Quality Assurance Framework for Component Based Solar Systems

Introduction

Global Sustainable Energy Solution staff have actively been involved in building the Solar Energy industry for over 25 years. GSES experience is that there are key "components" that must integrate with each other and if one or more is missing or weak, there is reduced probability of a sound and viable industry. These components are shown in Figure 1.

Figure 1: Components Required for a Building Sustainable Industry

Finance is essentially relevant to all components of figure 1 plus access to finance by companies and also end users is required in some countries to ensure growth in an industry.

Over recent years Global Sustainable Energy Solutions (GSES) has been involved with the introduction of Quality Assurance Frameworks for Component Based Solar Home Systems. GSES has been involved with solar projects internationally since 1998 and over this time has learnt that it

is important not to "trial" in a developing country what has not been undertaken in a developed country and be proven to work. This relates to products and systems but also in the capacity building area.

A quality assurance framework for Component Based Solar Home Systems requires all of the components shown in Figure 2.

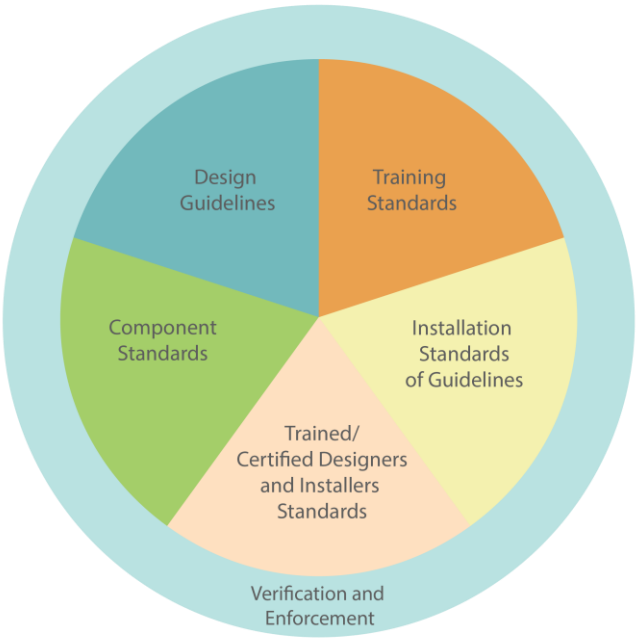

Figure 2: Components of a Quality Assurance Framework for Solar Systems

The work GSES has been undertaking in Vanuatu and Uganda has come from GSES staff experience in Australia, various countries and also the Pacific region. The Managing Director , Mr Geoff Stapleton was president of the New South Wales Chapter of the Australian Solar Energy Industry Association from 1992 to 2002 and been an active member of Australian Standards committees since 1993 and training committees since the early 2000's while GSES Technical Business Manager Mr Richard Collins was on the National Committee from 1995 -2000, including being the national president.

The process of implementing a Quality Assurance Frameworks for Component Based Solar Systems started in Australia in 1992, however it did not really become sustainable to about 2008 and in reality, not covering all aspects until a number of years later. The steps for the framework to become sustainable was seed funding from the Federal Government, industry-wide support and the drive from committed individuals within the industry association.

The only reason all components of the framework finally became sustainable however was because of the growth in the grid connected PV systems market from 2007 onwards.

The process in the Pacific had various methodologies trialled in the 90's and early 2000's but the push was started from about 2010 (possibly 2005-more later) and still has a long way to go.

This brief document provides a summary of what has been implemented and how, but more importantly what made it sustainable. The only reason the framework finally became sustainable was when the solar market grew due to the number of grid connected systems being installed and the boom in accredited designers and installers. In Australia all aspects of the QAF would never have been sustainable just for the off-grid market due to the penetration of the grid and hence relatively low volume of off-grid systems and installers.

Australia

Designer/Installer Accreditation Program and Industry Based Training

During the 1980's and early 1990's one of the issues of concern of the industry at the time was that many of the stand-alone power systems (off-grid) that were being installed were being oversold by some companies, that is overpromising what the system could deliver. Many industry players had stories of people complaining that their systems were not working properly. Some of these complaints were due to poor installation and poor equipment, most were due to poor design, and for example a system that could only meet a daily energy usage of 1-2kWh was being sold to customers as being able to meet much higher energy demand. There was a concern that this overselling of solar systems would damage the relatively young industry.

At the 1992 annual meeting of the industry participants it was reported that there had been one death on a system as a result of unsafe self-installed system and there had been a fire in a system on a bus. It was decided that the industry should develop a training course and introduce an accreditation program for designers and installers. The industry successfully applied to the Australian Government for support and a trainer was person was hired to act as trainer, developer of an accreditation scheme[1] and ongoing employee of the industry association.

The training course and accreditation scheme was launched in August 1993. Where possible the course was conducted face to face however with Australia being a large country with people working in various rural areas, the course was mainly conducted via distance learning with practical sessions being rotated around the country.

Figure 3: Attendees at first course:
Back Row : David Bartley, Rick potter, Lindsay Hart, Bob McDonald Stephen Garrett, Ray Prowse, Ron Tito, Roger Bunyan
Front Row: Tony Egan, Peter Browne, Stephen Ingrouille, Geoff Stapleton

[1] Note that the scheme is called accreditation because under the Australian Quality Training Framework, people could only be certified (levels I to IV) after completing a nationally endorsed training course. This accreditation scheme therefore was (and still is) an industry endorsed scheme however it is now recognised by the various Governments in Australia and the regulators

To become accredited a person had to successfully complete the course where they would be awarded provisional accreditation for designing and installing stand-alone (off-grid) power systems for a 12-month period. To obtain full accreditation they would have to submit three case studies on systems they had designed and installed. These case studies included a proforma form and they had to provide, load assessments, information on the systems and photos of the installed system. These were then assessed by the association's office before the person obtained full certification which was initially provided for life.

The scheme was voluntary; however, the industry association did liaise with various state governments which at the time were introducing state-based subsidy scheme for off-grid power systems. The state governments generally saw the merit in making it compulsory that the owner of a system would only receive the subsidy if they used an accredited designer and installer.

When the government funding stopped in about 1996 the association was not in a position to pay a person to work full time and had to release the one staff person. The voluntary committees took over and administered the training course and accreditation service on a fee for service basis.

In 2000 the Australian government introduced a subsidy program for roof top grid connected PV systems and off-grid system for those people not connected to the grid.

The industry association then introduced accreditation for the design and installation of grid connected PV systems.

The government made accreditation a requirement of the scheme and again funded the association to have a full time person administering the scheme. It was around this time that the accreditation was changed from being for life to the requirement of being renewed every two years again with the provision of a case study to allow the association the opportunity to assess whether the accredited person were still designing and installing system correctly, (well at least the case study one!)

In early 2000's a complaints procedure was introduced which could lead to an accredited installer having their accreditation removed.

When that funding support for the individual staff person administering the scheme finished in about 2003 there were only about 200 accredited people Australia wide and the scheme was not self-sufficient. However, it was still a requirement of the subsidy program and the administration of the accreditation scheme was continued by the association, with a full-time person. In summary the operation of the scheme was being cross subsidised by the voluntary actions of association members because they realised it was important for the industries' credibility.

In about 2005 the decision was made by the then association (Business Council for Sustainable Energy (BCSE) that the scheme had to be self-sufficient and the renewal fees had to be reflective of the actual operating cost which at the time turned out to be AUD440 per accredited person per year. Since it was a compulsory requirement of the still ongoing subsidy program, the accredited designers and installer had to pay fees to be able to sell and install systems. The scheme was now sustainable but only because of a high fee.

In 2007 the price of solar reduced sufficiently that combined with the subsidy that was still available led to a boom in the industry. The number of accredited installers grew from approximately 400 to 4000, 95% of these were only accredited for grid connected systems. The annual fees were then reduced to a level accepted by the industry but only because of the growth in the grid connect market. A few years later the renewal was changed from a case study requirement to a continual professional development system. An accredited person had to attend short training courses and other professional development activities to receive sufficient points each year to renew their accreditation.

After the subsidy programs the scheme was still compulsory because PV systems were eligible for Renewable Energy Certificates (REC) as part of the Renewable Energy Target (RET), however most State Regulators have indicated that they will make it compulsory when the RET program finishes.

Since 2007 the association administering the scheme is the Clean Energy Council (CEC).

A few years ago the scheme was expanded to have an endorsement for energy storage for those who already have grid connect accreditation.

As of end of April 2020 were 6845 accredited people. These are broken down as:

- 0.7% only have Stand Alone Power Systems accreditation
- 15% have at least both GC and SAPS
- 18% have energy storage endorsement
- 84.3% have GC accreditation only

The association administers a complaints program (also see section on inspections) and individuals have had their accreditation removed over the years. The scheme has always had a code of conduct which the accredited installer shall abide with.

Information on the accreditation process is available from
https://www.cleanenergycouncil.org.au/industry/installers/accreditation-process

When the accreditation scheme commenced in 1993 the majority of the industry comprised one person businesses or small companies of up to 20 staff. In this situation the majority of times the sales of the system were undertaken by the accredited designer/installer. Hence when a complaint was received about a system not performing it was easy to implement the complaints procedure against the business via the accredited designer who was also often the salesperson.

With the growth of grid connected systems the industry changed with larger companies comprising just sales people with the installation being sub-contracted to the accredited installers who were often indirectly taking responsible for the design of the system even when they had not made the sale. This led to an increase in people complaining that their grid connected system were not providing the energy savings that the "salesperson" had promised or the installer would arrive the undertake the installation and was unable to complete it because no site visit had been undertaken and the house switchboard actually required upgrading to cater for the new meters etc.

This has led to the CEC introducing Approved Solar Retailers scheme. Further information is available from:

https://www.cleanenergycouncil.org.au/industry/retailers

Quality Training

In Australia, vocational trade courses such as those for electricians, builders and plumbers, would require an apprenticeship and completion of a course at a Technical and Further Education (TAFE) college. These apprenticeships were typically 4 years and during that time a person could spend between 900-1200 hours at the training college. These trades were known as Certificate III or Certificate IV courses.

In the 1980's a Certificate IV in renewable energy had been developed. Although some TAFEs had commenced offering the Certificate IV in Renewable Energy, the course was not suitable for the people already working in the industry. The courses at the time were only offered at a TAFE facility in some capital cities and many in the industry were not located near those centres offering that training. Existing solar industry members could also not afford the 900+ hrs required to do the certificate course.

Hence the initial course offered by the industry association, for the purpose of obtaining accreditation, was primarily aimed at those who were already in the industry.

Although the initial objective of the accreditation scheme was to ensure that those already in the industry were trained, the industry association's training course was being used as the main training course for new people to enter the industry and gain accreditation. Many of those involved with the accreditation scheme at the time were concerned that the course was too short for someone to enter the industry. A person becoming an electrician spent 3-4 years in an apprenticeship and undertook up to 900hrs of formal training at a TAFE college, whereas those people entering the solar industry only had to do a relatively short course. Discussions did start on how the training required to become accredited could be undertaken through the Registered Training Organisations (RTO's) in particular the TAFEs.

The endorsement of the Certificate IV, Diploma and Advanced Diploma Renewable energy courses being conducted at TAFE's were to expire in 1999 and the Australian Quality Training Framework (or its equivalent at the time) was now requiring endorsed training courses and packages to be developed within Industry Technical Advisory Body (ITAB). At the time the Electrotechnology Industry Advisory Body (now E-Oz) was prepared to incorporate renewable energy courses within their training package. This process was being driven by those within the TAFEs conducting the renewable courses, however members of the association did play a role through attendance at some of the initial meetings. In later years representatives from the association became the chair of the relevant advisory committee.

Once this was completed then from 2002 onwards only those individuals who undertook the relevant short courses at an RTO could obtain their provisional accreditation.

So, the training of solar technicians had now become mainstream in Australia. These courses are fee for service, so the conducting of the training is sustainable with a number of private RTOs now offering training as well as the government owned TAFEs.

Technical Standards and Guidelines

In the early 90's the subsidy programs for stand alone power systems (off grid) required the installer to install the system in accordance with the Australian Wiring Standards and the then battery standard. The systems were inspected by government electrical inspectors before the subsidy was paid.

The Australian Standard that related to battery banks in buildings – at the time the existing standard was written around Telecom (the then name of Australia's telecommunications carrier) Battery exchanges and similar, and so was very irrelevant to an off-grid system.

The association lobbied Standards Australia for a new standard in 1993. This led to the development of AS4086- *Batteries in Stand Alone Power Systems* which was released in 1997.

The association by 1997 had developed technical guidelines which the accredited installers had to follow, however the industry was always concerned that this might not be recognised as robust enough. So again, the industry lobbied Standards Australia which led to:

- AS4509- Installation of Stand-Alone Power Systems being released in 1999 and
- AS4509-Guideline to the Design of Stand-Alone Power Systems being released in 2001.

Standards Australia then established an ongoing renewable energy technical committee which since then have developed:

- AS/NZS 4777 Grid Connection of energy systems by Inverters in 2002
- AS/NZS 5033 Installation and safety requirements for PV Arrays in 2005 (this was also used as the basis for IEC 62548)
- AS/NZS 5139 Electrical installations—Safety of battery systems for use with power conversion equipment in 2019

All of these are under constant review, however while these standards were being developed, the industry released best practice guidelines that had to be followed by accredited designers and installers until such time as the final Standard was released. These guidelines are continued to be released because the industry is changing rapidly and due to the time taken to release a standard they reflect state of the industry.

These guidelines were the ones first used in the Pacific which were then revised for Uganda and also the Economic Community of West African States (ECOWAS) countries.

The development of standards and guidelines is important however educating the industry and other stakeholders about them is just as important. BCSE started that process back in 2002 with workshops being undertaken around Australia on the different standards. These have continued over the years in some form or another both by the various associations and also private training providers on a fee basis. These workshops will generally attract CPD points for the accredited designers/installers to submit as part of their annual renewal.

Inspections

As mentioned earlier off-grid systems were often inspected by electrical inspectors in the early 1990's as a requirement of subsidy programs. The association always wanted to undertake random inspection however the cost was prohibitive for a country the size of Australia.

In 2004 the association (BCSE) was successful in obtaining funding from the Australian Government to undertake inspections. The inspections were managed by GSES. Every accredited installer had at least one of their systems inspected and the association obtained permission to survey the owners of the system. Over 95% of the systems were off-grid systems. The grid connected systems being installed at the time under the subsidy program were all being inspected the electricity utilities electrical inspectors before being allowed to connect to the grid.

The BSCE was pleased with the customer survey results as shown in table 1 because it vindicated that the focus by the association on designing systems correctly (and also supporting the customer) had been successful.

Table 1: Summary of Survey Results

	Very Satisfied	**Relatively Satisfied**	**Relatively Unsatisfied**	**Very Unsatisfied**
How would you rate your overall satisfaction with your system since it was installed?	59.7%	33.6%	2.7%	2.0%
How would you rate your overall satisfaction with your system installer?	63.8%	24.2%	6.0%	2.0%

Have you had a problem with the System?	**Yes**	**No**	
	50.3%	49.7%	
If yes, with what equipment?	**Yes (number)**		**% of Problems**
Batteries	21		14.1%
Inverter	38		25.5%
Solar Regulator	11		7.4%
Shading of Panels	15		10.1%
System Sizing	18		12.1%
Wiring Problems	4		2.7%
Other	33		22.1%
	Yes		**No**

Would you recommend a PV system to your neighbour or a friend?	86.6%	8.7%

However, the association was not happy with the installation standards of the systems. This led to revisions of the standard (AS/NZS4509). The government continued to fund the association to inspect systems for the next 4 years.

In 2010 Inspections were then restarted this administered by a Government Department. GSES was contracted to develop the checklists and the procedures. GSES was then selected as one of the inspection companies along with 2 other companies.

These inspections are continued today and are legislated in Federal Parliament as a requirement of the Renewable Energy Target for the provision of the Renewable Energy Certificates. The inspections are managed by the Clean Energy Regulator (CER). GSES is still one of the companies undertaking inspections on behalf of the CER.

The results of the inspections are used by the Australian Standards committee and those conducting training to:

- Update standards if required to eliminate concerns identified and
- improve training by including particularly areas where installers are not following the standards.

Where installations have any non-conformance to standards, the reports are provided to the CEC. The CEC will then implement their compliance procedures. (refer to Complaints and Sanctioning)

Quality Product Control

The Australian Wiring Rules (Known as AS/NZS3000) are legislated in each state through an act of parliament. This thereby makes it illegal for any system not to be installed in accordance to the standards. The various renewable energy standards are referenced in AS/NZS3000 and hence this makes them compulsory.

The relevant International Electrotechnical Commission (IEC) product standards (and when available Australian standards) are listed in the relevant standards. This makes it compulsory for any accredited installer to use equipment tested and certified as meeting the relevant product standards.

However, with the number of different products now available how does an installer know if the product has actually been tested and certified? To overcome this problem the Australian Government funded the CEC to establish an approved products data base. Any company that wants to import and sell products in Australia must apply to have their products approved and then added to the list. The CEC's compliance team verifies that the certificates are genuine and then adds the product to the Approved Products List. Currently the list covers modules, controllers (PCE's), inverters and batteries.

Information on the process and the Approved Products List are available from:
https://www.cleanenergycouncil.org.au/industry/products

The compliance team does have access to testing laboratories within Australia and at times will randomly purchase a product from a retailer and then have it tested to ensure that the products being sold are those that meet the standards. Products have been removed from the list based on complaints and also random testing.

Complaints and Sanctioning

When the accreditation scheme was launched in 1993 it had failed to introduce a complaints process against accredited designers and installers. A Code of Conduct had been developed and therefore an accredited person could technically have their accreditation removed if not designing/installing systems in accordance with the guidelines or not operating in accordance with a code of conduct.

In 2000 after accreditation had become a requirement of the Australian Wide roof top subsidy the association developed a robust procedure for handling complaints. It was a difficult issue because

theoretically removing a person's accreditation potentially removed their ability to earn money in the industry. Without a fair and robust procedure, they might sue the association, thereby potentially financially impacting the voluntary directors of the association.

At the time consideration was given that the accreditation should become part of the various state government licensing procedures (e.g. other trades are licensed). The government bodies administering these licenses had more legal protection when fining a licensed individual/company or removing a person's license. However, the relevant state departments approached basically thought the association was administering the accreditation scheme appropriately.

As mentioned previously the CEC is provided the name of installers whose system has been found to have some non-compliance during the inspections undertaken by the CER. CEC allocate demerit points to accredited installers and designers.

Once an accredited installer or designer has received 20 demerit points, their accreditation will be placed on probation. Probation will be removed from accreditation once the installer or designer has completed the required actions outlined by the CEC to prove their competency (which may be through assessments or rectifications). CEC at times has removed the person accreditation.

The CER also has compliance inspectors and designers/installers can be fined if they break any rules in relation to providing renewable energy certificates for a system.

If the system is found to be unsafe during an inspection, the matter is handed over to relevant state government electricity regulator who can fine or even remove the installers electrical license.

Further information can be found:

https://www.cleanenergycouncil.org.au/industry/installers/compliance-toolkit/compliance-procedure

Pacific Island Countries and Territories

There are 22 countries or territories within the Pacific region with a total population of 11.6 million. 8.6 million are in Papua New Guinea resulting in 3 million spread across the other 21 countries. These 21 countries are dispersed throughout the Pacific Ocean. The Pacific Ocean could fit the combined land areas of all the continents.

GSES first became involved with the Pacific region when it was contracted by the United Nations Development Program (UNDP) to co-author the document title: Pacific Renewable Energy Training Initiative (PRETI) in 2005. After years of ad-hoc training associated with many different donors and/or government supported projects it was felt that a co-ordinated approach was required to establish training in the Pacific. Since 2005 ad-hoc training has still been occurring, many different initiatives have been undertaken but it is fair to say, as far as the industry is concerned training is still not easily available. More on this later.

In 2008 GSES was contracted by the World Bank as a solar technical adviser to the Sustainable Energy Finance Project (SEFP) covering Fiji, Solomon Islands and Papua New Guinea. As part of this project 2-week training courses in the design and installation of off grid (solar home systems) were undertaken in the three countries. When conducting the course in Fiji, Geoff Stapleton was approached by two of the major companies in Fiji, CBS and Clay Engineering and asked for support in establishing a technician accreditation scheme in the Pacific like that operating in Australia. These two companies wanted to raise the quality of the industry in the region. However, one major concern was the many donor projects that were occurring where companies from overseas flew people in, installed the systems, left and any issues with the system reflected badly on solar in general which affected the local industry.

After discussions the two companies it was decided to follow the format in Australia, that is establish an industry association, establish the accreditation process and then undertake activities similar to what had happened in Australia.

In 2010 GSES successfully applied for funding from the Renewable Energy and Energy Efficiency Program (REEEP) for the funding to establish:

- Sustainable Energy Industry Association of Pacific Islands (SEIAPI)

- Technicians Certification and Company Accreditation Scheme

Sustainable Energy Industry Association of Pacific Islands (SEIAPI)

SEIAPI formally started in November 2010 with an executive committee comprising individuals from industry and electricity utility personnel from across the Pacific. Geoff Stapleton has been secretary since its inception and GSES acts as the secretariat.

One of the initial activities was to develop a business plan that comprised the association developing guidelines, training units standards and conducting workshops on the guidelines. SEIAPI then started approaching various donors about funding to undertake the above activities but also to allow a full-time person who could manage the activities and provide the day to day operation of the association. GSES 20-year experience with associations was that they require a full-time person to grow but initially the industry was typically too small to pay sufficient fees to cover the expenses. All industry associations in every country GSES has studied (including countries like USA and Australia) have struggled in the early days. It is only when the industry reaches a certain size that the associations become financially sustainable.

GSES had been involved in industry associations in Ghana and Sri Lanka. Both these had World Bank Solar Home System subsidy programs, and technical assistance funding was provided to the associations for operating the association, conduct training that would therefore support the programs.

The issue SEIAPI was finding that though there were many donor founded solar programs occurring through the Pacific none were regional hence no funding support for a regional organisation. SEIAPI was also only asking for USD1 million which for many donors was too small as a one-off project. In 2013 The New Zealand Government recommended that the Pacific Power Association (PPA) and SEIAPI work together since they were also asking for USD1 million to fund some of their capacity building activities.

SEIAPI and PPA worked together on a proposal with the relevant NZ ministry for more that 12 months and then the money that was allocated by NZ was given to the World bank for them to administer a project. The project finally became the Sustainable Energy Industry Development Project (SEIDP) and the World Bank sourced other funding and it became a USD5.66 million project with the SEIAPI requirements one component.

The SEIAPI portion of the project was released for international tender in 2017. GSES submitted a proposal, however the project team had to include experienced experts so there was no opportunity for hiring a person from Fiji who could act oversee the day to day activities of SEIAPI.

In late 2017 GSES was awarded the contract which was finally signed early 2018 and the project started in 2018. The activities are discussed in the relevant sections that follow.

During 2014 SEIAPI and PPA had signed a Memorandum of Understanding (MoU) for the two organisations to work together in particular on any technical activities that benefited both the utility members of PPA and the industry members within SEIAPI. This MoU allowed for SEIAPI to have a staff person located in the PPA offices in Suva.

In June 2018 GSES hired a Fijian national to represent GSES in the Pacific but also to spend some of his time (free of charge) on SEIPI activities. Mr Sandip Kumar was a renewable energy lecturer at Fiji National University (FNU) and therefore would become a training resource person for both organisations.

Currently Mr Kumar's salary and expenses are paid by GSES but it is hoped that his work in the Pacific will become more and more as SEIAPI and hence SEIAPI will then be in a position to have a full time person funded by the association.

Technician Certification and Company Accreditation Scheme

From the lessons learned in Australia the Pacific Scheme that was developed through the REEEP funding focussed on certifying technicians (designers and installers) and accrediting the companies.

The rules for the scheme can be found at the following site:

https://www.seiapi.com/certification-and-accreditation/

In many countries that do not have quality Training frameworks where "certificates" have government recognised significance, people are certified, and companies/programs etc are accredited. This is why the Pacific scheme used the terms certified for the individuals and accredited for the companies. However, it has caused issues because some of the South Pacific countries like Fiji have similar quality training frameworks and only the government can provide "certification". They have accepted that the scheme is an industry-based certification.

The scheme was launched by the Fijian President in 2012 as part of the launching of Sustainable Energy for All (SE4ALL) in the Pacific. The scheme has struggled because the training courses required to obtain certification were not available within the Pacific (see section on Quality Training). GSES as a training organisation has conducted a number of training courses to facilitate people obtaining their SEIAPI certification however what is required is in-country training. Some of these have been supported by international organisations such as International Renewable Energy Agency (IRENA) and the International Union for Conservation of Nature (IUCN).

Figure 4: Launch of the Technician Certification Scheme in Fiji in may 2012
Cathy Stapleton , Geoff Stapleton (SEIAPI Secretary), the then Fijian President Brigadier-General (Rtd) Ratu Epeli Nailatikau and Bruce Clay (Current SEIAPI President)

In 2014 as part of the MoU with the PPA the scheme was rebranded as the PPA/SEIAPI certification and Accreditation Scheme.

The unavailability of training has made it difficult for SEIAPI to encourage Governments and Donors to have the requirement that only accredited designers and installers can be used in any program providing solar systems. However, it was made a requirement within the Vanuatu Rural Electrification Project for Phase 2 Component 1 which related to component based solar home systems. Training was conducted, but not as part of the project, but paid for by the various companies approved as part of the project.

It is hoped that more training will become available in coming years and the number of certified designers/installers will grow and that more countries and donors will adopt the scheme as part of their projects and/or country requirements.

The day to day administration the certification/accreditation program will remain an activity of SEIAPI with some support from the PPA. At the moment this is undertaken as a voluntary basis by SEIAPI and it is not financially sustainable.

Quality Renewable Energy Training

In many ways the training being conducted in the Pacific is still ad-hoc and not consistent however there have been many initiatives to attempt to address this issue.

As stated in the introduction GSES was involved with developing PRETI in 2005, unfortunately this US$4 million project was never funded. However, over USD1 billion worth of solar projects have been implemented in the Pacific in the last 10 years! The PRETI represented only 0.4% of that budget!

In 2011 to complement the certification/accreditation scheme SEIAPI organised a workshop in Fiji and Renewable Energy & Energy Efficiency Training Competency Standards Advisory Committee. The role of this committee was to approve training unit standards that were developed by the technical committees that were formed.

These committees developed the Training Unit Standards in the similar format as the Job Task Analysis used by Interstate Renewable Energy Council (IREC). At the time the committee found that format better than that as used in the Australian quality training framework. SEIAPI/GSES acted as the secretariat of these committees and in 2012 and 2013 the following Training Unit Standards were developed to support the certification/accreditation scheme:

- Designer of Grid Connected PV Systems
- Installer of Grid Connected PV Systems
- Designer of Off Grid Power Systems
- Installer of Off Grid Power Systems
- Installer and Maintainer of Off Grid Power Systems

The off-grid units had 3 levels covering:

- 1 or 2 module Solar Home Systems
- PV systems with Inverters
- Fuel Generator/PV Hybrid Systems.

In 2015 the EU Pacific Technical and Vocational Education Training Project, known as EU-PacTVET commenced. This was a 6 million Euro project for developing training within the vocational education sector for Climate Change Resilience and Sustainable Energy. At the time SEIAPI thought that finally the Pacific will get the training that is required, however the training material that was developed was focused on the long term training through the development of certificate through I to IV courses. SEIAPI viewed the material as not detailed enough and did not meet the current needs of the industry and in particular having detailed units focussed on skillset required within the industry to meet the current market needs. However, one positive outcome is that the ownership of the Units of Comptency required for Certificate courses, that were submitted for accreditation through the Pacific Register of Standards and Qualification (PRSQ) has been given to SEIAPI. So, in the future SEIAPI does plan to upgrade these units or add into these units the ones developed through SEIDOP (see below).

As a result of the EU-PacTVET not meeting the needs of the industry GSES through the SEIDP have developed 17 Training Standard Units. Twelve of these have already been approved though the Educational Quality and Assessment Programme for submission into the PRSQ. The final 7 are being submitted in June 2020. Some of these units relating to grid connected PV systems and off-grid systems are similar to those offered in Australia.

Having these units on the register now allows any training centre located within the Pacific to adopt them.

The units that have been developed and approved to-date are available from:

https://www.seiapi.com/training/

GSES training philosophy internationally has been to build capacity within local training centres not just have GSES conduct the training.

In 2019 GSES signed an agreement with the PPA via funding support from the GIZ Fijian office where all the face to face training material (Powerpoint presentations, exercises, assessment and practical descriptor, not the resource books) would be available for any in-country training centre to use them. GIZ also supported providing equipment for:

- Solomon Island National University to provide technical training in off grid PV based power systems and grid connect PV systems
- Private training centre in Vanuatu to conduct off-grid PV systems training
- Pohnpei Community College in Federated States of Micronesia (FSM) to conduct grid connected PV systems training

GSES had worked with the Vanuatu centre with the training for the Vanuatu Industry to obtain their certification. While in January/February/March 2020 GSES was contracted by GIZ to conduct training the trainer courses in Solomon Islands and Pohnpei.

GSES/SEIAPI have identified Papua New Guinea, Fiji, Toga, Cook Islands and Samoa as the next priority countries to help establish appropriate solar training.

The updating of the training unit standards will remain an activity of SEIAPI.

Technical Standards and Guidelines

Though not a deliverable of the initial REEEP project to establish SEIAPI, GSES knew it was critical for credibility that SEIAPI release some technical guidelines. The following four guidelines were launched in 2011:

- Design of Grid connected PV Systems
- Installation of Grid connected PV Systems
- Design of Stand-Alone (off-grid) PV Systems
- Installation of Stand-Alone (off-grid) PV Systems

These were re-released in 2014 as PPA/SEIAPI documents.

Through SEIDP in the last 2 years GSES has updated the above 4 guidelines, developed 11 more and will be publishing 5 more by end of July 2020.

The published guidelines are available from: https://www.seiapi.com/guidelines/

As part of the SEIDP GSES has conducted a series of 4-day workshops in 13 Pacific island Countries. The workshops were conducted two times in 13 locations and once in 4 other locations. The workshops in the 4 locations will have their second workshop series when travel restrictions are lifted.

The off-grid guidelines are compulsory as part of the VREP II Component I. SEIAPI and PPA's objective in the coming years is to have other countries endorse the guidelines as part of their country's requirements.

The updating of the guidelines will remain an activity of SEIAPI with some support from the PPA.

Complaints and Sanctioning.

SEIAPI/PPA have developed a complaints processing procedure for the certification/accreditation scheme, however since the scheme is only small at this point of time it has not been implemented.

Conclusion

These two case studies emphases that the introduction of any Quality Assurance Framework takes time. In the case of Australia it was the growth of the industry, in particular due to grid connected solar systems that many aspects of the framework have become sustainable.

For the Pacific region a lot more work is required to have all aspects of the framework operating across the region. The operation is not sustainable however the industry through SEIAPI will continue supporting the promotion and development of many aspects of the framework. The objective is to have quality training available in established training centres on a fee for service in many countries, the guidelines and certification/accreditation accepted and endorsed by many countries and also by donors for their projects.