Development of regional quality infrastructure frameworks for solar photovoltaics products and services in the East African Community and the Pacific Community

Policy Brief on the Regional Harmonisation of Standards for Solar PV products and Services in the Pacific Community

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List of abbreviations

Abbreviation	Full Name
ACE	Africa Clean Energy
AFSEC	African Electrotechnical Standardisation Commission
CD	Committee draft
CREEC	Centre for Research in Energy and Energy Conservation
DRC	Democratic Republic of Congo
DC	direct current
FDHS	Final Draft Harmonised Standard
FCDO	Foreign, Commonwealth and Development Office
ICS	International Classification for Standards
IEC	International Electrotechnical Commission
ISO	International Organisation for Standardisation
NSB	National Standards Body
NWIP	New Work Item Proposal
PWI	Preliminary work item
PV	Photovoltaic
QA	Quality Assurance
QI	Quality Infrastructure
QIPR	Quality Infrastructure for the Pacific Region
SPC	Pacific Community
SC	Subcommittee
SAS	stand-alone solar
TAF	Technical Assistance Facility
THCS	Technical Harmonisation Committees
TMC	Technical Management Committee
WD	Working Document
WG	Working Group

1 Executive Summary

This policy brief emphasises the need for harmonising standards for solar products across the Pacific Community (SPC), a strategy aimed at strengthening the region's quality infrastructure (QI) Framework and enhancing trade integration. The primary objectives of this document are twofold: first, providing the grounds to establish a consistent quality framework across the region through the adoption of unified standards; and second, to provide recommendations about how to harmonise these standards to remove technical trade barriers, ensuring that products meeting these harmonised criteria are automatically recognised as compliant with the regulatory and legal requirements of all Pacific Community (SPC) member states.

Establishing a Quality Infrastructure (QI) framework is paramount for ensuring the safety, quality, and sustainability of solar products and services within the Pacific Community (SPC). Out of the solar products available, solar PV is seen as the most easily deployable technology, however, installing these without adequate standards leads to problems across safety, quality and sustainability, as follows:

- **Safety Risks and Need for Regional Standards:** PV systems face significant safety risks due to installation errors and lack of regional standards, these risks are typically associated to installation errors, including improper wiring, inadequate grounding, loose connections incorrectly installed components or use of poor-quality controllers, which lead to overheating and premature failure[1]. The baseline assessment conducted under the scope of this project revealed regulatory frameworks and national standards are lacking, and even existing regulations are not effectively enforced, exacerbating safety concerns in the PV sector.

- **Sustainability Challenges in Solar Products:** The region, as indicated the baseline assessment, faces sustainability challenges, including the entry of counterfeit products to the market and the lack of good practices for the end-of-life management of solar products. It is important to develop strong infrastructure to support the sustainable growth of the PV industry. A quality infrastructure framework can mitigate the environmental impacts of deploying PV systems, increase energy efficiency, and promote compliance with standards, thus helping local industries compete better and expand their markets, leading to sustainable economic development.

- **Quality Challenges in Solar Products:** Ensuring sustainable market growth in the PV industry within the SPC requires a high standard of quality assurance. It is crucial for investors, policymakers, and consumers to create confidence in the performance of PV products and services. Quality assurance, following international standards and best practices, is essential across the entire lifecycle of a PV system, from design to end-of-life.

The Regional Technical Committee (RTC) for the Pacific Region, will serve as the lead to deploy the framework necessary for enhancing PV products and services across their entire lifecycle within the region. This lifecycle encompasses crucial stages such as design, installation, operation, maintenance services, and end-of-life disposal.

[1] International Renewable Energy Agency (IRENA), "Boosting Solar PV Markets: The Role of Quality Infrastructure," IRENA, Abu Dhabi, 2017

This policy brief recommends a framework that is mainly aimed at the Pacific Community (SPC) through PCREEE, as main coordination body in charge of the promotion of QI and the harmonisation of standards, additional beneficiaries of this document are national government agencies, such as national standards agencies.

Furthermore, other stakeholders that can contribute to the measures outlined in this policy brief are regional non-governmental organisations (NGOs) such as the Sustainable Energy Industry Association of Pacific Islands (SEIAPI), the Pacific Power Association (PPA), international donors, national utilities and renewable energy agencies, whose active participation and coordination are critical to ensuring the framework meets regional needs and achieves its objectives.

2 Introduction

The Pacific Community (SPC) is represented by 22 member countries and territories across the Pacific Islands, collectively home to approximately 11 million people, with 6.45 million women. Among these members, 14 are categorised as Small Island Developing States (SIDS) by the United Nations Department of Economic and Social Affairs (UNDESA). Despite the rich diversity in cultures and characteristics, these island nations face common challenges—remote locations, limited human and natural resources, small economies, and reliance on distant markets. Their vulnerability is further exacerbated by external geopolitical and economic events, as well as the intensifying impacts of climate change and natural disasters.

The Pacific Community, particularly the Pacific Islands, have a high growth potential for solar energy, due to many nations aiming to reduce their dependence on fossil fuel imports. The promotion of renewable energy, in particular off-grid solar, is supported by international development organisations through investment facilities that mobilize investments for small-value renewable energy projects. These projects also have a relevant regulatory and capacity building components, aimed at promoting energy sector reforms, investment opportunities and involvement of private and civil society sectors.

In response, Pacific Island governments must prioritize the adoption of renewable energy technologies and foster collaboration with international and regional organizations to ensure sustainable and resilient development.

To address these challenges, the SPC has taken a proactive role in developing regulations, standards, and quality infrastructure guidelines for the solar energy sector in the Pacific region. However, effective implementation of these regional guidelines requires national-level consultations to ensure their acceptance, suitability, and sustainability. This involves engaging local governments, development partners, and communities in a collaborative effort to tailor these guidelines to the unique contexts of each Pacific Island nation.

Other relevant initiatives in the region include the work of the Sustainable Energy Industry Association of Pacific Islands (SEIAPI), which has been instrumental in creating technical guidelines, training standards, and workshops specifically for solar PV systems. Additionally, the certification and accreditation schemes introduced by the Pacific Power Association (PPA) and SEIAPI emphasize the importance of adherence to these guidelines by certified designers and installers, as well as international cooperation agencies and local utilities. However, widespread adoption of these guidelines may necessitate legislative and regulatory changes at the national level, highlighting the need for ongoing dialogue and cooperation across the region.

The energy landscape across the South Pacific region is shaped by a mix of international, regional, and national standards, reflecting the unique requirements and developmental goals of each country. The influence of Australian/New Zealand Standards (AS/NZS) is prominent across many Pacific Island nations, often used alongside or as alternatives to International Electrotechnical Commission (IEC) standards. This is largely due to regional proximity, trade agreements, and historical ties with Australia and New Zealand. At the same time, international aid organizations such as the World Bank and the Asian Development Bank drive the partial adoption of IEC standards through infrastructure and development projects, especially in the energy sector.

Across the region, individual countries have adopted various standards to guide their renewable energy and electrical system development:

- **American Samoa:** In 2016**,** the American Samoa Renewable Energy Committee adopted a goal to meet 50% of its energy needs from renewable resources by 2025. Challenges hindering the adoption of renewable energy are a lack of technician training for operation and maintenance of inverters and grid integration challenges.
- **Cook Islands:** Solar power contributes to 50% of the country's electricity mix. The Renewable Energy Development Division has adopted IEC standards, particularly for photovoltaic (PV) systems, while integrating AS/NZS standards within the national framework to ensure compatibility with regional practices.
- **Fiji:** Even though solar energy still corresponds to a small part of Fiji's energy supply, Solar Home Systems (SHS) have been used as an alternative to provide electricity in the smaller islands that are part of Fiji. Furthermore, licensed electrical contractors and wiremen are required to comply with AS/NZS 3000:2018, ensuring that electrical work aligns with regional wiring rules and safety standards.
- **Kiribati:** Kiribati has a solid regulatory base for the promotion of renewable energy sources, including a National Energy Policy (2009), an Integrated Energy Roadmap (2017) and an Energy Act (2022) that includes a section on Minimum Energy Performance Standards and Labelling (MEPSL). A comprehensive set of AS/NZS standards governs grid electricity and renewable energy systems, including those for electrical wiring (AS/NZ 3000), solar arrays (AS 5033), grid-connected inverters (AS 4777), and battery systems (AS/NZS 5139), as well as IEC standards for electrical safety.
- **Guam:** This territory has set a goal to provide 10% renewable electricity sales by 2025. The island has currently two commercial solar PV facilities and a net metering policy that allows for the installation of decentralised renewable energy sources.
- **New Caledonia:** This territory is highly dependent on imported fossil fuels. However, has been taking significant steps in the promotion of solar power plants and the promotion of rooftop PV for the residential, commercial and industrial sectors.
- **Palau:** As part of Palau's efforts to mitigate and adapt to climate change, the country developed, in 2012, Guidelines, Standards and Regulations for Renewable Energy Generation Systems Connecting to the Central Grid. Furthermore, renewable energy installations must meet USA's 2011 National Electrical Code and IEEE 1547 standards, reflecting Palau's alignment with American regulations for electric power systems.
- **Papua New Guinea:** This country makes up almost 75% of the Pacific Island Countries (excluding Australia and New Zealand). Papua New Guinea has set a target of connecting 70% of its population by 2030, whereby 78% of the power generation is anticipated to be supplied from renewable energy sources. This country has officially incorporated IEC standards such as IEC 62124 and IEC 62257 into its national framework, which guides the development and safety of energy infrastructure.
- **Samoa:** Solar made up 12% of the country's electricity generation in 2021. Technical standards for solar panel specifications are grounded in AS/NZS and ISO standards, including AS/NZS 1170.2:2011, ISO 4354, and AS 4040.3, ensuring compatibility with regional and international best practices.

- **Solomon Islands:** The country has a 76% electrification rate and a reliance on diesel for the generation of 90% of the electricity consumed. This country has collaborated with the Asian Development Bank (ADB) to convert electricity networks in five provinces to solar power. In this country, compliance with AS/NZS standards, such as AS/NZS 4777 and AS 5033, is required for solar PV installations, aligning the country's energy systems with regional norms.
- **Tonga:** Solar made up to 8% of the country's electricity generation in 2021. This country is highly vulnerable to the impacts of climate change and has collaborated with agencies such as the Green Climate Fund (GCF) and the ADB to replace fossil fuels and implement utility-scale solar systems and Mini-grids to their communities.
- **Tuvalu:** This country is highly vulnerable to the effects of climate change and is making considerable efforts to replace its diesel-based power generation systems with solar power through development cooperation projects such as the Tuvalu Solar Power Systems and the Tuvalu Energy Sector Development Project.
- **Vanuatu:** 30% of the households in Vanuatu still lack access to electricity, the national government is promoting the introduction of hybrid mini-grids and off-grid solar energy to achieve a transition to renewable energy and reach a 100% rural electrification. The country's solar PV installation and safety standards are based on AS/NZS guidelines, particularly for the structural design of stand-alone power systems and the installation of PV arrays.

In several other Pacific nations and territories, including the **Federated States of Micronesia**, **Marshall Islands**, **Nauru**, **Northern Mariana Islands**, **Niue, French Polynesia, Tokelau, Wallis and Futuna and American Samoa**, formal adoption of IEC standards is less common. These countries often lean on Australian standards due to their geographic proximity and economic relationships with Australia and New Zealand, or on the standards adopted by the countries they are a part of.

The establishment of a Regional Technical Committee for Quality Infrastructure for the Pacific Region (RTC) aims to significantly enhance the quality and sustainability of photovoltaic (PV) products and services throughout their entire lifecycle in the Pacific Islands. By providing a comprehensive framework that covers all stages, from design and installation to operation, maintenance, and end-of-life disposal. The RTC will provide key stakeholders in the Pacific with the tools to ensure that PV systems in the region meet high standards of performance, safety, and environmental responsibility.

The RTC's mandate is to develop and ensure compliance with a regional framework that streamlines certification and accreditation processes, promoting mutual recognition among SPC states. This will facilitate trade, ensure compliance with standards, and ultimately enhance the overall quality and sustainability of PV systems in the region. By addressing these critical aspects, the RTC will not only improve the performance and longevity of PV products but also support the broader goals of sustainable development and energy resilience in the Pacific Islands.

3 State of the art - relevant product and service standards for solar PV products and services

The following section follows the elaboration of a baseline assessment conducted within the Pacific Region and the elaboration of a regional QI framework, as part of this process, relevant international IEC and ISO standards for solar PV products and services were reviewed and listed below.

Furthermore, five relevant standards were selected and their adoption status within the SPC countries was evaluated to show the regional status of standard harmonisation.

The selected standards aimed at building a comprehensive knowledge of quality assurance requirements for solar PV products and the most relevant standards are listed below:

List of relevant standards for solar PV in the pacific region:

1. Testing Laboratories

Quality system components in the PV industry are typically tested and certified by qualified test laboratories. Grid connected PV system components shall be tested in accordance with relevant standards by a testing laboratory accredited to ISO/IEC 17025 **General Requirements for the Competence of Testing and Calibration Laboratories**.

The test laboratory shall have ISO/IEC 17025 accreditation for the standard / test method used.

2. Solar Modules

When selecting a solar module to be used in a Grid Connected PV system, the solar modules shall comply, as a minimum, with the following IEC standards:

- IEC 61215 Terrestrial photovoltaic (PV) modules – Design qualification and type approval
  - IEC 61215-1- Part 1: Test Requirements (see below)
  - IEC 61215-2 - Part 2: Test Procedures
- IEC 61730 Photovoltaic (PV) module safety qualification
  - IEC 61730-1 Part 1: Requirements for construction
  - IEC 61730-2 Part 2: Requirements for testing

The modules shall be certified as Application Class II per IEC 61730.

With respect to IEC 61215-1, the modules shall be qualified by the following relevant standard depending on the cell technology:

- IEC 61215-1.1, Terrestrial photovoltaic (PV) modules - Design qualification and type approval Part 1.1 Special requirements for testing of crystalline silicon photovoltaic (PV) modules
- IEC 61215-1.2, Terrestrial photovoltaic (PV) modules - Design qualification and type approval Part 1.2 Special requirements for testing of thin-film Cadmium Telluride (CdTe) based photovoltaic (PV) modules.
- IEC 61215-1.3, Terrestrial photovoltaic (PV) modules - Design qualification and type approval Part 1.3 Special requirements for testing of thin-film amorphous silicon based photovoltaic (PV) modules.

- IEC 61215-1.4, Terrestrial photovoltaic (PV) modules - Design qualification and type approval Part 1.4 Special requirements for testing of thin-film based photovoltaic (PV) modules.

It is recommended that the modules also comply with:

- IEC 61701 Photovoltaic (PV) modules - Salt mist corrosion testing
- IEC 62804 – (2020) Photovoltaic (PV) modules - Test methods for the detection of potential-induced degradation (PID) - Part 1-1: Crystalline silicon – Delamination

The solar module should have the following warranties:

- 10-year limited product warranty
- Limited Power Warranty with 25 years at 80% of the minimal output power

3. Inverters

When selecting an inverter to be used in a Grid Connected PV system the inverter(s) shall comply with all the following standards:

- IEC 62109 Safety of power converters for use in photovoltaic power systems
  - IEC 62109-1 Part 1: General requirements
  - IEC 62109-2 Part 2: Particular requirements for inverters

In addition, if the inverter can interact with the grid and potentially supplying power onto the grid, then it shall also comply with the following standard:

- AS/NZS 4777.2 Grid Connection of energy systems by Inverters
  - Part 2: Inverter Requirements

The inverter should have a minimum 5-year manufacturing warranty.

4. Solar Module Array Mounting Structure

The mounting system structure shall comply with the requirements set in:

- AS1170.0 Structural design actions – Part 0: General principles
- AS1170.1 Structural design actions – Part 1: Permanent, imposed and other actions
- AS1170.2 Structural design actions – Part 2: Wind actions.

The array mounting structure should have an expected life of 20 years.

5. Solar Cables

The cables used in wiring a PV array to the inverter or controller shall conform to IEC 62930: Electric cables for photovoltaic systems with a voltage rating of 1.5 kV d.c. (Note: cables meeting IEC 62930 are not to be installed directly underground; they must be installed in appropriate conduit).

6. Solar Plugs and Connectors

Plugs, sockets and connectors shall - conform to AS/NZS 62852: Connectors for d.c. application in photovoltaic systems - Safety requirements and tests.

7. d.c. Switch Disconnectors

d.c. switch connectors shall conform with the switch disconnector requirements of AS/NZS 60947.3 Low-voltage switchgear and control gear switches, disconnectors, switch-disconnectors and fuse-combination units. The switch disconnectors shall conform with utilization category d.c. PV2.

8. Other Electrical Equipment

Balance of system components that are included in grid connected PV systems, including circuit breakers, a.c. wiring and these all shall meet the many equipment standards referenced in:

- AS/NZS 3000,
- AS/NZS 5033,
- AS/NZS 4777
- AS/NZS 5139

9. IEC TR 63525 ED1 for the reuse of PV modules and circular economy

The standard IEC TR 63525 ED1, currently under development, is focused on the reuse of photovoltaic (PV) modules and promoting a circular economy within the solar energy sector. This standard was initiated by the International Electrotechnical Commission (IEC) Technical Committee 82 (TC 82), which specialises in solar photovoltaic energy systems. The project management for this report is handled by Working Group 2 (WG2) of TC 82, with significant involvement from PV Cycle, a non-profit organisation dedicated to waste management in the solar industry.

The report addresses the growing challenge of managing PV module waste, which is expected to reach 78 million metric tons globally by 2050. As many PV systems approach the end of their designed technical life (20-25 years) or are being upgraded with newer technology, the need for effective end-of-life management strategies becomes critical. IEC TR 63525 ED1 aims to provide comprehensive guidelines and recommendations for the reuse of PV modules, ensuring their performance, safety, and financial viability. By establishing clear guidelines and specifications, IEC TR 63525 ED1 seeks to facilitate the integration of reused PV modules into the market, thereby advancing circular economy principles within the solar energy sector.

The planned publication date for IEC TR 63525 ED1 is set for the first quarter of 2025. This milestone represents a significant step forward in developing sustainable solutions for the end-of-life management of PV modules. The standard's proactive approach to reuse and recycling aims to minimize environmental impact and maximize resource efficiency, contributing to a more sustainable future for solar energy.

4 Overview of regional standardisation status

Table 4-1. below serves as an example of the needs for the harmonisation and mutual recognition of international standards across the Pacific region, five relevant standards for solar PV products and services were selected and their status of adoption was assessed across the SPC region, based on stakeholder interviews and a desk review, with the objective of illustrating the gap in standard adoption and the need of regional collaboration for the adoption and enforcement of standards across countries.

Table 4-1. Standardisation status on SPC counties

Standard/Status of implementation in SPC countries	Cook Islands	Fiji	Kiribati	Palau	Papua New Guinea	Samoa	Solomon Islands	Vanuatu	Other countries
IEC 62124: Photovoltaic (PV) stand-alone systems									
IEC 62257 Series: Recommendations for small renewable energy and hybrid systems for rural electrification.									
IEC 62894: Requirements for photovoltaic inverters									
IEC 62446: Photovoltaic (PV) systems - Requirements for Testing, Documentation, and Maintenance									
IEC 62548: Terrestrial photovoltaic (PV) systems - Guidelines for the design and installation, including the configuration of PV arrays, safety considerations, the selection and erection of electrical equipment, operation and maintenance, and marking and documentation.									

Legend	
	Standard fully adopted nationally
	Standard partially adopted or similar standard adopted
	Standard not adopted

5 Barriers for regional harmonisation of standards

Some of the more significant challenges in promoting standardised solar products in the Pacific Community (SPC) region are the lack of regional coordination of standardisation efforts and the lack of capacity for standards enforcement at the country level. The number and diversity of countries part of the SPC has resulted in a disparity on the standard adoption process, with some countries being ahead of others in the process of adopting standards. Furthermore, some countries adopt UL standards, while some adopt IEC, and others adopt Australian and New Zealand Standards (AS/NZS).

In addition, even if standards are adopted by a country, enforcing them and preventing the entry to the market of substandard products remains a challenge to national authorities. These non-standardised products are available at considerably lower costs and are frequently prioritised over standardised, higher-quality products due to the immediate cost savings they offer.

The motivation for regional governments to enforce or promote the use of standardised products is low for several reasons. Firstly, the perceived short-term economic benefit of importing low-cost products outweighs the long-term advantages of investing in standardised, durable solar infrastructure. The initial costs of implementing international or regional standards for solar products can be prohibitively high, making governments reluctant to allocate resources to such initiatives.

The standards intended for adoption are not only expensive but also complex to implement. For many countries in the SPC region, the combination of these high costs and the complexity of the process discourages the adoption of proper standards, leading to inconsistent product quality across the region. As a result, the solar infrastructure in the SPC region is often of poor quality.

The absence of uniform standards leads to inefficiencies, suboptimal performance, and an increased need for maintenance or replacement of products. Over time, this undermines efforts to build a sustainable and reliable solar energy infrastructure, potentially leading to both economic and environmental setbacks.

The combination of a lack of national capacity to adopt and enforce standards, high costs, and the complexity of standard adoption leads to a weak quality infrastructure framework, this situation is further. Some of the main barriers that the standard harmonisation process and the Regional Quality Infrastructure Framework should address:

- **Absence of Regional Conformity Assessment Bodies:** There are no regional bodies dedicated to conducting certification processes for solar PV products and services. This lack of infrastructure hinders the development and enforcement of uniform standards across the region.
- **Lack of Regional Accreditation Bodies**: The absence of regional accreditation bodies for products, including solar PV, creates a gap in ensuring that products meet specific quality and safety standards. Without accreditation, the credibility and reliability of solar PV products in the region are compromised.
- **Challenges in Implementing Technical Regulations and Standards**: Implementing technical regulations and standards at the regional level is fraught with difficulties, partly due to varying national policies and the difficulty to establish cohesive regional strategies.
- **Human Capacities**: There is a significant shortfall in trained personnel capable of implementing, monitoring, and enforcing standards for solar PV systems. This includes

expertise in metrology, testing, certification, accreditation, and conformity assessment. Additionally, there is a gender gap in technical and managerial roles, starting already during education, limiting women's participation in the sector. Considering that the region has a 55.91% of female population, by promoting capacity building and equal opportunities for women, this untapped potential would increase the availability of trained staff.

- **Lack of Testing Infrastructure:** The region lacks the necessary testing infrastructure to verify the performance and safety of solar PV components. Without testing procedures, it is impossible to ensure the quality and reliability of the numerous products entering the market.
- **Market Surveillance Deficiencies**: Effective market surveillance is crucial to enforcing standards and regulations. However, many countries still lack the capacity for robust monitoring and controlling the quality of solar PV products in the market.
- **Need for Coordination of National Efforts:** profiting from the existing regional organisations, including PCREEE and SPC, it is necessary to provide the spaces for regional cooperation among the 22 states that are part of the SPC, such a cooperation approach should allow for the sharing of experiences and lessons learned and the establishment of partnership agreements among countries to set up testing facilities and adopt international standards. There is a pressing need of coordinating with relevant organisations at the regional and national levels to work together towards mutually recognising standards for PV products and supporting the adoption and enforcement of international standards at the national level.
- **Small Market and Financial Constraints:** The relatively small market size in the region, coupled with limited financial resources, not only from national governments to invest in solar power, but from end users to purchase PV systems incentivises the uptake of lower-cost substandard products and reduces the incentive for both local and international stakeholders to invest in the development of a robust quality infrastructure.
- **Lack of Information and Regulatory Frameworks**: There is a disparity among countries regarding the awareness among public sector stakeholders on solar PV products, which leads to a lack of a specific regulatory framework overseeing and enforcing quality assurance and hampers the development of standardised practices across the region. Some countries do not have specific laws or regulations to designate a responsible ministry for overseeing the solar PV sector.
- **Lack of gender equality:** Women's participation in the solar PV sector is hindered by gender biases and stereotypes, limiting their access to technical training and managerial positions. Promoting gender equity in the sector requires targeted interventions to support women's education and career advancement, ensuring that both men and women can contribute equally to the development and implementation of solar PV standards and initiatives. Moreover, many solar PV systems are not designed with gender inclusivity in mind, making them challenging for women to install due to technical complexities and physical requirements. Ensuring that solar PV systems are designed to be user-friendly and accessible to women, including providing appropriate training and tools, can significantly enhance women's participation in the installation and maintenance of these systems. The solar photovoltaic (PV) industry faces a significant shortage of skilled labour, particularly in developing countries. To address this, it is crucial to consider gender-sensitive design principles, such as reducing the maximum size and weight of PV panels, to make them easier for women to handle. Traditional design criteria often overlook the physical capabilities of women, making it challenging for them to handle large and heavy panels. By incorporating

gender-sensitive design principles, more inclusive and accessible opportunities for women in the industry can be created. According to the International Renewable Energy Agency (IRENA), the solar PV sector employed around 4.3 million people globally in 2022, with women holding 40% of these jobs. However, there is still a significant gap that needs to be bridged to ensure a diverse and skilled workforce. This approach not only promotes gender equality but also helps to fill the growing demand for qualified installers.

6 Supportive ecosystem for harmonisation of standards

Under the Quality Infrastructure framework for the Pacific Region, and particularly under the scope of the Regional Technical Committee, it is recommended to establish the following institutions to allocate responsibility:

- **Regional Technical Committee – through a working group on standardisation:** Oversees the entire standards harmonisation and mutual recognition process. The RTC should be led by PCREEE.

Said organisation should have two main sub-divisions

- **Technical Management Committee (TMC):** Manages and coordinates all technical work related to standards, this committee can be run by SPC and will coordinate the harmonisation work with country representatives and with regional and international organisations. Additional support to this committee can be obtained by working closely with organisations such as the Sustainable Energy Industry Association of Pacific Islands (SEIAPI), Standards New Zealand, Standards Australia and the Pacific Area Standards Congress (PASC).
- **Technical Harmonisation Committees (THC):** Specialised committees under the TMC focusing on specific standardisation tasks. Members of this committee include representatives of national standard bodies and regional experts on standards. Under the technical harmonisation committee, the following sub-structures can be established:
  - **Subcommittees (SCs):** Handle specific areas of work under the THCs.
  - **Working Groups (WGs):** Focused on short-term tasks, often resulting in draft standards.
  - **Task Forces (TFs):** Short-term groups for specific standardisation tasks.

- **National Standards Bodies (NSBs):** Participate in and implement standards at the national level, interacting with the entire committee structure.

Each of these committees should have an appointed chairperson or a representative and ensure the representation of both national and regional stakeholders, the chairperson of the committees can be shared among participant entities and can changed over periodic intervals.

It is important that all the committees established (RTC, TMC and THC), as well as the subcommittees, working groups and task forces are gender inclusive and follow a 40% to 60% gender balance as a benchmark. Furthermore, any subsequent activities, conferences, committees and/or meetings should ensure the participation of either gender within a range of 40% to 60%.

The section below provides more details on the proposed supporting structures, including an allocation of responsibilities.

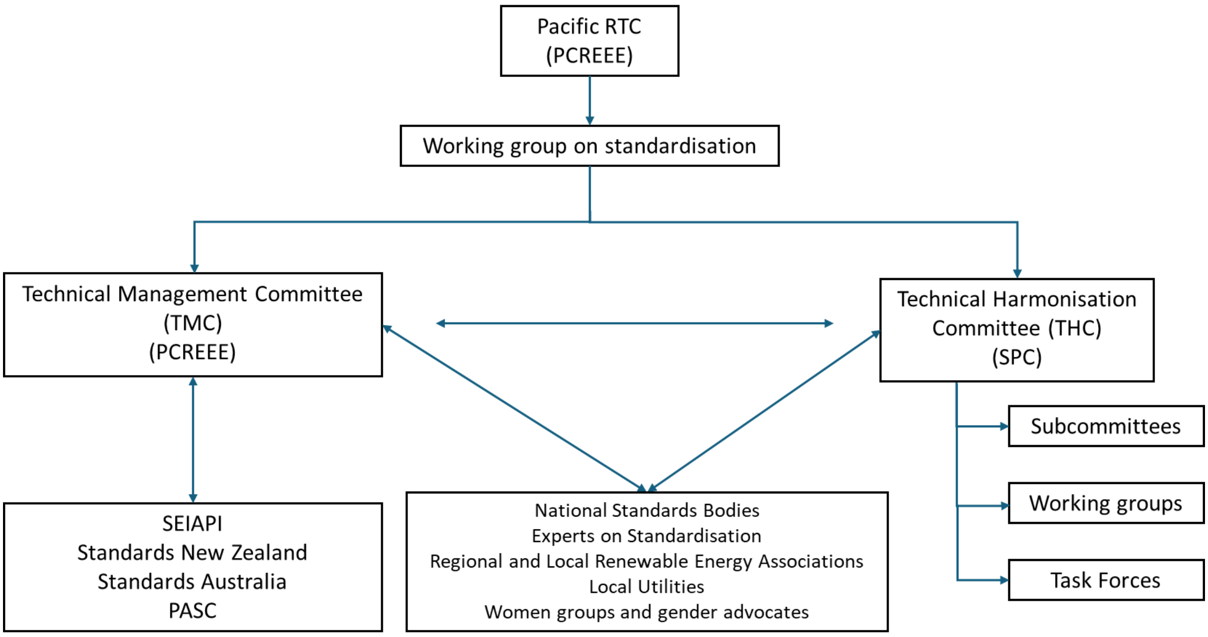

Figure 6-1. Supportive ecosystem for standard harmonistaion under the RTC

Establish the RTC's Working Group in standardisation: The working group would act as the central body coordinating the harmonisation of standards across member states, this body should be overseen by SPC and executed by PCREEE. This organisation would directly interact with National Standards Bodies (NSBs), international Quality Infrastructure and Standardisation Organisations and relevant regional organisations. Furthermore, this working group will take care of providing logistical and technical support to Technical Harmonisation Committees (THCs), and managing the catalogue of harmonised standards through the following responsibilities:

- Liaison with NSBs and Member States.
- Establishing priority areas for standardisation and harmonisation efforts.
- Provide logistical support to the THCs in the management of standards harmonisation projects.
- Maintain the catalogue and authoritative text of the Harmonised or Mutually Accepted Standards.
- Facilitate the liaison of regional standardisation, metrology and conformity assessment activities to other relevant sub-regional, regional and international activities.
- Assisting, arranging for or requesting the translation of documents.
- Publicise and promote standardisation activities.
- Receiving and keeping copies of progress reports, updating records with regard to the progress of work.
- Maintenance of THC procedures, particularly the execution of the regulations for standards work, including the management of the public enquiry and formal vote for draft harmonised Standards.
- Receiving from the responsible THC, Subcommittees (SC) and Working Groups (WG) the results of systematic reviews of already-approved Harmonised Standards and notifying the TMC of the results.
- Assistance to THCs in their standards development programmes.

Technical Management Committees (TMC): The TMC should oversee the technical work of harmonisation, including the establishment of THCs, appointment of chairpersons, and allocation of secretariats. It should ensure timely progress in standards development and address any issues related to due process or appeals, TMC should have the following responsibilities:

- Coordination of the technical work, including assignment of responsibilities for the development of standards regarding subjects of interest to several technical committees, or needing coordinated development
- Establishment of advisory groups of experts in the relevant fields to advise it on matters of basic, sectorial and cross-sectorial coordination, coherent planning and the need for new work.
- Monitoring the progress of the technical work of THCs and taking appropriate action.
- Reviewing the need for, and planning of, work in new fields of technology.
- Maintenance of these procedures and other rules for the technical work.
- Consideration of matters of due process raised by NSBs, and of appeals concerning.
- Decisions on new work item proposals, on committee drafts, on enquiry drafts.
- Ensure representation of all genders in all committees and working groups, promoting inclusivity in decision-making processes and technical roles. Gender-sensitive training and policies should be implemented to support the participation and advancement of women in standardisation efforts.

Technical Harmonisation Committees (THCs):

- THCs should be established to focus on different technologies, ensuring the development and harmonisation of standards.
- They should be empowered to create subcommittees and working groups for specific tasks and ensure that standards align with international norms.

National Standards Bodies (NSBs):

- NSBs should be responsible for implementing the harmonised standards at the national level and ensuring that national standards do not conflict with regional ones.
- They should participate actively in the development process by providing technical experts and national comments on draft standards.

Private sector (Renewable energy associations) and utilities

- Participate in the meetings and engagement of the THC
- Review and provide insights on draft documents and procedures for standards harmonisation
- Promote the use of products and services that fulfil the requirements of harmonised standards

Women's Groups and Gender Advocates:

- Ensure the inclusion of women in all levels of the process, from technical roles to decision-making positions.
- Advocate for gender-sensitive approaches in the development and harmonisation of standards.

- Promote training and support for women in technical and managerial roles within the solar PV sector.
- Promote gender-sensitive approaches in the development and harmonisation of standards to ensure that both men and women benefit equitably from the outcomes.
- Implement Gender-sensitive training and policies to support the participation and advancement of women in standardisation efforts.

7 Recommendations - Roadmap for the regional harmonisation of PV standards

The following section outlines the various stages involved in the harmonisation process for standards, it follows a similar standards harmonisation process within the ECOWAS region. The process has been adapted to the local context of SPC and can support the harmonistaion of technical documents such as IEC/ISO standards and other guideline documents such as the guidelines for solar PV developed by SEIAPI.

The process is structured to ensure that all standards undergo a thorough development and review process before they are adopted as Harmonised Standards. Below is a breakdown of the key stages:

7.1 Key Stages

Table 7-1. Stages of standard harmonisation process

Project Stage	Deliverable
0. Preliminary stage	Preliminary work item
1. Proposal stage	New work item proposal
2. Preparatory stage	Working draft
3. Committee stage	Committee draft
4. Enquiry stage	Draft harmonised document
5. Approval stage	Final draft harmonised document

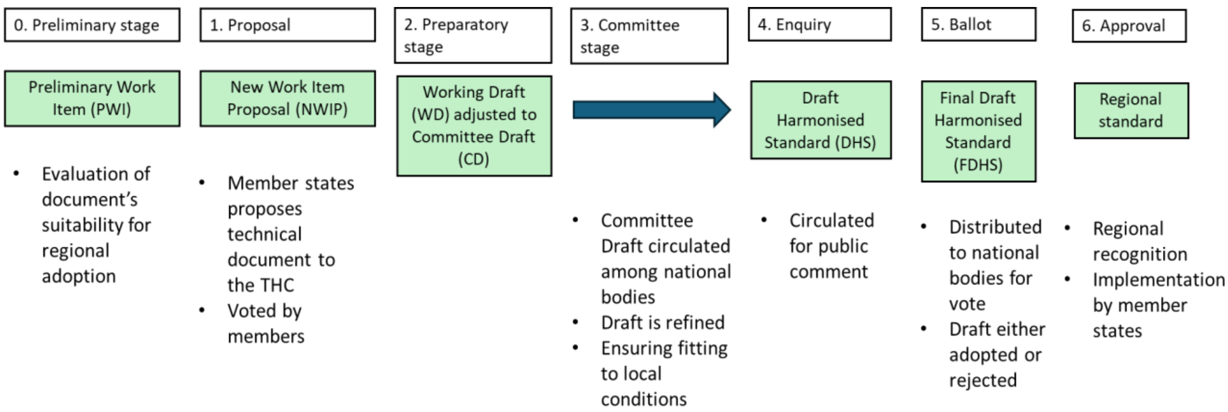

Figure 7-1. Overview of process for regional harmonisation of standards

Preliminary Stage (Stage 0):

- This is where potential new standards are introduced as **Preliminary Work Items (PWI).** At this stage, the work items are not yet ready for full processing, often due to emerging technologies or the lack of an existing international standard.
- No deadlines are set at this stage, and the item remains under review until it is mature enough to proceed.
- When adopting an existing guideline for the region, a discussion will be held to determine which specific guidelines should be introduced.
- For existing IEC or ISO standards, the relevant standard will be evaluated based on its suitability for regional adoption.

Proposal Stage (Stage 1):

- At this stage, a New Work Item Proposal (NWIP) is submitted to the relevant Technical Harmonisation Committee (THC). This proposal can originate from any member state or external organisation.
- The proposal undergoes a voting process to determine if it should proceed. Approval requires a simple majority of members, with a specific number of members committed to actively participate in its development.
- When an existing standard is considered, a review is conducted to determine the required adjustments or enhancements for regional adoption.

Preparatory Stage (Stage 2):

- A Working Draft (WD) is prepared, often involving a Project Leader and nominated national experts.
- This stage involves extensive collaboration to refine the draft until it is suitable to be presented as a Committee Draft (CD).
- Any adopted standards or guidelines will be analysed to ensure that they align with regional objectives and that adjustments are made accordingly.

Committee Stage (Stage 3):

- The draft is circulated as a Committee Draft (CD) among national bodies for comments. This is a critical stage where the draft is reviewed and refined to reach a consensus on its content.
- For adopted international standards, feedback focuses on regional compatibility, ensuring that the guideline or standard fits local conditions.
- The process concludes once all technical issues are resolved, and the draft is ready to move to the Enquiry Stage.

Enquiry Stage (Stage 4):

- The draft, now known as the Draft Harmonised Standard (DHS), is circulated for public comment. This stage involves a public review period of 60 days.
- Comments from various stakeholders are collected and addressed. This ensures that the proposed standard or guideline meets both international and regional requirements.
- After addressing all comments, the draft moves to the Ballot Stage.

Ballot Stage (Stage 5):

- The Final Draft Harmonised Standard (FDHS) is distributed to all national bodies for a vote. The criteria for acceptance are stringent, requiring explicit votes, and the stage ends when the draft is either approved or rejected.
- If an existing guideline or standard is being adopted, this stage ensures that the regional context has been fully accounted for in the final draft.

Approval Stage (Stage 6):

- This is the final stage where the FDHS is officially approved by the THC and declared a Harmonised Standard or document. It is then adopted and implemented by member states.
- Any adopted international guidelines or standards are now regionally recognised and become the official standard for the area.

7.2 Timelines

Table 7-2. Typical timelines allowed for commenting / voting

Stages	Time period allowed for commenting/voting	Adoptions from IEC or ISO Standards
0. Preliminary stage	Not Applicable	Not Applicable
1. Proposal stage	2 Months	3 Months
2. Preparatory Stage	Not Applicable	Not Applicable
3. Committee Stage	6 Months	Not Applicable
4. Enquiry Stage	3 Months	1 month (preparation)
5. Ballot Stage	2 Months	2 Months
6. Approval stage and Publication	Not Applicable	1 Month

The table highlights that the process for adopting existing ISO or IEC standards is more streamlined, with fewer stages and shorter periods for commenting and voting, in comparison to developing new standards from scratch.

7.3 Regional harmonisation of a guideline or standard for a PV product

The following section aims to illustrate the procedure recommended to ensure the regional harmonisation of relevant technical documents in the Pacific Region through an example. In this case, the document proposed are the "Grid-Connected Photovoltaic (PV) Systems Installation Guidelines", developed by the **Sustainable Energy Industry Association of the Pacific Islands (SEIAPI)**. These guidelines set out the minimum requirements for installing grid-connected PV systems, ensuring safety, reliability, and compliance with international and regional standards.

The guidelines are primarily based on three key sources of standards:

- **International Electrotechnical Commission (IEC)** standards
- **Australian/New Zealand Standards (AS/NZS)**
- **National Electrical Code (NEC)** from the United States

By referencing these established standards, the guideline ensures a consistent and harmonised approach to grid-connected PV installations across the Pacific region.

SEIAPI has released a comprehensive set of guidelines, which are organised into several key categories. It is strongly recommended that these guidelines be adopted across the South Pacific Community (SPC) region to support the development of sustainable energy practices.

The adoption of International Electrotechnical Commission (IEC) standards can be challenging for many in the region due to the high costs and complexity associated with these standards. Recognising this, SEIAPI has streamlined essential information from the IEC standards and distilled it into clear, practical guidelines. These guidelines are designed to be both accessible and easy to comprehend, ensuring that stakeholders at all levels can implement these best practices. These guidelines are available on their website.

The available guidelines have been categorised in the graphic below:

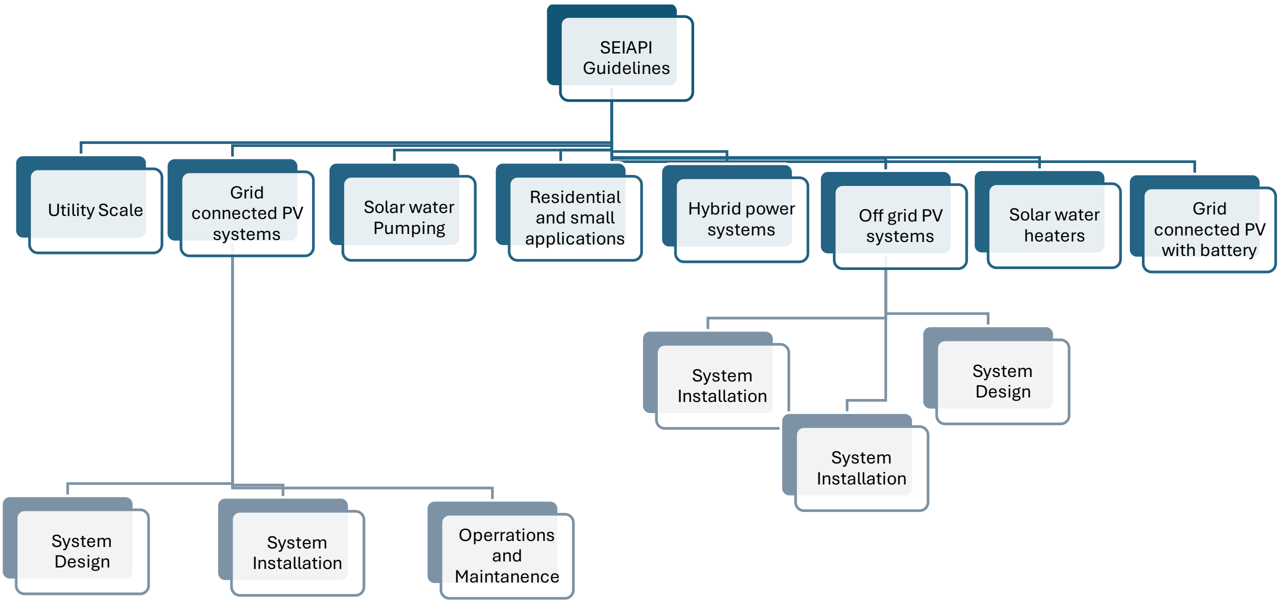

Figure 7-2. Structure of SEIAPI guidelines

Prioritizing the harmonistaion and adoption of SEIAPI guidelines instead of IEC/ISO standards has several advantages. Firstly, SEIAPI guidelines are tailored to the needs of Pacific Countries and refer relevant IEC/ISO standards that should be implemented to ensure Quality Assurance for PV products and services in a language that can be understood by non-technical staff. Furthermore, a significant barrier to the harmonisation of standards at the regional level and their implementation at the national level are the costs of purchasing access to the IEC/ISO standards, in contrast to guidelines, which are publicly available.

Institutional setup and operationalisation:

Regional Technical Committee (RTC)

The RTC, through its working group on standardisation, will oversee the entire process of adopting the "Grid-Connected PV Systems Installation Guidelines" for the Pacific region. They will decide whether the guideline should be adopted as-is or adapted to meet regional needs. Key areas of focus:

- High-level guidance on the adaptation of international standards (e.g., IEC 61215 and 61730) and specific regional needs (like cyclone-proof requirements).
- RTC will initiate a review of how the guidelines align with the region's renewable energy goals and infrastructure capabilities, taking input from various stakeholders.

The RTC will also supervise the practical implementation, enforcement, and monitoring of the adapted guidelines across all member states. They are responsible for ensuring that the Quality Infrastructure (QI) standards for safety, reliability, and performance are adhered to. The RTC will:

- Decide on how to enforce regionally adapted guidelines, especially in areas like cable protection (Section 11) and disconnection requirements (Section 7), ensuring these align with the local power grid infrastructure and national safety codes.
- The RTC will monitor the national bodies enforcement of the guidelines and oversee quality control in PV system installations.

Technical Management Committee (TMC)

The TMC will coordinate all technical decisions on the adaptation and approval of the guideline. Their role is critical in ensuring that the technical aspects of the guideline, such as the electrical safety standards, are consistent across the region. They will:

- Decide on which technical standards to adapt, focusing on areas like “Voltage Limits and Work Restrictions” (Section 3) and the “Installation of PV Array Wiring” (Section 6), which must meet safety codes such as AS/NZS or NEC.
- The TMC will coordinate the development of specific technical drafts that meet the regional requirements for PV installations, ensuring that key safety and performance metrics, such as wiring durability and voltage drop calculations, are suitable for Pacific conditions.

Technical Harmonisation Committees (THCs)

The relevant THC, likely focused on renewable energy and electrical safety, will carry out the specific task of tailoring the "Grid-Connected PV Systems Installation Guidelines" for Pacific Island nations. They will:

- Decide on which specific guidelines from international standards (e.g., IEC 62109 for inverter safety or AS/NZS 5033 for installation requirements) are directly applicable or need adaptation for regional contexts, such as ensuring PV installations withstand Category 5 cyclones.
- Focus on sections like “Roof Mounting” (Section 5.4) and “Free-Standing PV Arrays” (Section 5.5), where additional requirements for cyclone protection and saltwater corrosion need to be added.
- The THC will draft regionally specific modifications to address these challenges, such as mandating minimum spacing for natural ventilation of PV arrays and materials suited for high-humidity environments.
- Subcommittees (SCs): Would handle specialised areas like structural resilience for PV arrays in cyclone-prone regions (e.g., Section 5.7 on attaching modules to the array mounting structure). They will propose specific materials and methods that are better suited for Pacific environments.
- Working Groups (WGs): Focus on short-term projects like drafting sections of the guidelines related to wiring safety and voltage classifications (Sections 6.6-6.7), ensuring compatibility with both NEC and regional voltage classifications. They would ensure the adaptation of guidelines related to voltage limits and protective devices.
- Task Forces (TFs): Could be tasked with integrating the rapid shutdown requirements (Section 11.8) for PV systems on buildings following the NEC guidelines, as rapid shutdown for safety may be crucial for urban installations.

National Standards Bodies (NSBs)

Each NSB will play a critical role in implementing the regionally harmonized standards at the national level. They are responsible for training and certifying installers, as well as ensuring compliance with the guidelines. The NSBs will:

- Decide on how to implement guidelines such as earthing and grounding (Section 9) and installation of combiner boxes (Section 12), ensuring local installers follow safe practices that are compatible with regional standards.
- NSBs will oversee the adoption of national certification programs for PV system installers, ensuring that professionals are trained in the adapted guidelines.

Harmonisation Process Stages

Preliminary Stage (Stage 0):

- The Grid-Connected PV Systems Installation Guidelines are introduced as a Preliminary Work Item (PWI) by a member state or external body like the Pacific Power Association (PPA) or SEIAPI. Initial discussions focus on adapting key international standards (e.g., IEC, AS/NZS, NEC).
- Decide which guidelines are most suitable for the region (e.g., adapting IEC 61215 for PV module durability and type approval).

Proposal Stage (Stage 1):

- A New Work Item Proposal (NWIP) is submitted to the THC, which votes on whether the guidelines should move forward.
- Decide whether to proceed with regional adaptation based on feasibility and technical review. They may suggest changes for roof mounting requirements (Section 5.4) to ensure structures withstand high wind speeds.

Preparatory Stage (Stage 2):

- A Working Draft (WD) is prepared. National experts and project leaders collaborate to refine the guideline.
- Adjustments needed for technical specifications like voltage limits (Section 3), wiring installation (Section 6), and safety measures are made.
- Adapt international voltage limits to local infrastructure, ensuring they align with both IEC standards and local conditions.

Committee Stage (Stage 3):

- The Committee Draft (CD) is circulated among national bodies for comment.
- Decide whether to adopt proposed changes, especially around installation safety (Section 8) and disconnection requirements (Section 7). Adjustments for regional grid safety and compatibility would be made.

Enquiry Stage (Stage 4):

- The Draft Harmonised Standard (DHS) is circulated for public comment (60-day period).
- The final adjustments are based on public and stakeholder input. Feedback focuses on local environmental conditions, grid compatibility, and safety measures.

Ballot Stage (Stage 5):

- A Final Draft Harmonised Standard (FDHS) is voted on by national bodies.
- Final adoption and adjustments for local adaptation, ensuring cyclone-proofing measures (e.g., Section 5.7 on module attachment) are fully incorporated.

Approval Stage (Stage 6):

- The FDHS is approved and adopted as the official regional standard.
- The guideline is implemented nationally, with NSBs ensuring compliance through certification and enforcement.

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