and knowledge necessary to competently undertake the solar off-grid PV installation task successfully. A person who wants to be certified as an off-grid solar PV technician shall be skilled to undertake safe, quality installation and maintenance of stand-alone solar PV systems with multiple solar modules, a battery bank, controller, inverter and appliances as specified in the JTA. The JTA provides that a qualified technician shall be a person certified after demonstrating competency in

- (i) working safely with solar PV systems;
- (ii) understanding the basics of solar PV systems;
- (iii) understanding solar PV system design;
- (iv) installing all the mechanical and electrical components of the solar PV systems;
- (v) installing cables, connectors and protective devices for the solar PV systems;
- (vi) completing the installation, testing and commissioning and
- (vii) maintaining and troubleshooting of the solar PV system.

These skills will be evaluated in an examination that will be organized for the Regional Certification Body (hosted by the ECREEE secretariat in Praia) by partner examination institutions in each member state. RCB will manage the scheme with guidance and support from the Technical Committee representing all the 15 member states.

1.4. Certification Process

An applicant who wants to take the regional examination must register with an examination institution after meeting the examination eligibility requirements.

Solar PV trainees or experienced technicians who want to obtain the regional certificate can select and locate any of the approved examination institutions to register and undertake the regional examination. On the other hand, applicants that need training before undertaking the regional examination can receive training in any training institutions providing solar PV training courses covering all points of the JTA and then register with an approved examination institution before the scheduled registration deadline. The candidates that meet the minimum pass mark after undertaking the regional exam shall be awarded the regional certificate. The process from training to certification and maintaining certification is illustrated in figure 1.



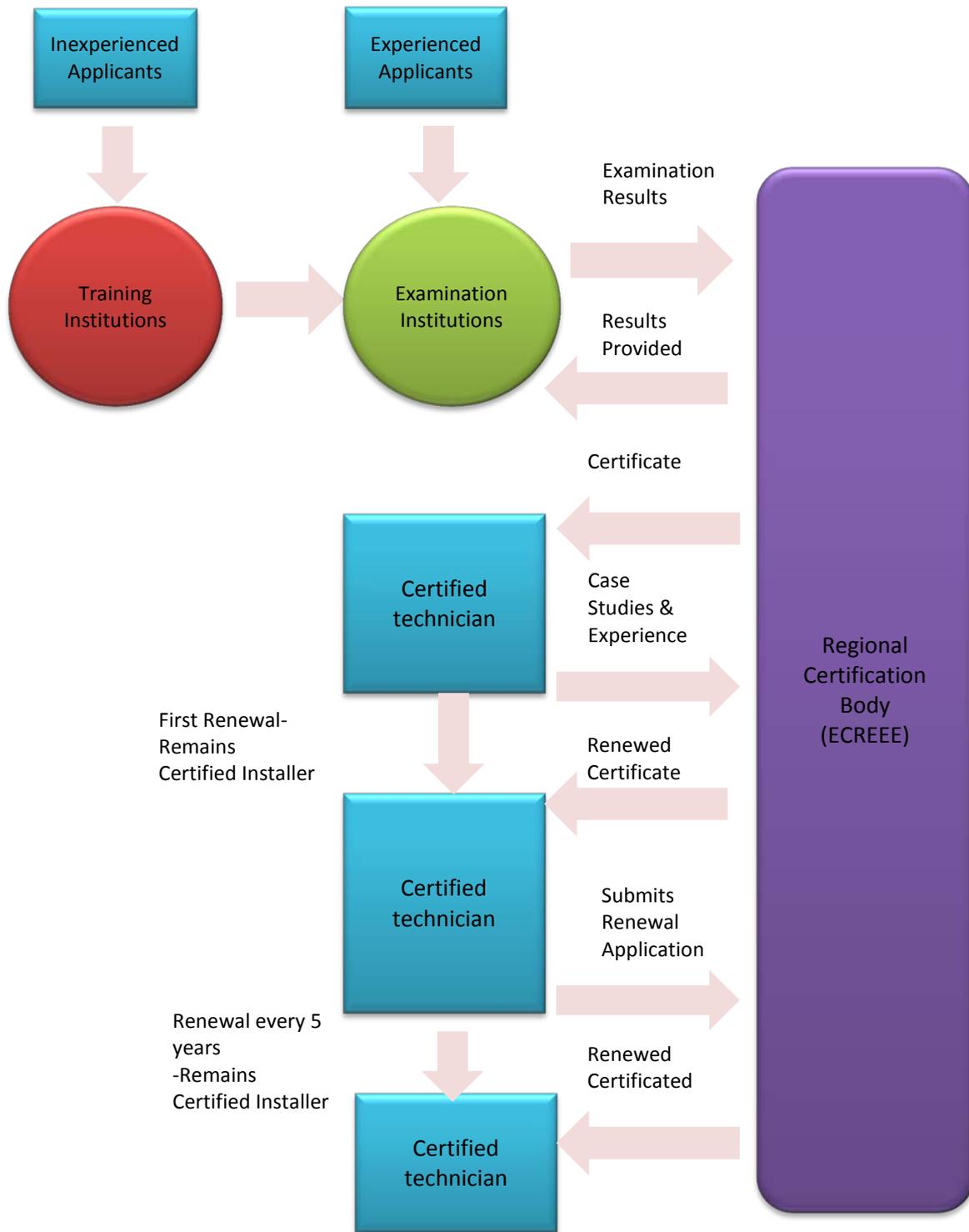


Figure 1: Training and certification process of the Scheme

1.5. Stages of Examination

The stages of the examination are practical and written illustrated in figure 2. An applicant can only be certified after passing the written and practical examination. The examination shall be designed to assess the competence of the candidates based on the JTA.

(a) Practical Examination:

The practical examination shall be based on the JTA. The applicant will be required to demonstrate skills in installing both the mechanical and electrical components of the solar PV systems including cables, connectors and protective devices.

(b) Written Examination:

The written examination shall also be based on the JTA, recommended to form the basis of the all the curriculum developed by the selected training institutions across the region. The written examination shall be practically oriented and shall involve the testing of the competency of the applicant to undertake safe, quality installation and maintenance of stand-alone solar PV systems with multiple solar modules, a battery bank, controller, inverter, and appliances.

N.B: Once the structures are put in place, the RCS may study the possibility of administering a special case examination for persons that are not highly educated but are competent and certified by other certification bodies (e.g. electricians) after they have been trained with the selected training institutions.

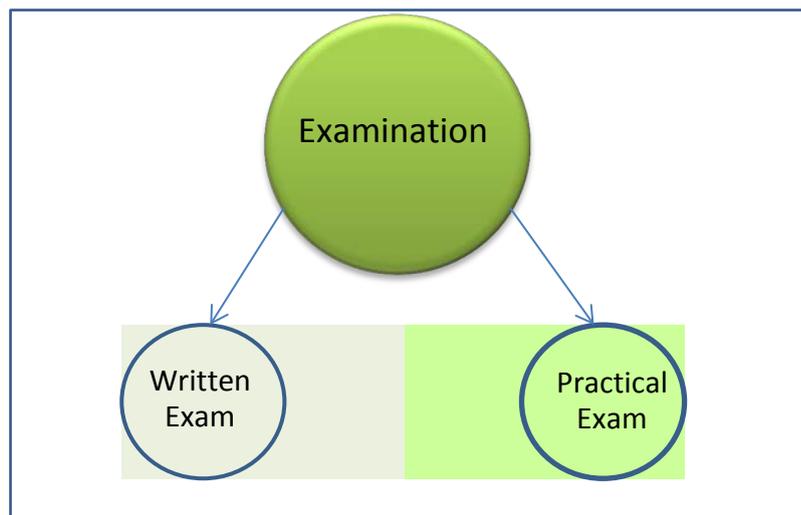


Figure 2: Stages of examination



2. REGIONAL CERTIFICATION BODY

The RCB shall create, manage and maintain a management system with the support of its partners including the Technical Committee from its Secretariat in Praia. It shall also cooperate with partner institutions of the Scheme in all ECOWAS member states as shown in table 1.

The regional certification body RCB shall ensure that all the involved parties understand the importance of impartiality in carrying out the certification activities and functions. It shall also ensure that the objectivity of the regional certification scheme is complete.

2.1 General Management Responsibilities of RCB

- 2.1.1 The RCB together with its partners and in cooperation with the Technical Committee shall manage, plan, control and lead the implementation of the key activities of the scheme.
 - 2.1.2 The RCB shall document information on the management system, the structure of the Scheme, the roles and responsibilities of partners and the RCB's activities. It shall also maintain a database including information about the applicants as well as the certified technicians (contact details, type of certificate, validity etc.).
 - 2.1.3 The RCB is responsible for the management of the scheme and shall not delegate important decisions relating to certification such as selecting and developing examination questions, awarding of certificates, recertifying, suspending and withdrawal of a certificate, expanding and reducing the scope of the scheme.
 - 2.1.4 The RCB together with the technical committee and stakeholders in solar PV shall set and pool examination questions to test the competence of candidates.
 - 2.1.5 The RCB together with the technical committee and stakeholders in solar PV shall continuously update the examination materials.
 - 2.1.6 The RCB shall select representatives as External Examiners to ensure that all conditions for the examination in an Examination Institution are set for the assessment of candidates. These may be staff members of the RCB or other qualified individuals (e.g. TC members).
 - 2.1.7 The RCB shall adopt a secure approach for delivering examination questions to the examination institution before the exams are conducted.
 - 2.1.8 The RCB and its partners shall ensure that information obtained from applicants is not disclosed to an unauthorized party without the written consent of the applicant. All confidential information must be kept safely by the EI and the RCB. The RCB and EI shall also make sure that all activities performed under the scheme do not compromise the reputation of the scheme.
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Table 1: Role of the Regional Certification Body, ECREEE

Function	Responsible	Role of RCB
Establishment and operation of the certification scheme	The RCB in cooperation with national partners, and the Technical Committee (see below)	<ul style="list-style-type: none"> Operationalize the scheme Extend the scheme to other clean energy professions (develop JTAs and exams etc.) Regular update of JTA Review and process complaints and appeals.
Training	Training institutions in all ECOWAS member states	<ul style="list-style-type: none"> Select and list training institutions conducting training courses covering all the competencies as detailed within the JTA
Examinations	Examination institutions (one or several per country) in all ECOWAS member states	<ul style="list-style-type: none"> Select partner examination institutions. Support promotion of examination. Review certification applications and select those who can undertake the examination. Provide the examination papers just prior to examination being conducted. Review the marked examination papers and determine who passed. Develop and continuously update examination materials.
Certification	RCB	<ul style="list-style-type: none"> Design logo and certificate Issue certificates and send them to the successful candidates (through EI, if applicable) Process Renewals

3. PARTNER INSTITUTIONS

The Scheme is structured to develop regional capacities in off-grid solar PV. It is designed to encourage public-private partnership. The public sector institutions that are partners to the RCB carry the needed political weight and authority to the process, while the private sector institutions have the required practical experience in training the regional technicians.

3.1 Training Institutions

It is not a prerequisite for taking the regional exam and being certified to have completed a training course with one of the registered Training Institutes (TIs listed on the RCB's website). However, the RCB will register TIs fulfilling certain requirements on its website in order to give guidance to individuals who are looking for quality solar PV courses that they can attend to prepare for the regional exam. The registered TIs will be listed on the RCB's website upon request after an assessment of whether they meet the requirements

The RCB will work with Training Institutions to be sure they meet specified conditions so that they can be listed on the RCB website as registered TIs offering courses that follow the approved Job Task Analysis (JTA).

3.1.1 Procedure for Training Institutions to be registered with the RCB

3.1.1.1 A Training Institution fills out an application form (**Schedule VIII** refers) and submits it to the RCB with all relevant supporting documents (listed in 6.1.1.2) including a receipt confirming the payment of [USD100] for the application fee.

3.1.1.2 The Relevant documents that must be submitted include:

- a. Copy of the curriculum (one for each relevant course/training module)
- b. A complete checklist (**Schedule IX** refers) mapping the curriculum to the Job Task Analysis (one for each relevant course/training module)
- c. Curriculum Vitae's of the trainers
- d. List of equipment available for conducting practical training
- e. Form(s) with information about the courses given during the last two years

3.1.1.3 The RCB shall have the documentation reviewed and if satisfactory the TI will be listed on the RCB website.

3.2 Examination Institutions

The RCB will select qualified EI to serve as the local partner institution for organizing the exams. The selected Examination Institutions shall support the RCB administer examinations as it keeps the credibility and impartiality of the Regional Certification Scheme.

It is preferred that Examination Institutions are not Training Institutions listed under the scheme. If in the future when more JTAs have been developed an EI could be a TI for a specific Regional JTA(s), however, the EI cannot conduct Regional Examinations based on that specific Regional JTA(s).

4. TECHNICAL COMMITTEE

During the validation workshop of the JTA for off-grid solar PV technicians held in Praia, Cabo Verde in December 2015 the participants from the ECOWAS member states suggested Technical Committee (TC) candidates to support the RCB in establishing and operating the certification scheme. As such, ECREEE has formed a Technical Committee with representatives from each of the 15 ECOWAS member states that serves as an advisory group to the RCB and is consulted at key stages of the implementation and further development of the RCS. The Technical Committee members will have a maximum 4 year term. The Technical Committee members support the RCB in undertaking the following activities to help achieve the objectives of the regional certification scheme:

- A. Participate in the review process of relevant documents such as:
 - The Guidelines for Regional Certification, the selection criteria for additional training institution, the assessment and examination framework, the certification decision, and maintenance of the certification processes. Consultations with national stakeholders.
 - The Job Task Analysis for the higher level of professionals within the solar PV industry and for other RE and EE professionals as needed.
- B. Inform national stakeholders (potential solar PV technicians, training institutions, government representatives, solar companies) about the details and benefits of the certification program.
- C. Participate in Sub-Committees comprising a minimum of 3 members to undertake complaint reviews and investigations.
- D. Participate in examination and JTA sub-committees.

The selected Technical Committee members are listed in Table 2.

Table 2: Technical Committee members

1	Country	TC Member	Association or institutions
1	Benin	Faustin Dahito	Association Interprofessionnelle des Spécialistes des Energies Renouvelables
2	Burkina Faso	Emmanuel Kabore	Association des Professionnels de l’Energie Solaire
3	Cabo Verde	Emílio Benrós	Lobosolar
4	Côte d’Ivoire	Mohamed K. Sako	Institut National Polytechnique Félix Houphouet-Boigny (INP-HB) de Yamoussoukro
5	Gambia	Ya Awa Njie	Gambia Technical Training Institute
6	Ghana	Nana K.S.	Association of Ghana Solar Industries (AGSI) / Ghana

		Asamoah	Inspection Council for Electrical Installation Contracting
7	Guinea	Aissatou Billy Sow	Centre de Recherche Scientifique de Conakry Rogbane
8	Guinea-Bissau	Soares Faustino Vaz	Direcção Geral da Industria
9	Liberia	Stephen V. Potter	Rural and Renewable Energy Agency
10	Mali	Alhoussein Issa Maiga	Centre National de l'Energie Solaire et des Energies Renouvelables
11	Niger	Saïdou Madougou	Université Abdou Moumouni de Niamey
12	Nigeria	Olunrinde E. Lafe	Federal University of Technology Akure (FUTA)
13	Senegal	Sidy Bouyan Ndiaye	Agence Nationale pour les Energies Renouvelables
14	Sierra Leone	Mohamed A. Jalloh	National Council for Technical and Vocational and Other Academic Awards (NCTVA)
15	Togo	Komi Apéléké Amou	Université de Lomé

5. SCHEDULES AND OPERATIONAL PROCEDURES

5.1 Schedules of Certification

The certification schedule covers the procedure and the timeline that must be adhered to by the applicants and the partner institutions (Fig. 3 refers).

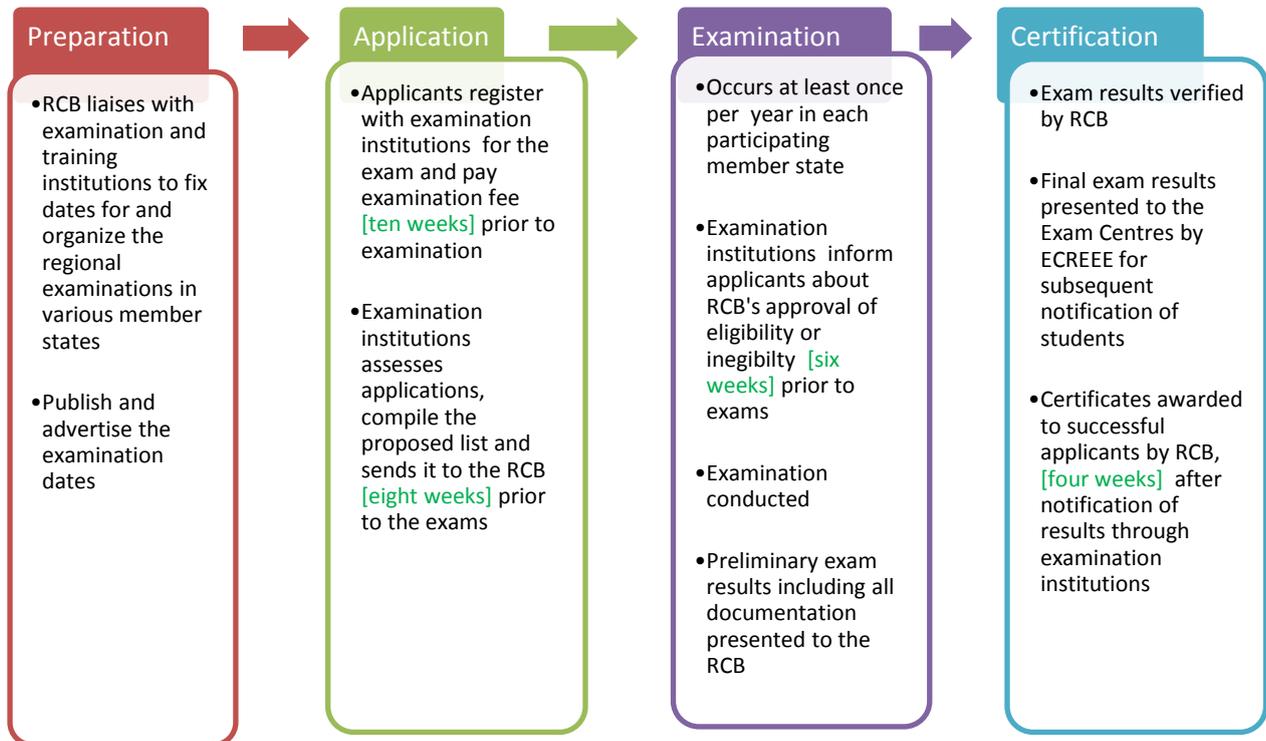


Figure 3: Certification timelines for the Scheme.

5.2 Preparation of the Examination

5.2.1 The RCB, with support from the national partner institutions, shall make provision and plan the functions and activities of the certification scheme in member states.

5.2.2 The RCB shall work with the respective examination institution to fix a date and organize of the regional examination. The EI and the RCB shall make publicity for the exam on various platforms at the national level.

5.3 Who is eligible for the Regional Certification Scheme?

The eligibility requirement for registering and taking the regional examination is illustrated in **Schedule III**. In brief, it requires that an applicant [must be at least 18 years of age]:

- a) with at least two (2) years of practice as a solar technician; or
- b) with at least two (2) years of practice as an electrician; or

- c) has completed a training course conducted by a Training Institution that covered all the contents of the approved regional JTA;

can register for the regional examination.

Applicants with a Diploma, Certificate, Bachelor, Master degree and beyond in fields related to electrical, mechanical, structural, or civil engineering, or architecture are eligible for regional certification and can also register for the examination.

It is recommended that all applicants undertake the sample examination that can be found on the website to determine their preparedness for undertaking the actual examination before registering at an Examination Institution.

5.4 Registering for the Regional Certification Scheme?

- 5.4.1 The dates of the upcoming examinations are published by the Examination Institution in the respective country and/or by the RCB.
 - 5.4.2 An applicant must complete an application form (Schedule I refers) and submit it to the Examination Institution with all relevant supporting documents
 - 5.4.3 The Examination Institution shall check if the application is complete and signed by the applicant seeking regional certification.
 - 5.4.4 The Examination Institution shall prepare and share a list with the RCB of:
 - a) the registered applicants together with all attachments at least [ten weeks] before the exam.
 - b) those who applied who were found to be ineligible.
 - 5.4.5 The RCB shall review and confirm which applicants meet the criteria and notify the Examination Institution of their eligibility.
 - 5.4.6 The RCB shall notify the applicants [by email] that they are:
 - a) eligible to undertake the examination if and only if they complete the examination registration form (Schedule II refers) and pay the required examination fee; or
 - b) eligible to undertake the examination but the advertised course has no vacancies and they will be informed on when the next examination is available; or
 - c) ineligible and provide the reasons why?
 - 5.4.7 The candidate that is eligible for sitting the examination shall:
 - a) sign a declaration that he/she agrees to abide by the RCB's Code of Conduct (see Annex 1) and follow the Industry Best Practice Guidelines (see Annex 2) and
 - b) submit a the acceptance form (Schedule II refers) with the examination payment receipt to the examination institution [2 weeks]) before the scheduled examination. The examination fees are non-refundable.
-

5.5 What is the Examination Process for the Regional Certification Scheme?

- 5.4.8 The EI shall follow the procedures of the “Guidelines for Conducting Examination for the Regional Certification Scheme” when conducting the regional examination.
- 5.4.9 The EI shall check the identity of the candidates and ensure that the candidates abide by the examinations rules.
- 5.4.10 Practical examinations will be done and marked on the spot [with possible overseeing by selected RCB representative].
- 5.5.1 If a candidate is found cheating during the examination, the RCB with the support of the Examination Institution and examiners shall
- a) give a strong warning to the candidate and if the candidate persists
 - b) stop the candidate from finishing the examination and inform him/her that he/she is ineligible to participate in RCS examinations within 12 months.
- 5.5.2 The EI shall request that all examination candidates complete the survey form (**Schedule V** refers)
- 5.5.3 The completed written examinations scripts will be evaluated by the Examination Institution in accordance with the marking scheme.
- 5.5.4 All results and marked scripts must be sent digitally to the RCB [at most two weeks] after the exams.
- 5.5.5 The EI shall submit a report on the training which includes: lessons learnt; overview of the examination results and based on the survey of the examination participants and implement any reasonable recommendation.
- 5.5.6 The RCB shall review the examination results and written scripts and make the final decision on candidates that meet the minimum pass mark.

5.6 Procedures for Awarding Regional Certification

- 5.5.7 The RCB shall notify the candidates about the results of the examination by e-mail and provide the Examination Institutions including a list of the unsuccessful candidates and their final assessed mark.
- 5.5.8 The RCB shall issue a Regional Certificate (with identification numbers and cards,) to successful candidates that meet the minimum pass mark (Schedule IV refers) after the examination [within four weeks].
- 5.6.1 RCB shall list all certified off-grid solar PV technicians on the RCB website;
-

- 5.6.2 The certificate will be posted to the EI for distribution to the successful candidates with information on how to maintain the credential as a regionally certified off-grid solar PV technician.
- 5.6.3 The unsuccessful candidates have the right to appeal by following the appeals process or retake the exam in accordance with the certification guidelines.
- 5.6.4 The initial certificate will have a validity period of 1 year [12 months from the date of issuance].
- 5.6.5 The 1 year validity period of the certificate may be extended to 5 years once the certified technician submits two (2) case studies and provides information on the role he/she played within the 12 months validity period of the regional certificate (Schedule VI refers to the format and requirements) to the RCB on systems they have installed.
- 5.6.6 The RCB shall review the case studies, re-issue a new Regional Certificate and add an identification card if the systems have been installed in accordance with industry best practice confirming that the certified PV technician has applied the knowledge that was included in the JTA and assessed in the examinations.
- 5.6.7 This newly issued regional certificate shall be valid for 5 years [from the expiration date of the initial certificate].
- 5.6.8 If the case study shows that the system does not comply with industry best practices the technician is informed of the non-compliances and the technician will not have his certificate re-issued until the non-compliances are rectified and evidence of the rectification is submitted to RCB.

5.7 Procedures for Renewing Regional Certification

- 5.6.9 The regional certificate shall be renewed [every five years from the date of initial issuance or from date of previous renewal].
- The renewal process shall involve the Certified off-grid solar PV Technician either:
- passing an oral examination; or
 - submitting three case studies (schedule VI refers) on systems installed in the 12 months prior to the certificate expiring; or
 - attending and completing a refresher training course.
- 5.6.10 The Certified off-grid solar PV technician shall submit an application form (schedule VII refers) and pay the renewal fee to the RCB at least three months prior to the Regional Certificate expiration date.
- 5.6.11 The RCB shall check if the application is complete and signed by the certified off-grid solar PV technician seeking renewal.
-

- 5.6.12 The RCB shall notify the certified off-grid solar PV technician on whether the renewal application has been successful or not and if not successful why the application has been unsuccessful.
- 5.6.13 The RCB shall reissue the Regional Certificate to certified off-grid solar PV technicians that meet the renewal criteria [within four weeks] and send the new certificate to the technician.
- 5.6.14 Certified off-grid solar PV technician that are unsuccessful in the renewal application have [eight weeks] to resubmit their updated renewal application.
- 5.7.2 The renewed Regional Certificate is valid for 5 years [5 years from the date of issuance].

5.8 Procedure for Withdrawing Regional Certification

- 5.8.1 The RCB shall withdraw regional certification of certified off-grid solar PV technicians when a complaint is made against the certified technician and the Complaints Sub-Committee recommends that the certification be withdrawn.
- 5.8.2 The RCB shall notify the certified off-grid solar PV technician in writing that his/her regional certification has been withdrawn (Note: This is final part of complaints process) and that he/she is forbidden to promote himself/herself as a Certified PV technician and that he/she shall return his/her certificate. (The ex-certified PV Installer does have the right to appeal to the RCB's Director— see section 6.7)
- 5.8.3 The RCB shall remove the name of the certified off-grid solar PV technician from the website and add the name of the technician to the list on the website of the technicians who have had their certification withdrawn.
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6. COMPLAINTS and APPEALS PROCEDURES

Within the Regional Certification Scheme there are three types of complaints and appeals:

1. Those from the applicants/candidates who has been unsuccessful either in their initial application or their examination,
2. Those against the Regional Certified off-grid Solar PV Technicians by the RCB; the general public (e.g. owner of a system supplied and installed by the certified technician); government entity or department; or other Regional Certified off-grid Solar PV Technicians.
3. Those against the Examination Institute.

6.1 Procedure when Applicant appeals Ineligibility Assessment after the initial application

- 6.1.1 All appeals shall be made in writing [within 1 week of the decision date] and addressed to the RCB. The appeals shall be made up of
 - a. the reason provided to the applicant why he/she was deemed ineligible; and
 - b. detailed explanation with relevant supporting documentation on why the applicant believes the assessment is incorrect.
- 6.1.2 The RCB shall review the appeal within [two weeks] and can either uphold the original decision, overturn it or refer the final decision to the TC's Complaints Sub-committee.
- 6.1.3 The RCB shall notify the applicant in writing about the outcome of the review. If the decision is in favour of the applicant, then he/she will be eligible to attend the next regional examination being conducted at the Examination Institution where the originally application was received.
- 6.1.4 If the decision is not in favour of the applicant, the decision of the RCB is the final outcome with no more avenues for appeal.

6.2 Procedure when Candidate appeals Examination Result

- 6.1.5 All appeals shall be made in writing [within 1 week of the decision date] and addressed to the RCB. The appeals shall be made up of
 - a. the result the candidate obtained in the examination; and
 - b. a detailed explanation with relevant supporting documentation on why the candidate believes the examination result received is incorrect.
 - 6.1.6 The RCB shall review the appeal including a review of the candidate's examination script and original marking within [two weeks] and can either uphold the original result, arrange for remarking of the written examination or refer the final decision to the Complaints Sub-Committee.
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- 6.2.1 The RCB notifies the candidate in writing about the outcome of the review. If the decision is in favour of the candidate, then he/she will be eligible to obtain their regional certification as per the procedures detailed in clause 5.6.
- 6.2.2 If the Candidate is still not satisfied with the final outcome, an appeal can be submitted in writing to the RCB's Director detailing exactly why he/she disagrees with the decision.
- 6.2.3 The RCB's Director reviews the appeal within [two weeks] and the decision of the RCB's Director is the final outcome with no more avenues for appeal.

6.3 Procedure with Complaint against the Examination Institution

- 6.2.4 The complaint must be submitted in writing to the RCB specifying:
 - a. the exact nature of the complaint;
 - b. the name of the Examination Institute;
 - c. the full name and contact details of the person making the complaint.
 - 6.3.2 Upon receiving the complaint, the RCB shall notify the Complainant in writing that the complaint has been received. If further information is required, this should be in the notification, but a courtesy phone call could also be made explaining why this information is needed.
 - 6.3.3 The RCB shall investigate the complaint within [two weeks] and determine if the complaint is justified or no further action is required.
 - 6.3.4 If no further action is to be taken, then the RCB shall write to the Complainant stating that the complaint is being investigated and he/she will be notified about the outcome of the investigation.
 - 6.3.5 If the complaint is justified, the RCB shall write to the Examination Institution of the technician specifying:
 - a. the exact nature of the complaint; and
 - b. that the Examination Institute has [two weeks] to respond to the complaint in writing.
 - 6.3.6 If the certified technician fails to respond, the RCB shall attempt to contact him/her through the Examination Institution by phone or electronically to determine why there has not been a response.
 - 6.3.7 If, after contact has been made with the certified technicians and the Examination Institution still fails to respond within [two weeks] of being contacted/notified, then the RCB can recommend to RCB's Director that the Examination Institution is in breach of the agreement and should be removed from the list of RCS Examination Institutes.
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- 6.3.8 If the Examination Institution does respond, then the RCB shall review the response within [two weeks]. If necessary, the review can include contacting the Examination directly in writing to clarify any issues.
- 6.3.9 The RCB shall take a decision based on the review. The decision could be to:
- a. Continue the investigation because further information is required;
 - b. Dismiss the complaint against the Examination Institution; or
 - c. Uphold the original complaint and provide recommendations to the RCB on what action is to be taken which could include recommending to RCB's Director that Examination Institute is in breach of the agreement and is removed from the list of RCS Examination Institutes
- 6.3.10 The RCB makes the final decision and then notifies the Examination Institute in writing about the outcome of the investigation.
- 6.3.11 If the final decision is that the complaint is upheld, the Examination Institute can appeal to the RCB's Director

6.4 Procedure with Complaint against Certified off-grid Solar PV Technician by RCB

- 6.3.12 If the RCB has any complaint with a Certified off-grid Solar PV Technician they shall write to the Technical Committee:
- a. specifying the exact nature of the complaint; and
 - b. requesting that a Complaints Sub-Committee is formed to investigate.
- 6.3.13 Then the Complaints Sub-Committee shall appoint one member to review the complaint within [two weeks] and report their findings back to Complaints Sub-Committee.
- 6.3.14 The Complaints Sub-Committee determines whether to continue to investigate the complaint or inform the RCB in writing why its members do not think the complaint warrants further investigation.
- 6.3.15 When the Complaints Sub-Committee continues the investigation the RCB shall write to the certified technician specifying:
- a. the exact nature of the complaint; and
 - b. that the Certified Technician has [two weeks] to respond to the complaint in writing.
- 6.3.16 If the certified technician fails to respond, the RCB shall attempt to contact the certified technician by phone and/or electronically to determine why there has not been a response.
-

- 6.3.17 If, after contact has been made with the certified technician and the Certified technician still fails to respond within [two weeks] of being contacted/notified then the RCB can recommend to the Complaints Sub-Committee that Certification is either removed or suspended. The final recommendation shall be provided by the Complaints Sub-Committee and the RCB makes the final decision.
- 6.4.2 If the certified technician does respond, then the original investigator appointed by the Complaints Sub-Committee shall review the response within [two weeks] and report the findings back to the Complaints Sub-Committee. If necessary, the review can include contacting the certified technician directly in writing to clarify any issues.
- 6.4.3 The Complaints Sub-Committee makes a decision based on the report of the investigator. The decision could be to:
- a. Continue the investigation because further information is required;
 - b. Dismiss the complaint against the certified technician; or
 - c. Uphold the original complaint and provide recommendations to the RCB on what action is to be taken which could include withdrawing of the Certification as detailed in Clause 5.8.
- 6.4.4 The RCB makes the final decision and then notifies the certified technician in writing about the outcome of the investigation.
- 6.4.5 If the final decision is that the complaint is upheld, the certified technician can appeal to the RCB's Director.

6.5 Procedure with Complaint against Certified off-grid Solar PV Technician by anyone except another Certified Technician or the RCB

- 6.4.6 The complaint must be submitted in writing to the RCB specifying:
- a. the exact nature of the complaint and if with respect to a system installation the details of the system, location and date of installation;
 - b. the name of the certified technician;
 - c. the full name and contact details of the person making the complaint; and
 - d. what, if anything, has been undertaken to resolve the complaint with the certified technician.
- 6.4.7 Upon receiving the complaint, the RCB shall notify the Complainant in writing that the complaint has been received. If further information is required, this should be in the notification, but a courtesy phone call could also be made explaining why this information is needed.
- 6.4.8 The RCB shall investigate the complaint within [two weeks] and determine if the complaint is justified or no further action is required.
-

- 6.4.9 If no further action is to be taken, then the RCB shall write to the Complainant stating the complaint has been investigated and notify him/her about the outcome of the investigation.
- 6.4.10 If the complaint is justified, the RCB shall write to the certified technician specifying:
- a. the exact nature of the complaint; and
 - b. that the certified technician has [two weeks] to respond to the complaint in writing.
- 6.4.11 If the certified technician fails to respond, the RCB shall attempt to contact the certified technician by phone or electronically to determine why there has not been a response.
- 6.4.12 If, after contact has been made with the certified technician and the certified technician still fails to respond within [two weeks] of being contacted/notified, then the RCB can recommend to the Complaints Sub-Committee that Certification is either removed or suspended. A recommendation shall be provided by the Complaints Sub-Committee and the RCB makes the final decision.
- 6.4.13 If the certified technician does respond, then the RCB shall review the response within [two weeks]. If necessary, the review can include contacting the certified technician directly in writing to clarify any issues.
- 6.4.14 The RCB will make a decision based on the review. The decision could be to:
- a. Continue the investigation because further information is required;
 - b. Dismiss the complaint against the certified technician; or
 - c. Uphold the original complaint and provide a report to the Complaints Sub-Committee that includes recommendations what action could be taken which might include withdrawing of the Certification as detailed in Clause 5.8.
- 6.4.15 The Complaints Sub-Committee reviews the report within [two weeks] and provides the RCB with the Complaints Sub-Committee's recommendations.
- 6.4.16 The RCB makes the final decision and then notifies the certified technician and the Complainant in writing about the outcome of the investigation.

6.6 Procedure with complaint against Certified off-grid Solar PV Technician by another Certified Technician

- 6.4.17 If a certified technician wants to complain about the installation of a system that has been installed by another certified technician or the business practices of another certified technician, the complaint must be submitted in writing to the RCB specifying:
- a. the exact nature of the complaint and if with respect to a system installation the details of the system, location, owners of the system and contact details and date of installation;
-

- b. the name of the certified technician;
 - c. the full name and contact details of the person making the complaint.
- 6.4.18 Upon receiving the complaint, the RCB shall try to ascertain within [two weeks] that the complaint is justified, that it is not just a case of a competitor making comments about the other individual for their own commercial gain.
- 6.4.19 If the complaint is not correct and it was not justified then a letter should be sent to the certified technician informing him/her that a complainant stated that he/she was in breach of the code of conduct and that he/she must explain why he/she should not have his/her Certification withdrawn. The standards complaints process should be followed.
- 6.4.20 If the complaint is justified RCB shall write to the certified technician specifying:
- a. the exact nature of the complaint; and
 - b. that the certified technician has [two weeks] to respond to the complaint in writing.
- 6.4.21 If the certified technician fails to respond, the RCB shall attempt to contact the Certified technician by phone or electronically to determine why there has not been a response.
- 6.4.22 If, after contact has been made with the Certified technician and the Certified technician still fails to respond within [two weeks] of being contacted/notified then the RCB can recommend to the complaints sub-committee that his/her Certification is either removed or suspended. A recommendation shall be provided by the Complaints Sub-Committee and the RCB makes the final decision.
- 6.4.23 If the certified technician does respond, then the RCB shall review the response within [two weeks]. If necessary, the review can include contacting the certified technician directly in writing to clarify any issues.
- 6.4.24 The RCB makes a decision based on the review. The decision could be to:
- a. Continue the investigation because further information is required;
 - b. Dismiss the complaint against the certified technician; or
 - c. Uphold the original complaint and provide a report to the Complaints Sub-Committee that includes recommendations what action could be taken which might include withdrawing of the Certification as detailed in Clause 5.8
- 6.4.25 The Complaints Sub-committee reviews the report within [two weeks] and provides the RCB with the Sub-Committee's recommendations.
- 6.4.26 The RCB makes the final decision and then notifies the certified technician and the complainant in writing about the outcome of the investigation.
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6.7 Procedure for Appealing the Withdrawal of Certification

- 6.4.27 If a certified technician has had his/her certification withdrawn he/she can appeal in writing to the RCB's Director specifying exactly why he/she disagrees with the decision and/or feels that it is unjust.
- 6.4.28 The RCB's Director reviews the appeal within [two weeks] and can either uphold the original decision, overturn the original decision or ask that the complaint is investigated again with a new Complaints Sub-Committee and an investigator who is a member of that Sub-Committee. The new Complaints Sub-Committee shall include no individual involved with the initial investigation.
- 6.4.29 If it is a new investigation, the new investigator reviews the complaint within [two weeks] and provides a report to the new Complaints Sub-Committee.
- 6.4.30 The new Complaints Sub-Committee provides a report with recommendations to the RCB's Director.
- 6.4.31 The RCB's Director reviews the appeal within [two weeks] and the decision of the RCB's Director is the final outcome with no more avenues for appeal.
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Schedule I: Regional Certification Application Form



APPLICATION FORM FOR CERTIFICATION AS CERTIFIED OFF-GRID SOLAR PV TECHNICIAN

Please write all information clearly.

1. IDENTIFICATION INFORMATION			
Last Name:	First:	Middle:	Suffix:
Current Mailing Address:			
Address line 1:			
Address line 2:			
City:	Region:	Postal Box:	Country:
Phone Number:	E-Mail Address:		
<input type="checkbox"/> Experienced Applicant	<input type="checkbox"/> Solar PV Installer/Technician	<input type="checkbox"/> Electrician (Licensed)	
<input type="checkbox"/> Inexperienced Applicant	<input type="checkbox"/> Schooled Applicant	<input type="checkbox"/> Unschooled Applicant	
<input type="checkbox"/> Completed course at TI that followed approved Regional JTA			
Please tick one or both and attach required documents:			
<input type="checkbox"/> Proof of experience as a solar installer, technician or electrician or other professional certificate			
<input type="checkbox"/> Highest schooling certificate obtained: _____			
2. EXAM SCHEDULING			
Please tick one exam date, mark one exam category and write an exam location:			
<input type="checkbox"/> [Exam date entered]	<input type="checkbox"/> [Exam date entered]		
<input type="checkbox"/> [Exam date entered]	<input type="checkbox"/> [Exam date entered]		
Exam location and city :			
Exam seating may be limited, and ECREEE's Examination Partner might schedule Applicants on a first-come,			
Note: Off-grid solar PV Systems Technician Candidate must have competency in (i) working safely with solar PV systems; (ii) understanding the basics of solar PV systems; (iii) understanding solar PV system design; (iv) installing all the mechanical and electrical components of the solar PV systems; (v) installing cables, connectors and protective devices for the solar PV systems; (vi) completing the installation, testing and commissioning of the solar PV system; and (vii) maintaining and troubleshooting of the solar PV system. The skills and competency requirements can be located in the Job Task Analysis (JTA) adopted regionally.			
3. SIGNATURE AND DATE			
I, the undersigned, certify that my Certificates, CV and other documents attached correctly describe me, my qualifications, and my experience. I understand that any misstatement or misrepresentation leads to my disqualification. I affirm that I have read the examination rules and authorize the Examination Centre to process my application.			
Signature: _____		Date: _____	
Incomplete or missing information will delay or prevent processing.			
ECOWAS CENTER FOR RENEWABLE ENERGY AND ENERGY EFFICIENCY (ECREEE), Achada, Santo, Antonio, ECREEE Building, 2nd Floor, C.P. 288, Praia, Cape Verde. Email: certification@ecreee.org			

Schedule II: Examination Acceptance Form



EXAMINATION ACCEPTANCE FORM FOR CERTIFICATION AS CERTIFIED OFF-GRID SOLAR PV TECHNICIAN

Please write all information clearly.

1. IDENTIFICATION INFORMATION			
Last Name:	First:	Middle:	Suffix:
Current Mailing Address :			
Address line 1:			
Address line 2:			
City:	Region:	Postal Box:	Country:
Phone Number:	E-Mail Address:		
2. EXAM SCHEDULING			
You have been accepted to attend the examination being conducted at:			
Exam location and city:			
3. FEES TO BE SUBMITTED (check one)			
<input type="checkbox"/>first time exam fee		<input type="checkbox"/> for 2 nd 3 rd or <input type="checkbox"/> th time taking the exam	
4. SIGNATURE AND DATE			
I, the undersigned, accept the offer to undertake the sign and will attend the examination as specified above. I also agree to abide by the RCB's Code of Conduct and follow the Industry Best Practice guideline			
Signature _____		Date _____	
ECOWAS CENTER FOR RENEWABLE ENERGY AND ENERGY EFFICIENCY (ECREEE), Achada, Santo, Antonio, Electra Building, 2nd Floor, C.P. 288, Praia, Cape Verde. Email: certification@ecreee.org			

Schedule III: Eligibility Requirements

ECREEE will determine if an applicant is eligible or ineligible to take the regional examination for solar off-grid PV technicians. ECREEE understands that professionals in the field of renewable energy obtain their training and work experiences in a variety of ways and will select the candidates that best suit the certification category.

Table 3: Eligibility Requirement of Applicants

Eligibility requirements	
A.	Be at least 18 years of age; and
B.	Have two (2) years of practice as an electrician; or
C.	Have two (2) years of working experience as a solar PV Installation technician; or
D.	Have completed a course offered by a TI that follows the JTA for technicians of Off-Grid Solar Photovoltaic Systems; or
E.	Have professional certificates or tertiary level diplomas in renewable energy technology or
F.	Three (3) or four (4) years Diploma or degree in a field related to electrical, mechanical, structural, or civil engineering, or architecture (Diploma, Baccalaureate or its equivalent, BSc, BEng, MSc, Ph.D.)

NB: All applicants must complete the application form in Schedule I; attach all relevant supporting documents as well as payment for the examination.



Schedule IV: Grading and Scoring System

The examination will consist of:

- A written component where the candidate will demonstrate their technical knowledge through providing written answers to multiple choice questions and questions that will require a short answer.
- A practical component where the candidate will demonstrate their practical skills.

A seventy percentage (70%) pass mark is required in each of the examination components to be awarded a certificate stating that he/she is a certified technician.



Schedule V: Candidate Survey form

Candidate Information					
Name					
Address					
Country					
Phone Number					
E-mail address					
Exam Information					
Name of Examination Institution					
Date of Examination					
Physical Location of Examination					
SURVEY					
Please answer the following questions providing the answer either by circling/ticking your response or writing your answer.					
How would you rate the application process?					
Are the eligibility requirements fair?				Yes	No
If no, why not?					
Was the application process easy?				Yes	No
If not, how could it be improved?					
How would you rate the service provided to you by the Examination Institution in processing your application and informing you about the exam?	Very bad	Bad	Fair	Good	Very Good
Can you suggest any improvements?					
How was the organization of the examination?	Very bad	Bad	Fair	Good	Very Good
Can you suggest any improvements?					
How was the written examination?	Very Difficult	Difficult	Easy	Very Easy	
How was the practical examination?	Very Difficult	Difficult	Easy	Very Easy	
Can you suggest any improvements?					

Schedule VI: Case Studies Pro-Forma

One completed form is provided per case study.

Certified technician Details			
Name			
Address			
Country			
Phone Number			
E-mail address			
Certified technician Certificate Number			
Certificate Expiry Date			
System Owner and Location			
Name of System Owner			
Address or nearest Village of System Owner			
Contact Phone Number or any other way of electronically contacting the owner.			
Latitude of Installation			
System Details			
Solar Array			
Solar Module Manufacturer			
Model Number of Solar Modules			
Number of Solar Modules			
Number of Modules in series in a string			
Number of Strings in Parallel			
Rating of Array in W_p			
String V_{oc} (V)		Array I_{sc} (A)	
Solar Array Mounting (Tick appropriate)	Roof Top Array		Pole Mounted Array
Tilt Angle (degrees)		Orientation Direction (Azimuth or Compass Direction)	
Solar Controller			
Solar Controller Manufacturer			

Model Number					
Type- Standard or MPPT					
Input Voltage Rating (V) (Max for MPPT)		Maximum Input Current (A)		Output Voltage (V)	
Number of Controllers					
Battery					
Battery Manufacturer					
Battery Model					
Individual Battery Voltage		Ah rating of Battery			
Number of Individual Batteries in Series		Number of Battery strings in parallel			
Total Number of Batteries		Rating of Battery Bank (Ah)		Battery System Voltage (V)	
System Performance					
Customers Daily Energy Requirements (Wh)		Was a load assessment form completed?	Yes/No	If yes has it been included?	Yes /No
Estimated daily Energy Output of Systems (Wh)		Daily Irradiation Figure used in estimate			
Voltage drop between solar array and controller		V %	Voltage Drop between controller and battery		V %
Photos to be provided must show (tick those provided)					
Solar Array, Controller Installation, Battery Installation, Wiring between array and building if pole mounted array, wiring into building if roof top array, all protection and isolation devices.					
Solar Array,		Wiring between array and building if pole mounted array		Wiring into building if roof top array	
Controller Installation		All Protection and isolation devices		Battery Installation	
Other Documents to be Provided -Checklist					
Single Line Wiring Diagram showing interconnection of the whole system, cable sizes, and all protection and isolation devices					



Schedule VII: Renewal Application Form

Certified technician Renewal Application			
Name			
Address			
Country			
Phone Number			
E-mail address			
Certified technician Certificate Number			
Certificate Expiry Date			
Application for renewal based on one of the following: (tick appropriate answer or fill in information)			
<i>Passing an oral examination</i>			
Examination Institution where exam conducted			
Date Exam Conducted		Exam passing certificate attached to Application	Yes/No
<i>Undertaking a Refresher Course</i>			
Training Institution where course conducted			
Date course conducted		Course attendance certificate attached to application	Yes/No
<i>Submitting three Case Studies</i>			
Three completed case studies with photos and single line diagram attached to application			Yes/No



Schedule VIII: Training Institute Application Form

Training Institute Application			
Training Institution Name			
Address			
Country			
Contact Person			
Phone Number			
E-mail address			
Qualified Trainers (fill in for each trainer)			
Name			
Phone Number			
E-mail address			
Qualification	Degree/Diploma/Certificate?		
Years Training			
Any experience in working in solar industry?			
CV Attached	Yes/No		
Name			
Phone Number			
E-mail address			
Qualification	Degree/Diploma/Certificate?		
Years Training			
Any experience in working in solar industry?			
CV Attached	Yes/No		
Name			
Phone Number			
E-mail address			
Qualification	Degree/Diploma/Certificate?		
Years Training			
Any experience in working in solar industry?			
CV Attached	Yes/No		
Curriculums			
Name of Course		How many years has the course been conducted?	
Curriculum attached	Yes/No	Completed Curriculum vs JTA Form Attached	Yes/No
Name of Course <i>(add if more than 2 courses)</i>		How many years has the course been conducted?	
Curriculum attached	Yes/No	Completed Curriculum vs JTA Form Attached	Yes/No

Equipment Available	
Describe the equipment (system components, tools, measuring equipment) available for conducting practical training	



Schedule IX: Curriculum vs JTA checklist

This form shall be completed by each training centre verifying how the training centres course meets the PV Technician Job Task Analysis.

1. Working safely with Photovoltaic systems	Tick if it is in the curriculum	State where it is in the curriculum - e.g. conducted in the session titled XXX
1.1 Maintain safe and appropriate work habits		
1.2 Demonstrate safe and proper use of required tools and equipment		
1.3 Adequately ensure safe and accepted practices for the protection of personnel and property		
1.4 Possess knowledge related to health and safety hazards and prevention		
1.5 Apply appropriate codes and standards concerning installation, operation, safety, and maintenance of PV systems and equipment		
1.6 Identify safety hazards for personnel and property associated with PV installations		
1.7 Ability to administer first aid in case of accidents		
2. Understanding Solar Energy and PV System Basics	Tick if it is in the curriculum	State where it is in the curriculum - e.g. conducted in the session titled XXX
2.1 Demonstrate knowledge of correct units for electrical potential (voltage), electrical flow (current) , electrical resistance, power, and energy		
2.2 Demonstrate knowledge of basic electric circuit theory and be able to identify series, parallel and series/parallel circuits		
2.3 Understand Ohm's and Power Laws to be able to calculate energy loads		
2.4 Demonstrate understanding of differences between AC and DC power, power factor and true power vs. real power		
2.5 Demonstrate necessary knowledge for proper orientation and inclination of solar array		
2.6 Demonstrate understanding of the term "peak sun hours" (irradiation) and the impact of irradiation on battery charging and overall energy generation		
2.7 Interpret the technical specifications and output characteristics of photovoltaic modules (e.g. Isc, Voc, Imp, Vmp, Pmax) and the controller, the inverter and battery		
2.8 Demonstrate understanding of the factors which influence the output characteristics of photovoltaic modules (irradiance, temperature, load, etc.)		

2.9 Demonstrate understanding of the effect on array output (current, voltage, power) of connecting modules in series , parallel and series/parallel configurations		
2.10 Understand the disadvantages of using dissimilar modules in the same array		
2.11 Demonstrate the impact of shading on overall production of solar energy		
2.12 Understand the installation techniques for pole mounted as well as roof mounted PV arrays		
2.13 Interpret and explain different PV module and battery technologies, criteria for battery selection and majors factors affecting battery performance characteristics		
2.14 Understand the operating principles of charge controllers and explain the major controller features (e.g. low voltage disconnect)		
2.15 Understand basic operating principles of an inverter and list factors which affect efficiency and reliability of inverters		
2.16 Know how to properly use electric measuring instruments		

3. Understanding PV Design	Tick if it is in the curriculum	State where it is in the curriculum - e.g. conducted in the session titled XXX
3.1 Confirm system design matches client expectation, e.g. load assessments, site drawings		
3.2 Review and confirm compatibility of chosen major system components with sizing requirements		
3.3 Locate and evaluate desired PV array and equipment locations		
3.4 Identify and assess any site specific safety hazards associated with the installation of the system		
3.5 Verify the appropriate module/array layout, orientation and mounting method for ease of installation, electrical configuration and maintenance		
3.6 Verify suitable location for battery bank, including ventilation and access requirements		
3.7 Understand selected conductor type, ampacity, ratings and run distance		
3.8 Confirm location, size and type of selected grounding method and overcurrent protection is appropriate for the application		
3.9 Verify the compliance of protective elements between the different components of a photovoltaic system		
4. Installing Mechanical and Electrical PV Components	Tick if it is in the curriculum	State where it is in the curriculum - e.g. conducted in the session titled XXX
4.1 Demonstrate necessary mounting techniques for attaching modules to array frame and array frame to its supporting structure		

4.2 Demonstrate necessary working knowledge of how to fit PV arrays to roofs by interpreting layout diagrams and apply different methods of fixing PV arrays at optimum pitch and orientation to roofs typical within the country of installation		
4.3 Demonstrate the safe handling of batteries and its appropriate placement to ensure good aeration		
4.4 Choose the correct layout, safe positioning and sound mounting techniques of all system components, e.g. charge controllers, inverters and appliances		
5. Installing Cables, Connectors and Protection Devices	Tick if it is in the curriculum	State where it is in the curriculum - e.g. conducted in the session titled XXX
5.1 Discuss current carrying capacity and the implications for proper cable selection		
5.2 Demonstrate the calculation and measurement of voltage drop in a conductor		
5.3 Apply voltage drop and current carrying capacity calculations to select appropriate cables for a stand-alone PV energy system		
5.4 Specify appropriate protection for all conductors in a circuit		
5.5 Understand the need for and recognize the different modes of grounding (earthing) on a systems as well as component level		
5.6 Perform safe techniques for laying, securing and terminating cables		
5.7 Label, install and terminate electrical wiring, verify proper connections, continuity, voltage and polarity relationships		
6. Completing System Installation, Testing and Commissioning	Tick if it is in the curriculum	State where it is in the curriculum - e.g. conducted in the session titled XXX
6.1 Visually inspect entire installation, identifying and resolving any deficiencies in workmanship		
6.2 Check system mechanical installation for structural integrity and weather sealing		
6.3 Check electrical installation for proper wiring practice, polarity, earthing, and integrity of terminations		
6.4 Activate system and verify overall system functionality and performance; compare them with expectations		
6.5 Apply procedures for connecting and disconnecting the system and equipment from all sources		
6.6 Explain to end-user safety issues associated with operation and maintenance of system		
6.7 Complete system documentation and transfer system documentation package to end-user/operator		



7. Conducting Maintenance and Trouble Shooting Activities	Tick if it is in the curriculum	State where it is in the curriculum - e.g. conducted in the session titled XXX
7.1 Identify maintenance needs on system and component level, design appropriate maintenance plan and demonstrate proficiency in selecting and using of required tools		
7.2 Perform visual inspection of entire installation, check mounting systems, ventilation, cable runs and connections/ junction boxes		
7.3 Verify system operation by measuring system performance and electric parameters, by comparing with specifications and expected performance parameters, by performing diagnostic procedures and by recommending corrective actions		
7.4 Identify performance and safety issues and perform corrective measures		
7.5 Verify effectiveness of corrective actions by retesting system operations and electrical parameters		
7.6 Compile and maintain records of system operations, performance and maintenance		
7.7 Demonstrate knowledge of the environmental impacts		



Annex 1: CODE of CONDUCT

A Certified off-grid Solar PV Technician agrees to

- a. Deal with all customers fairly and truthfully;
 - b. Respect the rights of the customer;
 - c. Provide customers with safe systems and explains the types of risks involved and how to avoid them;
 - d. Provide customers with systems comprising quality equipment and installations protected by warranties.
 - e. Install all systems in accordance with the Industry Best Practice Guidelines (see Annex 2) and any relevant standards that are applicable in the country in which the system is being installed.
 - f. Not undertake any business practices that could damage the reputation of the solar energy industry.
 - g. Avoid any conduct which might lead to a conflict with the customer or others.
 - h. Not use the certification in such a manner as to bring the RCS into disrepute.
 - i. Discontinue use of and all claims to certification upon expiry, suspension or withdrawal of certification, and return any certificates to the RCB.
 - j. Not use the certificate in a misleading manner.
 - k. Inform/remind the customer about the electrical equipment to be used and their daily time usage.
 - l. Inform the client about maintenance (preventive and curative) and the role they need to play
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Annex 2: ECSES SOLAR PV TECHNICIAN BEST PRACTICE GUIDELINES

These Industry Best Practice Guidelines detail the actions, activities and procedures that a Certified Off-Grid PV Technician should apply to act as a provider of quality services to customers. They are broken into two sections. The first section is for all certified off-grid PV Technicians. The second sections relates to those Certified off-grid PV Technicians who operate a business where they sell the systems that they install. However, those Certified off-grid PV Technicians who work for companies where others in the company manage the sales and customer service are encouraged to make their companies aware of these Industry Best Practice guidelines.

Best Practice Guidelines for all certified off-grid PV Technicians:

- a. When installing a system, the certified o Technician shall follow the relevant technical guidelines and appropriate standards for that installation.
 - b. After installing the system, the Certified off-grid PV Technician shall :
 - i. train the system owner (end-user) on the show the system operates, how to safely shut down and start up the system and the maintenance requirements.
 - ii. Explain all the relevant equipment and installation warranties,
 - c. A Certified technician should not criticise the work of another certified technician directly to a customer. If the Certified technician believes the other certified technician has provided a poor system or service, then a formal complaint should be lodged to the RCB.
 - d. If a complaint against the certified technician is formerly lodged to the RCB, the certified technician should abide by the complaints procedures.
 - e. If a technical system audit (also called inspection) is undertaken on the work of a certified technician, the certified technician should respond to any reasonable request by the auditor (inspector) to fulfil his or her duties.
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Best Practice Guidelines for certified technician who sell the systems that they install or provide:

- a. When a potential customer makes an inquiry about a system, the certified technician shall respond in a professional and timely manner.
 - b. If a site visit is undertaken to determine the customers system needs and , the Certified technician should undertake a thorough site visit that includes:
 - i. completing a load assessment to determine the customers' requirements; and
 - ii. selecting the most suitable locations for all the equipment.
 - c. If no visit is undertaken, collect all relevant information and make the client understand the implications and consequences that the non-correspondence of the provided information may have
 - d. If providing a written quotation to a potential customer the Certified technicians should provide the following information:
 - i. Full specifications of the system equipment being offered including quantity, make (manufacturer) and model number of each type of equipment being offered or if it is offering services, a detailed outline of the services to be provided
 - ii. The expected output (daily or yearly) of the system and how it meets the electrical energy requirements of the customer
 - iii. If it is a solar lantern or similar type of product, the promotional literature should provide an honest estimate of the expected performance.
 - iv. Warranty information on the offered equipment and installation (if applicable)
 - v. A Firm quotation which includes all equipment and installation charges. It will also include all government tax charges.
 - e. When a potential customer agrees to purchase a system the certified technician should have a simple agreement stating payment and delivery terms which also includes any specified requirements of that country.
 - f. For system installation, the certified technician should provide the customer with a minimum of 1 year's warranty on the installation workmanship of the system, and this would be in addition to the warranties offered by the manufacturers on the equipment supplied.
 - g. A Certified technician should provide support to the customer when a product fails under warranty. This support will include liaising with the manufacturer or equipment agent on behalf of the customer.
 - h. If a customer complains to a Certified technician that the system has failed:
 - i. If the failure occurs within the 12 months' installation workmanship warranty period, the Certified technician:
 - Should respond to the complaint in a timely manner.
 - If remote monitoring is available, this should be analyzed to attempt to determine the fault. If the fault cannot be determined remotely, then the response should involve arranging for a technically competent person
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- (preferably certified installer or a maintenance technician) visiting the system to determine the fault and then rectify the fault as soon as possible.
- If it is a fault arising from the installation workmanship, it is the certified technician's responsibility to rectify the problem.
 - If it is an equipment fault, the certified technician should liaise with the equipment manufacturer or equipment agent to fix or replace the product as soon as possible.
- ii. If the failure is after the 12-month installation warranty period:
- The Certified technician should still provide back-up service to the customer and should respond to the complaint in a timely manner.
 - This response should initially involve attempting to determine the fault remotely and then, if required, to organize a visit to the system to determine the fault and then to rectify the fault as soon as possible. A reasonable price should be quoted to the customer for the call-out that is the price should be reflective of the price quoted for other work and not be higher than standard pricing.
 - If there is a fault in the installation's workmanship, the certified technician should provide the customer with a quotation for repairs.
 - If it is a fault in the equipment, the certified technician should liaise with the equipment manufacturer or equipment agent to fix or replace the product as soon as possible. The cost in providing the repairs will be quoted to the customer. If the equipment is still under warranty, the cost should just be for the time spent travelling to/from site and onsite while undertaking the replacement.
- i. If a customer complains to a certified technician that they believe the system is not performing as stated in the quotation, the certified technician should request from the customer the evidence as to why they have come to this conclusion. If it appears that it is really not performing as anticipated, then the certified technician should investigate why in a prompt and professional manner.
- j. The certified technician should attempt to solve all complaints in a professional manner and directly with the customer.
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Regional Certification Scheme

ECOWAS Centre for Renewable Energy and Energy Efficiency



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