International Quality Standards and Quality Assurance Mechanisms for RE/EE Training Programmes

Market Assessment & Benchmarking

Final Report, April 2015

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Abbreviations

ADEME	Agence de l'environnement et de la maîtrise de l'énergie (French Energy Agency)
ANSI	American National Standards Institute
AQF	Australian Qualifications Framework
AQTF	Australian Quality Training Foundation
ASQA	Australian Skills Quality Authority
BFE	Bundestechnologiezentrum, Federal Technology Centre for Electricity, Information and Energy, Oldenburg (Germany)
BFW Bremerhaven	TVET College (Berufsfortbildungswerk) Bremerhaven
BIS	Department for Business, Innovation & Skills (UK)
BMZ	German Federal Ministry for Economic Cooperation and Development
BPEC	British Plumbing Employers Council (Training) Ltd.
BS	British Standard
BZEE	Training Centre for Renewable Energy (Bildungszentrum für Erneuerbare Energien) (Germany)
CEC	Clean Energy Council (Australia)
CEPRI	China Electric Power Research Institute
CGDC	China Guodian Corporation
CHP	Combined Heat & Power
City & Guilds	One of the leading qualification awarding organisations in the UK
CLER	Comité de liaison des énergies renouvelables (French educational organisation which establishes quality standards for RE/EE training providers, Format'eree)
CLYPG	China Long Yuan Electric Power Group
CPD	Continued Professional Development
CSIR	Council for Scientific and Industrial Research (South Africa)
CWPC	China Wind Power Centre (also known as the Suzhou Longyuan Bailu Wind Power Training Centre)
DECC	Department of Energy & Climate Change (UK)

DHET	Department of Higher Education and Training (South Africa)
DWPA	Danish Wind Power Association
ECSA	Engineering Council of South Africa
ELIDZ	East London Industrial Development Zone (South Africa)
EN	European Norm
Enercon	German wind turbine manufacturer
EnTF	Energy Training Foundation (South Africa)
EQF	European Qualifications Framework (EU)
ESETA	Energy Sector Education and Training Authority (South Africa)
EU	European Union
EUREM	European Energy Manager scheme
FIT	Feed-In Tariff
Format'eree	Formed by CLER to provide quality standards for RE/EE training providers (France)
GIZ	Gesellschaft für Internationale Zusammenarbeit (Germany)
GLH	Guided Learning Hours
H&S	Health & Safety
IEC	International Electrotechnical Commission
IEC 61400	International standard for wind turbine testing
IREC	Interstate Renewable Energy Council (USA)
ISO	International Standard Organisation
ISO/IEC 17024	International standard for the certification of persons
ISO/IEC 17065	International standard *for the certification of products, processes and services*
JTA	Job Task Analysis
LGCs	Large-scale Generation Certificates (Australia)
MCS	Microgeneration Certification Scheme (UK)
MEASNET	International network for harmonised andrecognised measurements in wind energy
MENA	Middle East & North Africa
MREA	Midwest Renewable Energy Association
MWh	Megawatt hour
NABCEP	North American Board of Certified Energy Practitioners (USA)
NCPC	National Cleaner Production Centre (South Africa)

NOS	National Occupational Standards (UK)
NSW	New South Wales (Australia)
NVQ	National Vocational Qualification (UK)
O&M	Operation & Maintenance
OFQUAL	Office of Qualifications and Examinations Regulation
PV	Photovoltaic
QA	Quality Assurance
QCF	Qualifications and Credit Framework (UK)
QCTO	Quality Council for Trade and Occupations (South Africa)
Qualibois	Qualit'EnR quality label for biomass boilers (France)
QualiPAC	Qualit'EnR quality label for air source and ground source heat pumps (France)
QualiPV	Qualit'EnR quality label for grid-connected photovoltaics (France)
Qualisol	Qualit'EnR quality label for solar thermal (France)
Qualit'EnR	Qualit'EnR awards the four quality labels Qualisol, QualiPV, Qualibois, QualiPAC (France)
RE/EE	Renewable Energy / Energy Efficiency
RECC	Renewable Energy Consumer Code (UK)
RECP	resource efficiency and cleaner production
RET	Renewable Energy Target (Australia)
RGE	Reconnu Garant de l'Environnement (French RE/EE quality label)
RHI	Renewable Heat Incentive (UK)
RTN	Renewables Training Network (UK)
RTO	Registered Training Organisation (Australia)
RWE npower	A major UK energy group
SAGEN	South African-German Energy Programme
SANEDI	South African National Energy Development Institute
SANS/ISO 50001	South African National Standard/International Standard Organisation for Energy Management Systems
SAQA	South African Qualifications Authority
SARETEC	South African Renewable Energy Technology Centre
SFA	Skills Funding Agency (UK)
SGCC	State Grid Corporation China

SGCs	Small-scale Generation Certificates (Australia)
SITN	Solar Instructor Training Network
SMA	German PV inverter manufacturer
Solarteur	The German certified training programme for solar and RE installers
SSB	Sector Skills Body (UK)
SSC	Sector Skills Council (UK and Australia)
SSO	Standards Setting Organisation (UK)
STA	Solar Trade Association (UK)
TAFE NSW	Technical And Further Education commission of New South Wales (Australia)
TSO	Transmission System Operator
TVET	Technical and Vocational Education and Training
UKAS	United Kingdom Accreditation Service
UKCES	United Kingdom Commission for Employment and Skills
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNEVOC	**UNE**SCO and **VOC**ational education
UNIDO	United Nations Industrial Development Organisation
Vestas	Danish wind turbine manufacturer

1 Executive Summary

This study was developed on behalf of the Regional Project RE-ACTIVATE ("Promoting Employment through Renewable Energy and Energy Efficiency in the Middle East and North Africa") which the German Society for International Cooperation (GIZ) is implementing for the German Ministry of Economic Cooperation and Development (BMZ).

It describes, and provides recommendations for, the process of developing approved training programmes in the RE/EE sector with the aim of ensuring high quality RE/EE installations. It draws on a large number of international best practice examples of quality standards and quality assurance mechanisms in RE/EE training programmes.

The typical bodies and actors involved in the **process of developing approved training programmes** are the Occupational Standards Body, the Training Development & Approval Body, the training providers, examiners and the overarching training regulator. The steps in the process are:

- **Developing occupational standards:** The occupations or work activities in the RE/EE sector with the **greatest training needs must be identified**. A working group of technical experts should be set up to carry out assessments of existing RE/EE installations and identify where installation quality is lacking and the reasons for this (e.g. poor design, poor installation, poor maintenance, low quality components, etc.). This working group should also develop the Job Task Analyses for the various occupations. **The benchmark for installation quality should be set by recognised Codes of Practice**. Initially, international Codes of Practice can be used but these should be adapted to suit the country-specific requirements as soon as possible.
- **Developing training programmes**: Based on the occupational standards, training programmes are developed including learning outcomes, entry level requirements and qualification levels, course duration, syllabi and teaching materials. The practical and theory examination requirements are also defined. It is essential that training programmes incorporate a high proportion of practical, hands-on training.
- **Identifying and preparing training providers:** Existing training providers and trainers should be identified who would be suitable to deliver the RE/EE training programmes. Train-the-Trainer programmes should be conducted to prepare trainers for the new teaching demands (both technical and didactical).
- **Defining criteria for the approval of training providers and developing auditing and evaluation mechanisms:** Approval criteria should include requirements for trainers, training facilities, examinations, and general administration and management. Training providers are audited, evaluated and awarded approval to a certain level such as 'good quality' or 'outstanding quality'. Re-approval should take place after a defined period.
- **Defining the regulation process for formal company-based training:** Training regulations for company-based training should be developed with the cooperation of company representatives, technical experts and the Training Development & Approval Body.

This study recommends the introduction of a **certification scheme for RE/EE installation companies** as an important instrument to ensure installation quality, and explains the procedure for setting up such a scheme. In summary:

- Governments should use their power to introduce a mandatory certification scheme for companies operating in the RE/EE sectors, especially where installations are co-financed with public funds.
- The company certification scheme should cover all occupation levels involved (i.e. installers, technicians and engineers).
- The scheme should be introduced progressively: firstly, the requirements should be kept to a necessary minimum to avoid overwhelming the industry; secondly, only those technologies and work activities displaying the greatest training needs should be included at the beginning. Requirements can then be progressively increased.
- The phase of mandatory certification should not remain in force indefinitely. Certification obligation should come to an end when a large and mature market has become established. This means the certification scheme should be developed into a market instrument.
- **Accreditation**: A certification scheme does not need to be accredited to international standards immediately but the quality management and quality assurance mechanisms should be put in place from the outset so that the possible transition to becoming accredited at a later stage runs smoothly.

  The value of an accredited training programme lies in its replicability: a participant can expect the same quality and standard from an accredited training programme wherever it is being offered.

The extensive annex describes various best practices of RE/EE installer certification schemes, Continued Professional Development (CPD) training programmes, Technical and Vocational Education and Training (TVET) programmes and standardisation initiatives.

In conclusion, this study provides policy makers and RE/EE stakeholders with a short but comprehensive set of guidelines for implementing or improving best practice training programmes and certification schemes that can be used for any country or region. By doing so, it intends to contribute to improving the quality of RE/EE installations and thus their wide-spread acceptance and deployment worldwide.

2 Introduction

2.1 Context and aim of the project

This study is part of a wider project whose main objective is to support MENA countries in achieving their ambitious RE/EE-related socio-economic goals by helping develop and implement quality standards and quality assurance mechanisms for vocational and further training institutions active in the RE/EE sector. Quality assurance in academic education is beyond the scope of this study.

Training standards for RE/EE-related professions in most of the MENA countries are to date poorly defined (if at all). A growing number of MENA countries have identified this as a major bottleneck in attaining a sustainable and dynamic local market for reliable and competitive RE/EE products. They are currently launching (or preparing to launch) national initiatives in various shapes and forms to address the need for clear and sound training standards for RE/EE.

The aims of the wider project are to:

- develop standards/benchmarks, curricula, training materials, marketing tools etc. for the targeted training of professionals in key RE/EE sub-sectors, based on international experiences as well as in line with national/regional initiatives in the MENA.
- develop methodologies for how such standards and quality mechanisms can be defined, adopted, implemented and enforced. These will require a transparent and inclusive multi-stakeholder approach and governance process.
- create ownership and consensus around the proposed training standards and related quality mechanisms in close collaboration with key public and private sector bodies involved in standards setting training provision, approval and accreditation, and market development.
- disseminate and implement these standards and mechanisms at regional and country level together with local partners and country representatives.
- identify/select appropriate partner institutions at a local (or international) level which could participate in the definition and promotion of these standards and mechanisms, including with the help of pilot projects to be launched in a second phase of the project.

The outcome of this project will serve to inform and support related institution and capacity building processes and activities for RE/EE vocational and further training in MENA countries at both national and regional levels (in the preparation and implementation phases). It will do so in close collaboration with the competent and involved institutions at both national and regional levels, including international cooperation agencies and training providers active in the field. It should also serve to design and develop concrete capacity building measures to be implemented in the framework of pilot projects in cooperation with selected training providers. Involved parties will have the opportunity to discuss the findings of the project and conclude how to proceed in the framework of a stakeholder workshop scheduled to take place in the second quarter of 2015.

2.2 Scope and structure of the study

The first phase of this study took the form of research into the main existing standards and quality assurance schemes for RE/EE vocational and Continued Professional Development training. A compilation of the most well-established and successful schemes and programmes can be found in the appendices.

The second phase of this study draws on best practice examples from this research to describe the process of realising high quality installations in the RE/EE sector. It defines the roles and responsibilities of all bodies and actors involved, and explains the methodologies for developing occupational standards and training programmes, approving training providers, and setting up a certification scheme. For each step the mechanisms for ensuring high quality are described.

Finally this study provides recommendations for delivering quality assurance in vocational and further training of professionals in the MENA region.

The final draft presented in February 2015 has been subject to a review process. A number of stakeholders (especially GIZ experts and RCREEE staff) provided comments and inputs. The authors of the study would like to extend their warmest thanks to all those who contributed to the success of this project.

3 Developing competency in RE/EE professions

The focus of this study can be broadly represented by Figure 1 which depicts the process of individuals developing competency in their RE/EE profession through a combination of on-the-job training and attending external training courses. Proof of competency is achieved via an examination (or assessment), which also contributes to external verification of the quality of training.

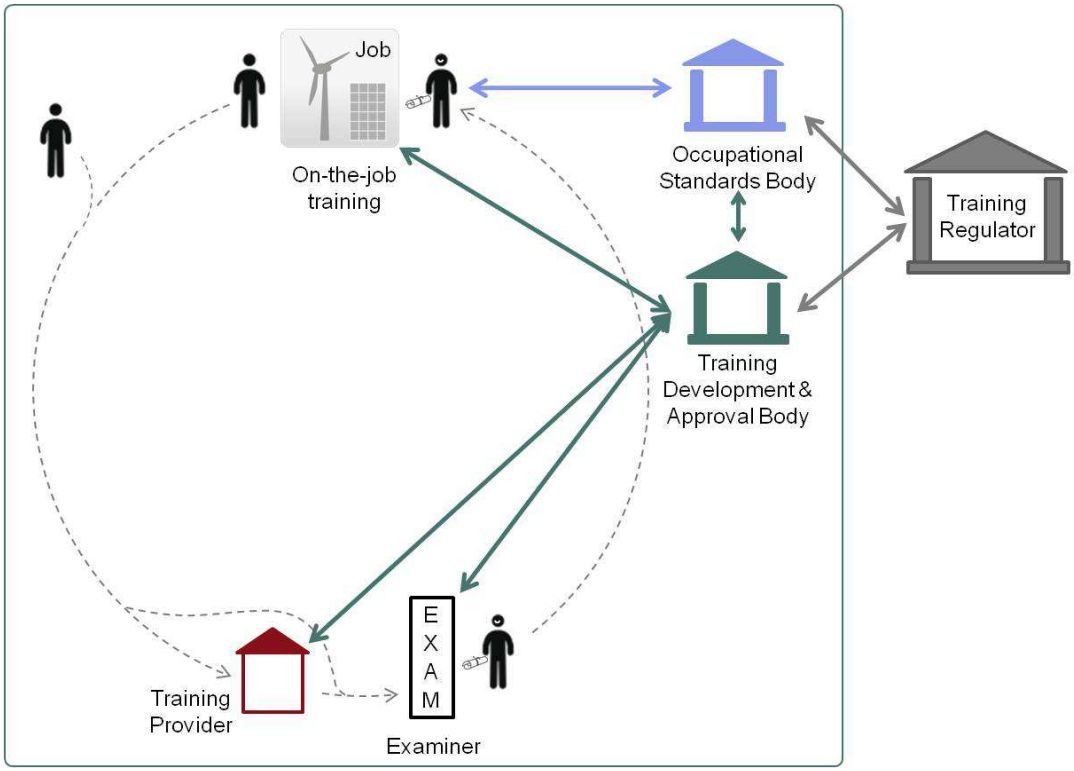

Figure 1: developing competency and skills: bodies and stakeholders involved

3.1 Developing competency from the point of view of the individual

We see in Figure 1 that a person with little or no relevant experience can gain footing in the RE/EE job market by attending a training course and passing an exam which provides proof of skill and competence to a certain level. Alternatively, a person who already has relevant experience but no proof of this can improve his/her chances of moving up the career ladder by simply attending and passing an exam at a certain level. It is intended that both individuals will progressively increase their levels of skill and knowledge through a combination of continued on-the-job training (Continued Professional Development) and completing progressively more advanced training courses.

The proof of competence will be provided in the form of certificates which the individuals receive upon successful completion of exams after every level. The desire to learn, as well as the honour associated with being awarded well-regarded certificates may be incentive enough for individuals to embark on this journey. However, improved job prospects with higher pay should also be expected. This is one way in which employer support is critical to the success of approved RE/EE training programmes.

This training path can equally apply to installers, technicians and engineers as well as any other professions involved in the RE/EE industry.

3.2 Developing competency from the point of view of the bodies and actors

This section briefly outlines the roles and responsibilities of the various bodies and actors in the process of developing approved RE/EE training programmes. Note in Figure 1 that all bodies and actors are inter-linked. These linkages are essential in the overall process leading to improved quality in RE/EE installations: knowledge, skill and experience move not only from the bodies to the actors (Training Providers, employers, examiners) but also back in a two way process of continual learning, review and improvement. It is crucial that all bodies and actors work closely together.

The roles and responsibilities of the bodies and actors are illustrated in Figure 2 below. These are briefly described in the text below.

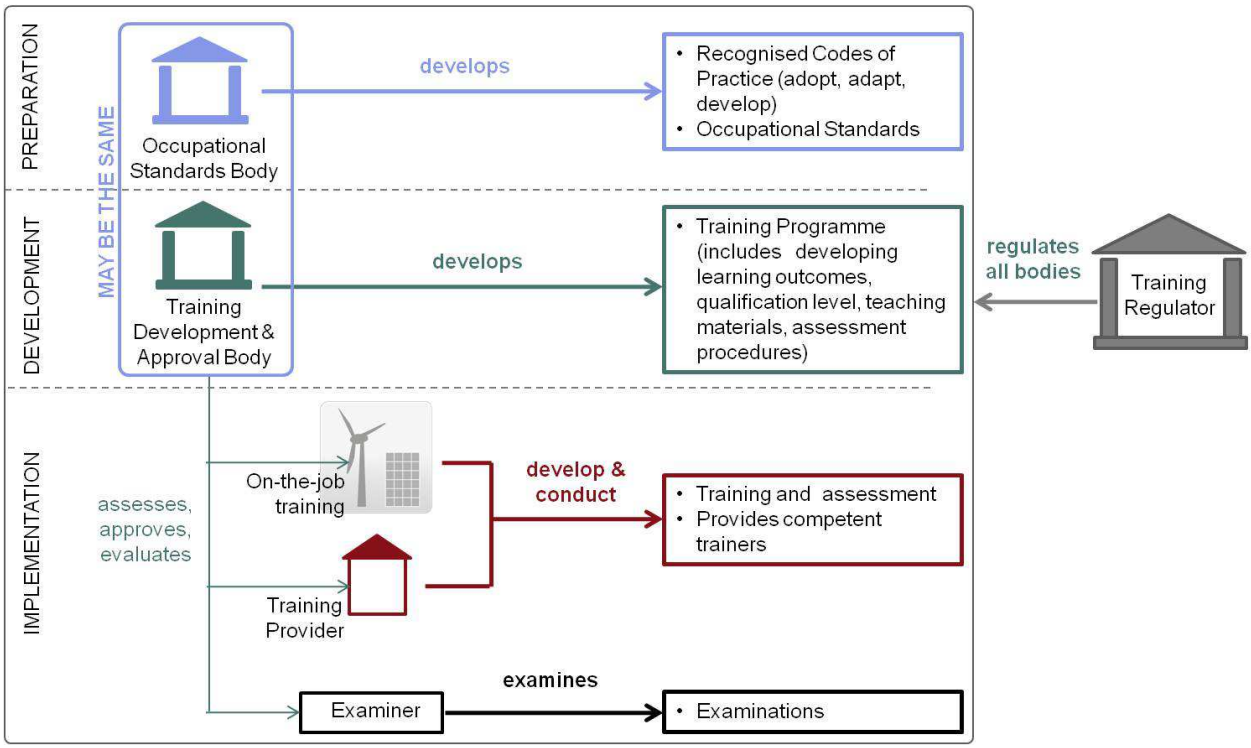

Figure 2: Roles and responsibilities of the various bodies and actors involved, and linkages between them

- The **Occupational Standards Body** is responsible in the first instance for compiling recognised Codes of Practice that aim to ensure the installation, operation and maintenance quality of RE/EE installations. Next the training needs must be identified by developing accurate Occupational Standards. The Occupational Standards are made up of Job Task Analyses. From these, target groups are identified and profiled (e.g. a Job Task Analysis might cover design tasks, installation tasks, and operation & maintenance tasks – each of these would form one target group for future training programmes). Target group profiling is carried out to determine factors such as entry level requirements, qualification level, duration and teaching methods of a future training programme. Working groups made up of representatives from employers, other stakeholders and technical and educational experts are involved in this process and guided by the Occupational Standards Body.
- The **Training Development & Approval Body** takes the Occupational Standards and, with the support of a working group, develops them further into full training programmes for each identified Task Group (sometimes referred to as Training Standards). This involves defining learning outcomes for each task, entry level requirements, qualification level, course duration, syllabi, teaching methods,

equipment needs, and examination specifications. The Training Development & Approval Body will also develop teaching and learning materials to cover all of the content of the training programme (e.g. in the form of teacher guides and student guides).

The Training Development & Approval Body is also responsible for assessing and approving Training Providers and Examiners.

Note: The Occupational Standards Body and the Training Development & Approval Body can in practice be combined into one. However, for clarity in definitions of roles and responsibilities they have been kept separate here.

- **Training Providers** are responsible for providing the training facilities and equipment required to deliver the training courses. They are also responsible for supplying trainers with the required competency and for conducting training courses and learner assessments. All these aspects are described in detail in Section 7.2. They gain approval once all these requirements are fulfilled.

  Training Providers for the newly developed RE/EE training programmes will on the one hand be existing training institutions such as vocational training colleges and on the other hand be new companies set up specifically to deliver these courses. Both public institutions and private companies will require additional financial support during the start-up phase to bring themselves in line with the requirements for approval.

  Training Providers gain approval from the Training Development & Approval Body to deliver the training programmes by fulfilling approval criteria defined by the Training Development & Approval Body. These include aspects such as having a quality management system in place, having trainers with the required skills and competences, and having facilities with sufficient equipment to conduct the training and the trainee assessments.

  Once the new training programmes have become established, it is envisioned that these RE/EE subjects are taken up in standard curricula of traditional courses of learning so that individuals entering vocational or further education no longer need to train in a traditional subject first before embarking on their careers in the RE/EE sector.

- **Examiners** gain approval from the Training Development & Approval Body to conduct examinations by conforming to examination regulations relating to ensuring objectivity, authenticity and fairness.

- If the **employer** is offering a formal on-the-job training programme to its trainees, as in the German dual vocational education system, this will also need to gain approval from the Training Development & Approval Body.

- The overall training system will be regulated by an overarching **Training Regulator** who will provide quality assurance of the Occupational Standards Body and the Training Development & Approval Body and all their activities.

- A further stage in the overall process leading to higher quality RE/EE installations will be described at the end of this study. Once training programmes have become established, an instrument to drive the RE/EE sector towards higher quality installations can be introduced in the form of a mandatory company certification scheme: companies will have an obligation to become certified. They will only be able to meet this obligation if they can prove that key employees have relevant competency to a certain level.

These processes for developing standards and mechanisms for assuring quality will be described in more detail in subsequent chapters. They draw on the research carried out as part of this study into existing quality standards and quality assurance schemes for RE/EE vocational training and Continued Professional Development (CPD) programmes on an international level.

Before the above aspects are discussed further, the following chapter first aims to define and clarify the terminology which will be used throughout.

4 Clarification and explanation of terminology

4.1 Standards

- **Technical standards:** a technical standard is an established norm or requirement with regard to technical systems. It is usually a formal document that establishes uniform engineering or technical criteria, methods, processes and practices. Examples of international technical standard setting organisations are ANSI, ASME, IEC, ISO, IEC.
- **Health & Safety standards:** these define standards to support a safe and healthy work environment. e.g. Occupational Safety & Health Administration (OSHA) standards, US Department of Labor (www.osha.gov)
- **Recognised Codes of Practice:** a set of regulations compiled from existing technical norms and standards, health and safety regulations, and laws and directives. For further information, refer to Section 6.1.
- **Occupational standards:** these are defined in terms of the tasks and activities performed by a person in a selected occupation. Several different methodologies exist for developing Occupational Standards, e.g. Job Task Analysis, DACUM (Developing A CurriculUM), Functional Analysis. The methodologies each have their merits. The methodology adopted varies between countries and even between occupational sectors. Attempts have been made, for example by the European Training Foundation (ETF) to produce a standardised methodology for Occupational (and Training) Standards development. However, no single standardised methodology has been adopted internationally to date. For further information, refer to Section 6.2.
- **Training Standards:** these are developed from the tasks and activities defined in the Occupational Standards. They include learning outcomes and assessment specifications to ensure that a person can develop the necessary skills and knowledge to enable him/her to function *at an agreed level* in an occupation. **In this study the term 'Training Programme' will be used synonymously with 'Training Standards'. The reasoning is that the Training Development & Approval Body develops a standard training programme to be delivered by all approved training providers.**

4.2 Training programme, curriculum, qualification

The terms 'training programme', 'curriculum' and 'qualification', along with 'Occupational Standards' and 'Training Standards' are often used interchangeably depending on the country and context. For clarity this study will use the following definitions:

- **Training programme** – the sequential learning activities, associated with curriculum implementation, leading to the achievement of a particular qualification. In this study the term 'Training Programme' encompasses learning outcomes, entry level requirements, qualification level, course duration, syllabi, teaching methods, equipment needs, and examination specifications. Teaching and learning materials are also included.
- **Qualification** – the formal recognition of the successful completion of a training programme at the specified level. In some countries, for example Germany, the term 'Qualification' is sometimes used

synonymously with 'Training Standard'. In this study it will be used to describe the level of competency achieved, e.g. EQF[1] Level 3 Certificate.'

- **Curriculum** – all aspects associated with planning, implementing and evaluating a training programme. According to this definition, curriculum development includes the processes of developing occupational and training standards (occupation, learning and assessment specifications) as well as the specifics of training programme development. From this definition we see that the Occupational Standards Body, the Training Development & Approval Body, and the Training Provider have roles in curriculum development. Therefore **it is essential that there is a close working relationship between all bodies and actors.**

4.3 Accreditation, certification, approval, endorsement

- **Accreditation** – the formal recognition by an accreditation authority to the technical and organisational competence of a conformity assessment body to carry out a specific service in accordance to the standards and technical regulations as described in their scope of accreditation.
- **Certification** – the procedure by which a third party gives written assurance that a product, process, system or person conforms to specified requirements.
- **Approval** – the recognition of technical and organisational competence of a body to carry out a specific service in accordance to guidelines. If the recognition is awarded by an accreditation authority then 'approval' is the same as 'accreditation'.
- **Endorsement** – a form of support or public approval. Endorsement is not attached to any formal recognition by an accreditation authority or to any recognised certification.

The question of which credential is appropriate for the different bodies and actors in the MENA context will be discussed in more detail in the relevant sections. It is, however, worthwhile explaining here briefly the value of the different credentials. **The value of an accredited training programme is in its replicability: a participant can expect the same quality and standard from an accredited training programme whether he/she takes it in Italy or Egypt or anywhere else in the world.**

In countries with well-established and formal vocational education systems it would be typical for the Training Programme, the Training Development & Approval Body and the Examiner to be accredited or approved by the overarching education regulator. To aid international recognition, the Training Programme could further be referenced to, for example, the EQF by following the EQF referencing criteria[2].

Accreditation is typically carried out by the national accreditation body which is recognised by the government to assess, against internationally agreed standards, organisations that provide certification, testing, inspection and calibration services (e.g. DAkks (Deutsche Akkreditierungsstelle GmbH) in Germany, UKAS in the UK, ANSI in the USA). Accreditation ensures that services are provided in a consistent, comparable and reliable manner. It is a means to provide additional trust in the service or product.

[1] The European Qualifications Framework (EQF) attempts to standardise qualifications across Europe so that a qualification achieved in one European country will be understood and recognized in another. Refer to Appendix 8.5 for more information.

[2] For further information, refer to the European Qualification Framework document 'Referencing National Qualifications Levels to the EQF – Note 3'.

Accreditation of RE/EE training programmes and training providers in the MENA region is useful/desirable if these training programmes should be internationally recognised and comparable with training programmes and training providers in other countries.

Certification is a means of providing assurance that the certified product, service or person meets the requirements of the relevant certification scheme. If the certification body is accredited to an international certification standard, e.g. ISO/IEC 17024:2012 'Certification of persons' (refer to Appendix 9.2 for more details) this provides the further assurance that the process of certification and the value of the certificate bear the same high standard as in other parts of the world.

Accreditation and certification of the relevant actors and bodies in the MENA Region does not need to take place immediately but the quality management and assurance mechanisms should be put in place from the outset so that the possible transition to becoming accredited or certified at a later stage runs smoothly. In the meantime, the term 'approval' can be used to signify conformance to the standards set out by the approval body.

5 Process of developing approved training programmes

5.1 Introduction to the process of developing approved training programmes

This study provides a compilation of best practice examples of different types of RE/EE training programme (refer to Appendices 2 to 8). These examples display common features but also significant differences with respect to their structures and quality assurance mechanisms. This diversity is due in part to the different educational traditions between countries but also the political and market value of the various approaches: different aspects of quality assurance are attributed more or less significance in different parts of the world. For example, USA and UK lay more emphasis on health and safety considerations than Germany or other parts of Europe.

These different approaches also have consequences on the design of vocational training or CPD programmes: a single common regulation to guide training programme developers will not exist, alone due to the geographical and educational differences in the countries. However, the following is a proposal for a *common process* to developing training programmes. Features that differ from country to country can then be slotted into this process.

As a starting point, the general framework must be analysed (explicitly to include the educational level and experience of the student) in order to avoid the development, for example, of redundant, unsuitable or incomplete training programmes.

A further important aspect is that recognised Codes of Practice must be defined before a training programme can be developed. These codes provide an important benchmark to design, build and operate installations to a high quality standard.

5.2 Overview of the process of developing approved training programmes

Figure 3 provides an overview of the main linkages in the process of developing an approved training programme and approved training providers.

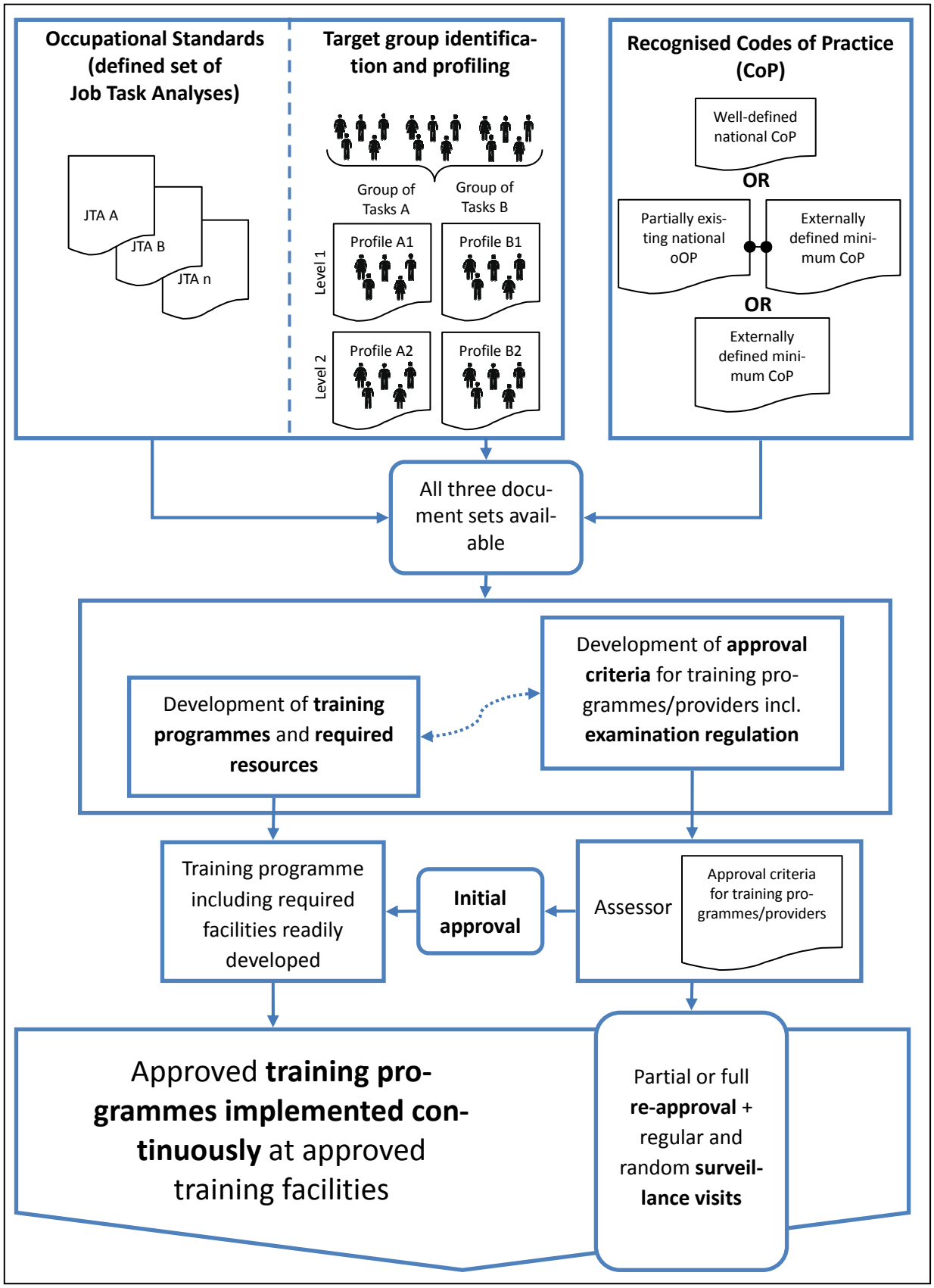

Figure 3: Overview of process of developing approved training programmes at approved training providers

The following questions must be answered in order to ensure that critical training needs are indeed met by training programmes and training providers:

1. Do recognised Codes of Practice exist which clearly define application-relevant technical norms and standards, health and safety regulations, and laws and directives (and which must be covered by the training programme)? Can existing national codes be used and built upon for this, or must, in the first instance, codes be adopted from, for example, tried-and-tested international standards? **Technically accurate training programmes can only be developed when recognised Codes of Practice are in place.**
2. Have all tasks been identified where lack of competence leads to poor system design, installation and operation? Have comprehensive analyses been carried out to define these tasks? Can existing Occupational Standards (for example, Job Task Analyses) from other international sources be taken and adapted? **It is only possible to develop a goal-oriented training programme if a job or task is known and clearly defined.**
3. Have the target groups for the different Job Task Analyses been defined? Has each target group been broken down into sub-groups based on skills and experience? (Profiling.) **It is only possible to develop an appropriate training programme once the level of skill and experience of each target group is known.**

Only when these questions have been satisfactorily answered can training programmes be developed, approval criteria for training providers be set, and training providers become established.

In practice, training programmes and approval critera can be developed in parallel. This saves time, and allows the parties involved in each process to communicate and exchange technical expertise. During the start-up phase of training programme development, the requirements of the approval criteria should be realistic and achievable. As the processes become more established, the approval criteria can become more stringent.

Once the training programme and all required resources, including competent trainers, are in place, the training provider can apply for approval and, if successful, will be permitted to deliver the approved training course or courses.

Two instruments should be put in place in order to ensure the continued quality of the training provider and the training programme:

1. Re-approval should be scheduled at regular intervals with full approval procedures being repeated at longer intervals.
2. Scheduled and random surveillance visits by independent assessors should be carried out.

Alongside approval processes and surveillance visits, trainee examinations are an important medium for assessing training programme/training provider quality. It is therefore recommended that only a part of the examination is conducted in-house by the training provider (e.g. the practical element), while the other part of the examination (e.g. the theory element) is conducted by an independent examination board or assessor.

Further details of these processes will be described in the following sections with respect to the roles and responsibilities of the various bodies and actors.

6 Occupational Standards Body: roles and responsibilities

The Occupational Standards Body is responsible for compiling recognised Codes of Practice and developing Occupational Standards for identified RE/EE occupations. These tasks must be carried out at the very start of the process of developing training programmes for RE/EE. A working group made up of representatives from employers, trade unions, and technical experts provide support. It is strongly recommended that the working group draws on international experience at the outset.

6.1 The foundation: developing recognised Codes of Practice

In the first instance it is essential that recognised Codes of Practice are in place to ensure that systems are designed, installed and operated safely and to a high quality standard. In most countries the supplier is liable (at least in theory), if a system underperforms, or is faulty or even dangerous in operation. In a legal dispute, a court of law would require proof that the system had been designed, installed and operated in accordance with recognised Codes of Practice. These Codes of Practice can have different origins depending on the application or technology. Codes of Practice can be relevant laws or regulations that have been passed by the legislator; national, regional or international norms which have been published by recognised standardisation bodys (e.g. ISO); or rules that, though they have never been written down, have become established and proven over many years of experience and are thus considered to be valid.

It can be observed, in new RE/EE markets in particular, that stakeholders are interested in having a set of well-defined codes in place: the legislator wants its deployed funds or subsidies to generate the highest possible yields or savings, customers want investment security, and the industry needs legal certainty with respect to possible liability claims from customers. In addition, RE/EE applications are unique in that the value chain involves a relatively large number of people who all need to be appropriately trained to perform their work activities.

It is of course not necessary to develop an entirely new set of regulations, or Codes of Practice, for each technology. Figure 4 shows how such Codes of Practice could be compiled for a given application. Explanations of Areas A to G are provided in Table 1 below.

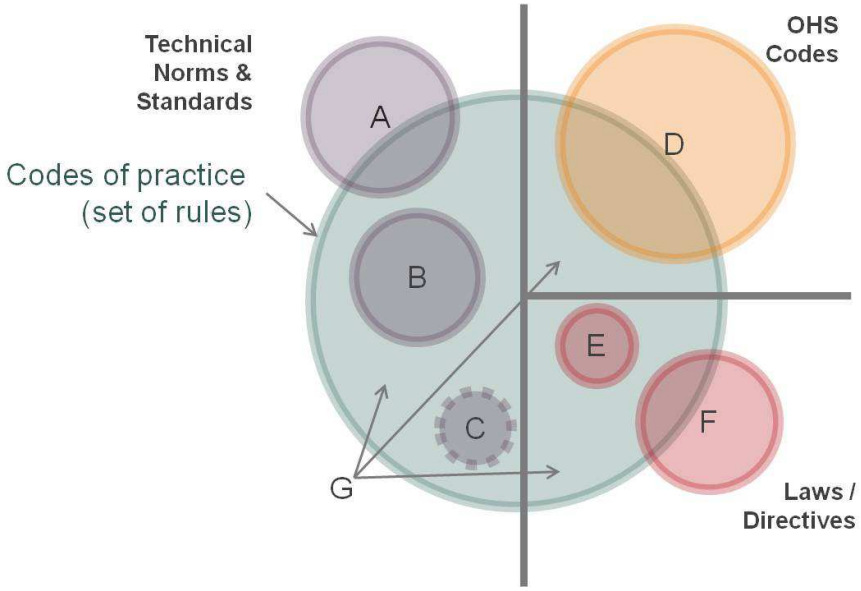

Figure 4: The Codes of Practice are comprised of technical codes, occupational health & safety (OHS) regulations and laws and directives

Only the elements which are contained within the green circle are part of the application-specific Codes of Practice. It is possible to split such Codes of Practice into three main components:

1. Technical codes relating solely to technical characteristics and procedures;
2. Occupational Health & Safety (OHS) Codes which encompass regulations for safe work practices in system installation, operation and maintenance;
3. Laws or directives that are issued directly from the legislator.

The Areas A to G in Figure 4 are areas of regulation that are either partially or fully applicable to the relevant Codes of Practice. Table 1 below describes these areas and illustrates them with examples from the PV sector.

Area	Description	Example from the PV sector
A	Technical norms and standards which are not application- or technology-specific but are nevertheless relevant	Regulations on protection provided by enclosures can be taken from Norm IEC 60529 (Degrees of protection provided by enclosures); the Norm is not specific to the PV sector but is generally valid for the protection of enclosures.
B	Technical norms and standards which are purely application-specific	The norm on design and type approval tests of crystalline silicon modules is defined in international norm IEC 61215. This norm is purely PV-specific.
C	Additional, non-binding recommendations	The German code of practice for obtaining the RAL solar system certification (RAL GZ 966) recommends in its set of rules for mounting systems that there should (not must!) be a possibility for weather protected cable routing integrated in the mounting system. (If there is no such feature, the binding rule is that there must be at least a possibility to fasten cables at the mounting system with fastening material which is weather-resistant.)
D	Occupational Health and Safety regulations	Accident prevention regulations are typically applied for electrical and roof work in the PV sector and are included in the relevant Code of Practice. These regulations are universally valid and not technology-specific.
E and F	Laws and directives	PV equipment, as any other electronic equipment, can cause electro-magnetic disturbances or be disturbed by other equipment. Since such disturbances may have severe effects on other equipment (e.g. destruction of electronic equipment or failure of vital devices) the European and consequently the German legislators have released the so-called Act on the Electromagnetic Compatibility of Equipment which also applies to PV equipment. The Act refers to other norms deemed as acknowledged Codes of Practice; but, in addition to that, it also regulates, for example, penalties for non-compliance and official responsibilities.

G	Application-specific mandatory requirements that are not regulated in any other code	Shading analysis is an essential part of PV system design. Since this is a very application-specific task, there are no reference standards available. It may be advisable to include such mandatory requirements in good Codes of Practice on the basis of practical experience.

Table 1: Descriptions of the different areas of regulation illustrated with examples from the PV sector

The majority of the Codes of Practice can be taken from existing recognised regulations (e.g. accident prevention regulations or general construction regulations), international technology-specific norms and standards (e.g. IEC test standards for PV modules), or existing laws and directives (e.g. directives on electromagnetic compatibility). Such Codes of Practice can of course also contain additional non-binding recommendations that can provide the impulse for further improvements in quality.

The challenges when developing these Codes of Practice are:

- codifying new technology-specific regulations if these do not yet exist, or if existing regulations are not appropriate to the application or need to be adapted;
- identifying relevant regulations which define a consistent minimum standard without creating unnecessary barriers due to wrong or over-regulation;
- finding consensus across all stakeholders who may be pursuing different interests

6.2 Choosing the approach to developing Occupational Standards

Different approaches to developing occupational standards exist, the main ones being Job Task Analysis, DACUM (Developing a curriculum), and Functional Analysis[3]:

- Job Task Analysis – an assessment of the core knowledge areas, critical work functions, and/or skills typically found across a representative sampling of current practitioners or job incumbent workers. The Job Task Analysis approach requires repeated onsite observations to identify all tasks which can then be generalised into an occupation. It divides and subdivides jobs and tasks into their constituent part in order to provide information for training. Empirical results from a Job Task Analysis provide examinees and the public with a valid, reliable, fair, and realistic assessment that reflects the skills, knowledge, and abilities required to competently perform a job.

[3] For more background information on the development of Occupational and Training Standards, refer to the European Training Foundation (ETF) and its comprehensive document library, for example,

- Volumes 1-3 of ETFs series on 'Development of Standards in Vocational Education and Training', and 'Linking Vocational Education and Training Standards and Employment Requirements', an International Manual Prepared for the European Training Foundation, by Bob Mansfield PRIME Research and Development Ltd, with contributions by Hermann Schmidt, February 2001
- 'A Framework for Defining and Assessing Occupational and Training Standards in Developing Countries' Information Series No. 386, by David H. Fretwell, World Bank; Morvan V. Lewis, The Ohio State University; Arjen Deij, European Union-European Training Foundation, 2001.

- The DACUM approach (Developing A CurriculUM) uses guided group discussions with expert workers. It defines occupational specific tasks as well as general knowledge and skills required, and tools and equipment used. The tasks become the focus of curriculum development.
- The Functional Analysis approach identifies the Key Purpose of an occupation and then breaks this down into key functions and modules. The modules are analysed one by one to identify performance requirements.

Although all have their merits, the approach which will be adopted in this study is the Job Task Analysis (JTA) approach since this is appropriate where:

1. failure to perform the task or job exactly as required carries a potential for considerable liability.
2. very specific Occupational Standards are beneficial (often the Occupational Standards resulting from the other two approaches are more general).

These two points are relevant and important for RE/EE occupations where comprehensive Codes of Practice and guidelines must be followed to ensure high quality and reliable system design, installation and operation.

6.3 Getting started: developing a Job Task Analysis

If we want complex systems to be designed and built to high quality standards, we need engineers, technicians and installers with the relevant skills and competence to do this: a training programme should orientate itself as closely as possible to the tasks and knowledge required for a certain work activity.

This section describes the development of Occupational Standards, in this case using the Job Task Analysis approach. The Job Task Analysis can then be developed further into a Training Programme.

Figure 5 illustrates how tasks within a company are delegated either to internal staff or external service providers. (Component suppliers are included in the figure for completeness since they also play an important role in system quality. They should however not be considered further in this example.)

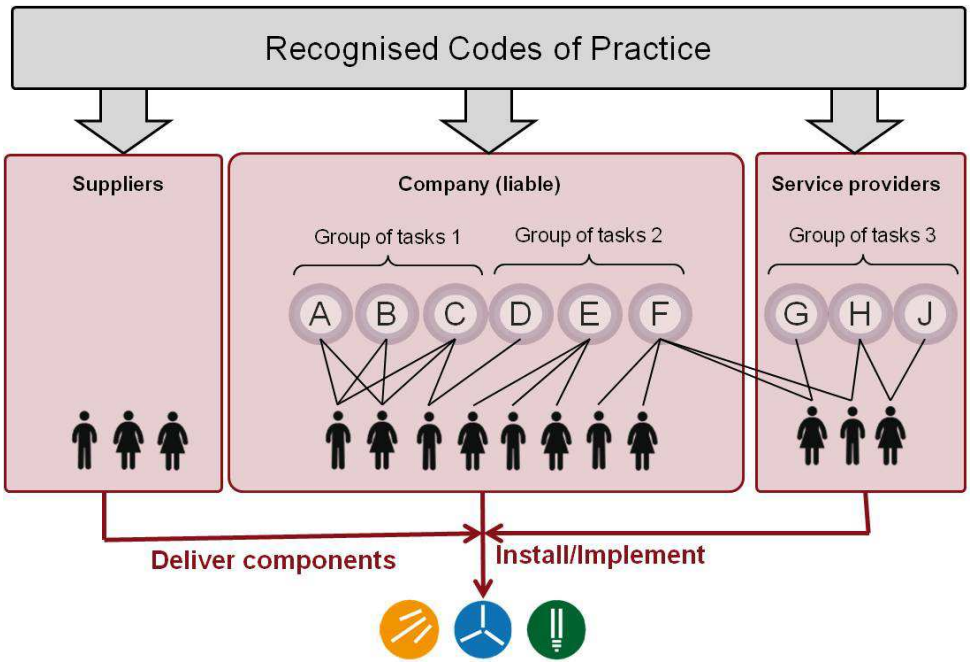

Figure 5: Tasks A to J are delegated by a company to its employees

Fields A to J represent tasks required to build a system. Field A could, for example, represent technical design using specialist software. Field F could be the installation of various system components. Fields G to J could be other installation tasks that are carried out by external service providers. In some cases the Fields could overlap: tasks which normally are carried out internally could be tendered out, for example to relieve overstretched capacities (see here Field F). It will often be the case that each employee is assigned several tasks (see here A to C), or that many employees share one task (see here Task E). All Tasks A to J should of course be carried out in line with recognised Codes of Practice (see Section 6.1).

Tasks in a value chain can often be classified into separate groups of tasks. So, for example, Group 1 could be responsible for all design tasks while Group 2 carries out all installation tasks.

These considerations lead us to two points which are important for the further development of Occupational Standards into useful and effective Training Standards:

- It is important to know how tasks and task groups are organised within the RE/EE sector. This allows a precise target group definition which in turn allows a relevant training programme to be developed.
- If market information is available about frequent faults in a certain application (this would of course require a market analysis), these can often be traced back to certain tasks or task groups. A system could, for example, be designed well but installed badly. A training programme can then be focused on, in this example, installation activities.

These analyses result in a set of priority tasks. There can of course be several qualification levels within a Job Task Analysis (e.g. EQF Levels 1 to 5 where EQF Level 3 corresponds to the expected competency level of a skilled worker – refer to Section 7.1.2 for more detail on qualification levels). The definition of these can help to structure the training programme at a later date.

Next, the individual task steps in the Job Task Analyses must be described more closely. These form the basis for defining the learning outcomes of the training programme.

The NABCEP (for more information, refer to Appendix 2.1) Job Task Analyses provide a good example of the content and structure of such a document. NABCEP analyses the tasks as follows:

- The Job Task Analysis defines precisely for which occupation or work activity it is relevant;
- The responsibility of the worker is described for each task;
- With consideration to the final examination, an estimated importance weighting is allocated to each task. (For example, for PV installers, maintenance and troubleshooting are allocated less importance at 11% than installation of components at 22%; the examination questions are designed accordingly.)
- All individual task steps are listed and categorised according to their importance as critical, important or useful.

The complete list of task steps and their categorisation are particularly helpful in the development of training programmes and should absolutely be included.

For clarification, Table 2 shows an excerpt from the NABCEP Job Task Analysis for PV installers.

Task Step	Category
Confirm conductor ampacity calculations	Critical
Confirm conduit fill calculations	Critical
Confirm conductor run distance	Critical
…	…
Confirm continuous current calculations	Important
Confirm continuous load calculations	Important
Confirm conditions of use calculations	Important
…	…
Confirm thermal expansion calculations	Useful

Table 2: Example: excerpt from the task step list from the NABCEP Job Task Analysis for PV installers from the Task ‚Review Wiring and Conduit Size Calculations' (only for illustration: list not complete)

6.4 Target groups: identification and profiling

The previous section explained how a Job Task Analysis is developed and how it can be used when developing Training Programmes. The focus will now shift to the individuals who carry out these tasks.

6.4.1 Target group identification

The following considerations should help to identify the possible target groups for future training programmes:

- Tasks in RE/EE companies are generally very specialised. We can therefore plan training programmes to cover only certain tasks or work areas. **Designing a training programme which attempts to teach everyone everything should be avoided!** No one needs to be able to do everything; it is much more important that the appropriate competencies are transferred to the appropriate individuals.
- Employees of engineering and installation companies are generally split into different areas and levels of responsibility. It is especially important to provide task- or technology-specific competency there where particular requirements must be fulfilled. For example, a foreman who is responsible for managing a group of unskilled workers should have the appropriate level of task- or technology-specific competency: the workers on the other hand do not necessarily need this. Accurate target group profiling is therefore crucial in order to later be able to develop an effective training programme.
- Company certification schemes are closely linked to the development of training programmes: a company certification scheme defines, amongst other aspects, the required level of skill and knowledge (i.e. competency) of a company's employees. These requirements do not apply to *all* employees, rather only to those undertaking or overseeing tasks relevant to system quality. In practice this is achieved by ensuring that one employee, or a certain proportion of employees, per work area meets the required level of competency.

Figure 6 below illustrates via a series of examples how target groups can be identified.

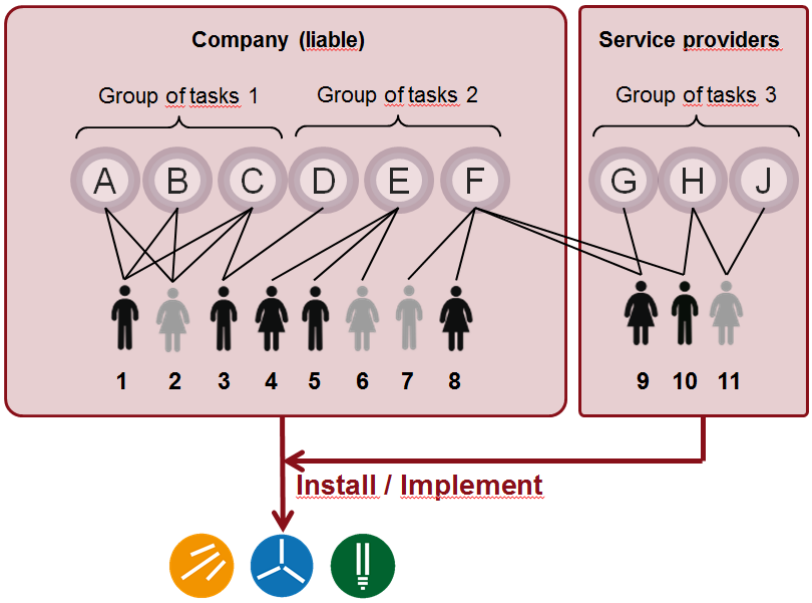

Figure 6: Target group identification and profiling

Example 1:

In this example we assume that Target Group 1 carries out design tasks A, B and C. Person 1 is the defined 'Responsible Person' for system design. Person 2 performs the same tasks but under supervision from Person 1. Person 2 would of course also be a target person for a training course on system design, but it may only be necessary for one person to have the relevant qualification. It is of course conceivable that Person 1 passes his/her acquired knowledge on to Person 2.

Example 2:

Person 3 interfaces between Work Area 1 and Work Area 2. Work Area 2 in this case covers installation tasks. It would of course be theoretically possible to develop a unique training course for Tasks C and D, but it would probably be more efficient to send the interface personal on two training courses (one on Work Area 1, and one on Work Area 2).

Example 3:

The three People 4, 5 and 6 carry out Task E which is essential installation work and demands certain minimum requirements. If, for example, a company certification scheme requires that at least 50% of employees in this work area hold a relevant qualification, the company would have to send at least 2 people (Persons 4 and 5) to receive training. The training course would, in the example, not be limited to covering Task E, but Tasks D and F may be so closely related to Task E that it makes sense for the employees to also be trained in these tasks. These employees could then also be employed more widely.

It is crucial that the Groups of Tasks are well defined, and well separated from one another. Then it is possible to carry out accurate target group identification and from this to develop a suitable, modular training programme.

6.4.2 Target group profiling

Once the target groups have been defined they must be profiled. The people performing the tasks will already possess a certain level of competency. This entry level standard will determine the starting level for the training programme.

Target group profiles should comprise the following information:

- the subject of the vocational or academic qualification
- the typical maximum qualification level (high school, vocational and/or academic)
- the typical type and duration of relevant on-the-job experience
- the level of responsibility held within the company
- the typical Continued Professional Development training that the target group may have undertaken
- the expected age group where appropriate

It is also important to get an estimate of the target group's availability and mobility. An employed installer, for example, will only have limited time to take part in a training programme. A person who, on the other hand, is currently in full time education may be available to participate in a longer term training programme. Information about a target group's mobility will help to select the optimum training and examination location(s).

The target group profiles also help to define the minimum entry level requirements for the respective training programmes.

7 Training Development & Approval Body: roles and responsibilities

The Training Development & Approval Body is responsible for developing a complete training programme for each Task Group as identified in the Occupational Standards (see previous chapter). It is also responsible for ensuring that training providers deliver training courses to a high quality standard. It does this by developing assessment criteria and carrying out assessments of the Training Providers and Examiners.

A working group made up predominantly of educational and technical experts but also including representatives from employers and trade unions provides support in these processes. It is strongly recommended that the working group draws on international experience at the outset.

7.1 Training programme development

A training programme is designed to the needs of a particular Task Group Profile as defined in the previous section. The following subsections describe the processes involved.

7.1.1 Defining learning outcomes

Firstly, learning outcomes need to be defined for each subtask from the relevant part of the Job Task Analysis. An example is given in Table 3 which shows that each subtask from the Job Task Analysis can produce many learning outcomes. This example is derived from the Job Task Analysis and Learning Outcomes for NABCEP Solar Heating Installers. Input from industry experts will without a doubt be necessary to develop a comprehensive set of learning outcomes.

From Occupational Standard	From Training Programme
Job Task Analysis: Solar Heating Installer Area D: Install system Task 8: Implement site safety plan:	Learning Outcomes
Subtask: Identify unsafe practices	2.2 Demonstrate safe and accepted practices and safety equipment for personnel protection
	2.3 Identify appropriate codes and standards concerning installation, operation and maintenance of solar thermal systems and equipment
	2.4 Identify physical personnel safety hazards associated with solar heating installations
	2.5 Identify environmental hazards associated with solar heating installations
	2.6 Determine components that require identification tag

Table 3: Training programme development: learning outcomes as defined for a particular subtask from the NABCEP Job Task Analysis for solar heating installers (only for illustration)

7.1.2 Defining entry level requirements and level of resulting qualification

Formal training programmes always define entry level requirements. It is useful if a common framework is used when defining these entry levels. A standard which is becoming more widely used and referenced across EU Member States and other parts of the world (for example, Australia) is **the European Qualifica-**

tions Framework (EQF). The EQF is an 8-level learning framework and covers all types of qualifications ranging from those acquired at the end of compulsory education (Level 1) to the highest qualifications such as Doctorate (Level 8). The EQF is focused on the outcome of learning and the person's actual knowledge and skills rather than the amount of study needed to complete the qualification programme. (For more information, refer to Appendix 8.5.)

Target Group Profiling defines the typical qualification level of a particular Target Group. The training programme for that target group will thus be set at that level. For example, Target Group profiling may have identified that personnel performing commissioning of PV systems are typically qualified electricians. Therefore the entry level for a training programme on good practices in PV system commissioning will be set at qualified electrician level. A qualified electrician is considered to be a 'skilled worker'[4] which is equivalent to EQF Level 3.

If a training need is identified for personnel with lower or no relevant qualifications then either the existing training programme will need to be adapted, or an entirely new training programme will need to be developed.

The level of a training programme can be reduced by:

- reducing the number of learning modules,
- or by removing complex elements of modules.

The level of a training programme can be increased by:

- adding modules relating to additional tasks,
- adding modules relating to management tasks,
- adding modules relating to increased technical specialism.

7.1.3 Defining course duration

The course duration will depend on the training programme content but will also take into consideration the availability of the Target Group (as described in the previous Section 6.4.2). It may be necessary or desirable to split a training programme into a series of learning units to make attendance more manageable for learners. Thus, for example, a training programme might be split to take place over a series of five weekends. The successful completion of each weekend will earn the learner, for example, 10 credit points. At the end of the training programme the learner will have earned 50 credit points and will thus be eligible to receive the training programme qualification.

This modular approach to training programme delivery allows for greater flexibility, both for the learner who can pick and choose exactly the combination of learning units he/she wants to complete, and also for the training provider who can offer different combinations of units depending on demand.

[4] A 'skilled worker' as defined by the European Training Foundation is expected to be able to: meet technical requirements; manage the work process (identify resource needs, plan work, monitor quality, revise working methods, hand over work); develop good communication relationships with co-workers; contribute to the organisation of work by solving problems, making judgements, suggesting improvements and adapting as work requirements change; recognise social and environmental responsibilities by working safety and ethically.

Another option for acquiring knowledge is the online learning model. Here the training programme developer will define the length of time that each unit of learning should take, but the amount of time that the learner in fact invests is up to him/herself.

7.1.4 Defining syllabi and developing teaching and learning guides

The syllabus encompasses course outlines, lesson plans and teaching methods. It is essential, in particular for training programmes aimed at installers and technicians, that lesson plans incorporate significant amounts of practical, hands-on training where learners get to work with training rigs as well as real-life working systems.

Developing syllabi is often the responsibility of the training provider. In this case, however, it is recommended that, in the first instance at least, the Training Development & Approval Body covers this to ensure quality and consistency in materials and methods.

In addition to syllabus definition, it is recommended that the Training Development & Approval Body develops teaching and learning guides to accompany each training programme. These guides should provide technical content on precisely how each 'Learning Outcome' (as described in Section 7.1.1) is to be interpreted and implemented as well as a set of exercises that students can do to test their own learning. They should include detailed technical descriptions as well as references to all relevant parts of the Codes of Practice (as defined in the relevant Occupational Standard) that the trainer and learner must be familiar with.

Also to be developed is a literature list of books and other technology-specific publications that the training provider should have as a reference library.

7.1.5 Developing examinations

It is recommended that learner examinations are split into two parts: a practical element which is assessed in-house by the training provider and a theory element which is invigilated by an independent examiner or assessor.

<u>Practical examination</u>

Particular emphasis should be laid on the practical examination since this allows not only knowledge but also skill to be assessed. This is especially important for installer and technician training programmes. Practical assessments should be designed to establish that the learner's competence (knowledge and skill) meet the qualification requirements. The assessor should, for example:

- observe the learner carrying out a range of relevant practical activities (such as working with relevant equipment in a correct and safe manner, carrying out installation, commissioning, testing and inspection tasks in a correct and safe manner);
- appraise a piece of practical work that the learner has completed.

The practical examination must be conducted by an individual with the relevant level of technical competency.

<u>Theory examination</u>

The theory element of the examination will assess the learner's knowledge and can take the form of multiple choice questions and questions requiring short, structured answers.

7.2 Defining Approval Criteria for Training Providers

Clear criteria must be defined for the approval of training providers. These approval criteria are largely formed from the training programme content and must also include requirements for trainers, training facilities, theory and practical examinations, and general administrative duties.

7.2.1 Defining trainer requirements

It is acknowledged that in a fledgling market where there are severe training deficits there will also be a lack of competent personnel to conduct training courses. The Training Development & Approval Body must therefore also develop training requirements which themselves can be converted into a training programme for trainers (Train-the-Trainer).

These requirements should include the following. A trainer should be:

- technically competent in the relevant Task Area;
- conversant with the relevant Codes of Practice;
- pedagogically competent to train the Target Group.

It is recommended that trainers are classified into, for example, Assistant Trainer and Master Trainer where an assistant trainer has enough technical and pedagogical experience to assist the master trainer in delivery of training. With continued experience the assistant trainer will of course have the opportunity to undergo an assessment to graduate to Master Trainer.

7.2.2 Defining facility requirements

Training provider facilities should include:

- classrooms and training laboratories fitted with all required safety features;
- training kits to teach basic principles of the technology;
- samples of real equipment and tools;
- complete ‘knock-down’ systems for mounting/installation/operation and maintenance training;
- any technology-specific software used, for example, in system design.

7.2.3 Defining examination requirements

The in-house practical examination will be primarily regulated via assessment documentation that the training provider must complete for each trainee and then submit for checks to the Training Development & Approval Body. This primary regulation will be supplemented by planned and random surveillance visits from an approved examiner/assessor.

The external theory examination will provide another layer of quality assurance – significant discrepancies between a trainee’s practical performance and theoretical performance can be identified and pursued by the Training Development & Approval Body.

Some sample examination requirements which the training provider must meet are:

- Is all equipment which is needed for hands-on examinations available?
- Is enough time allocated for the completion of hands-on tasks?

- Is sufficient guidance and preparation time allocated for the learner to understand how to execute the hands-on tasks?
- Is an approved examiner supervising the completion of the tasks?
- Are examination results documented and delivered on time to the examination board?
- Do examinations comply with all other rules of the examination regulation for in-house exams?

7.2.4 Defining administrative and management requirements

These requirements include aspects such as:

- Are organisational, training and quality goals documented?
- Is a quality management system in place?
- Are records (e.g. complaints and appeals, contracts, internal audits, learner records) retained?
- Are systems in place for providing learners with organisational information and support?

Once all approval criteria are defined, they should be converted into assessment forms which should be made available to the training providers to enable them to prepare for assessment. The Training Development & Approval Body is also responsible for giving training providers support and guidance as they prepare for the approval audit.

7.3 Training Provider approval audit and evaluation

The mechanism by which a training provider becomes approved is described by the flow chart in Figure 7.

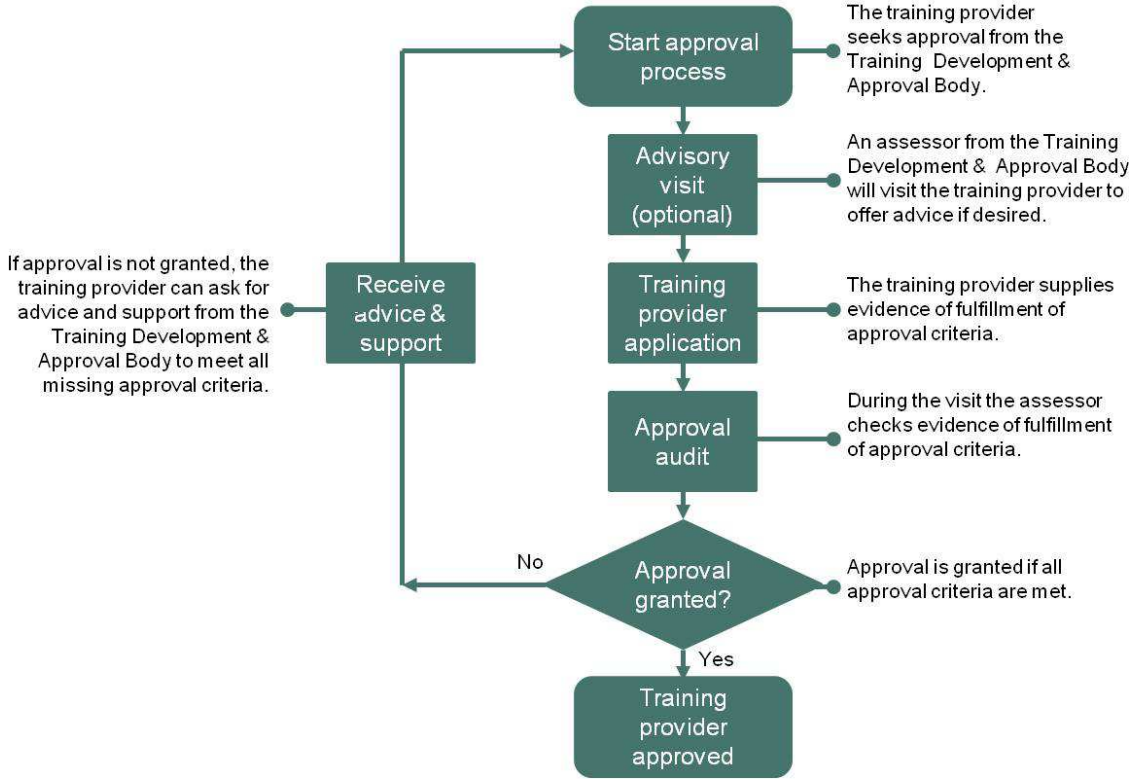

Figure 7: Mechanism by which a training provider gains approval from the Training Development & Approval Body

The approval audit is carried out by an assessor from the Training Development & Approval Body. This assessor will also be available to provide guidance and support to the training provider prior to the approval process.

In the first instance the training provider, with the advice and guidance of the assessor, will have developed its resources and facilities in accordance with the approval criteria. When applying for approval the training provider must provide a list of the type of evidence it will present during the audit. For example, under 'Resources required to deliver the training course', the training provider might list 'equipment store, inventory of equipment, procedures to identify and report deficiencies, equipment maintenance schedules'. During the audit visit the assessor will then check that all these items are in place.

Once the audit is complete, the assessor can evaluate the information obtained using a scoring model. Each approval criterion receives a weighting since some criteria are critical to assuring quality while others are useful but not critical. The scoring model considers all the approval criteria. The scoring scale ranges from 0 to 4. The meaning of the scores is explained in Table 4.

Score	Meaning
0	Capacity or resource non-existent
1	Capacity or resource exists only in fragments and/or substantial revision/improvement/adaptation needed
2	Capacity or resource exists in parts and/or revision/improvement/adaptation needed
3	Capacity is available or resource is complete, but little revision/improvement/adaptation needed
4	Capacity is available or resource is complete and ready to be deployed or used

Table 4: Scoring scale for the evaluation of capacities and resources of a training programme and its facilities

When applying this scoring model, the training provider must achieve a minimum total score as well as a minimum score in each category in order to receive approval to carry out a specific training programme.

Audit results may be presented as shown in Figure 8. In this sample result we can see that the training provider received a high score for all approval criteria falling under the category 'teaching staff' but scored less well in the category 'evaluation and quality assurance'.

It is recommended that training providers do not simply receive a classification 'approved' or 'not approved, but rather should be provided with incentives for continued improvement. For example, two levels of approval could be awarded, one for outstanding level of quality and the other for good level of quality. A further classification could also be included where approval is awarded subject to certain conditions being fulfilled. The training provider would in this case have to provide proof within a defined time period that shortcomings had been rectified.

It is recommended that each training provider undergoes re-approval after a defined period. This may take the form of a desk-top assessment unless the Training Development & Approval Body has reason to believe that a more in-depth assessment is necessary, for example if complaints have been made against the training provider or if learners consistently perform very differently (either much worse or much better) than learners from other training providers.

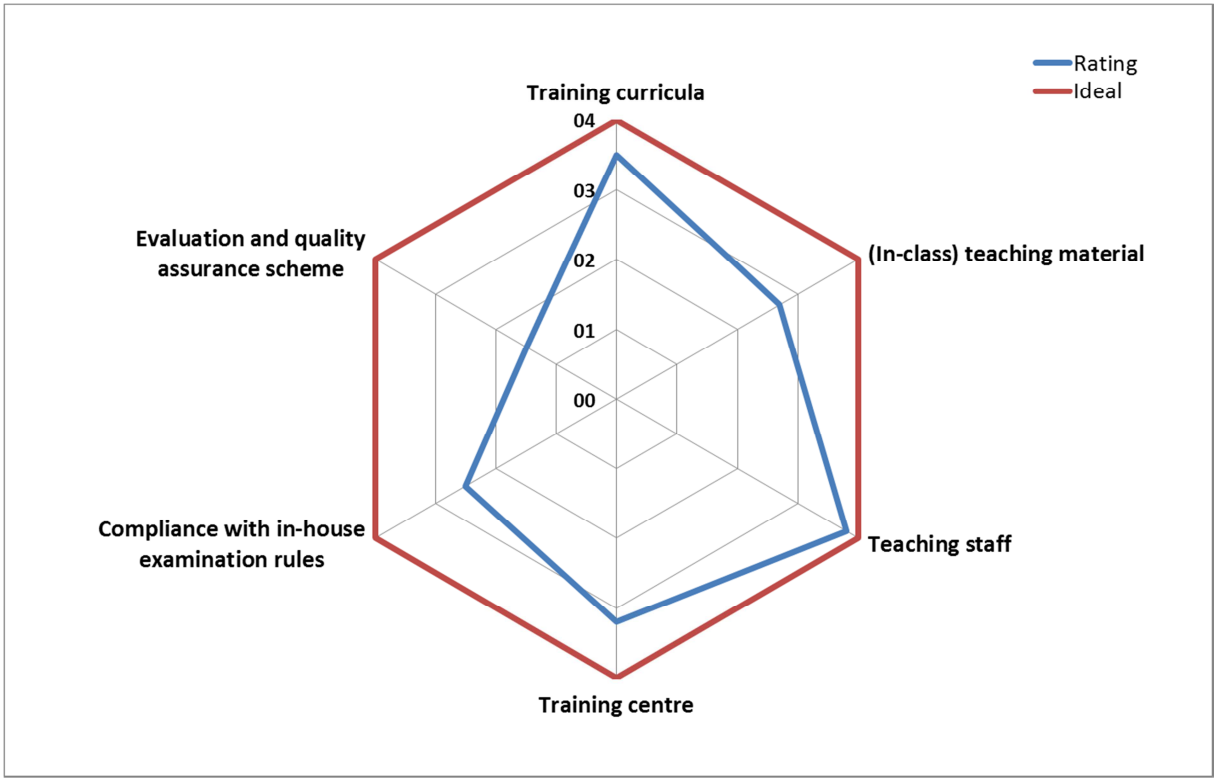

Figure 8: Example of how assessment results may be displayed. The blue line for the actual rating is a sample result and serves for illustration only.

8 Employers offering formal on-the-job training: roles and responsibilities

A further training model which could be introduced into the MENA RE/EE sector at a later stage once the training provider model has become established is that of the German dual vocational education system in which the RE/EE employer offers a formal on-the-job training programme to its trainees in parallel to external training provision. Such a company-based training programme would also need to complete an approval audit similar to the one described for training providers in the previous chapter. Here it would be essential that a wide base of installation companies support the process and are willing to invest more in the professional development of their employees. The following sections describe how company-based training within the dual vocational education system is implemented in Germany.

8.1 Vocational training regulations[5] for company-based training

In the German dual education system, trainees attend vocational college on a part-time basis in parallel to their company-based vocational training. Company-based vocational training is regulated nationally by the reformed Vocational Training Act of 2005[6]. All actors involved in vocational training work together in planning and preparing the profiles for new or updated occupations:

- the companies and chambers (employers)
- the trade unions (employees)
- Germany's federal states
- the German Federal Government

8.1.1 Development of vocational training regulations

Technical experts develop the outlines of new training regulations in collaboration with the Institute for Vocational Education and Training (BiBB) and harmonise them with the draft framework curricula in consultation with experts from the vocational schools. The relevant ministry of the German Federal Government (generally the Federal Ministry for Economics and Technology (BMWi) acting in cooperation with the Ministry of Education and Research (BMBF)) issues the training regulations. Employers and trade unions promote the new training regulations in the companies.

8.1.2 What the training regulations regulate

The training regulations contain the minimum standards for the company-based part of initial vocational training. These standards define the skills, knowledge and capabilities required by personnel to carry out the occupation.

The training regulations regulate:

- the designation of the training occupation
- the duration of traineeship (2-3 years)

[5] Note that here ‚training regulations' encompass occupational standards and training programmes according to the definitions of these that have been used throughout this study.

[6] Vocational Training Act, Berufsbildungsgesetz (BBiG) 2005, Federal Ministry of Education and Research (BMBF)

- the profile of the training occupation (a summary of the typical skills, knowledge and capabilities of the occupation)
- the general training plan (an outline of the syllabus structure and time allocations for teaching the required skills, knowledge and capabilities)
- the examination requirements

The training regulations constitute the regulatory framework for the around 350 state-recognised occupations in Germany.

8.2 Quality assurance in company-based vocational training

8.2.1 Company eligibility to offer vocational training

Each company finances the training that it provides. In order to qualify to provide vocational training, a company must meet training criteria such as employing trainers who have the requisite skills for the specified role. Trainers are considered to be *technically* qualified if they have passed the final examination in the relevant occupation or if they can demonstrate relevant practical experience. They are considered to be *pedagogically* qualified if they have passed Trainer-aptitude or Master Trainer exams or can supply proof of relevant pedagogical experience (including planning, conducting and monitoring training).

The implementation and design of company-based vocational training is the responsibility of the company itself. The curricula formulated in the training regulations represent minimum standards. Thus, each company can introduce additional topics and qualifications in its training package.

The general training plan specified in the training regulation for the company-based element is coordinated with the corresponding vocational school framework curriculum so that in-company training and classroom instruction complement one another.

8.2.2 Verification of company vocational training by Competent Body

The quality of the training that a company provides is verified by the relevant Competent Body which, in the case of TVET, will be either the Chamber of Crafts and Trades or the Chamber of Industry and Commerce. The responsibilities of the Competent Body are:

- to supervise vocational training preparation, vocational training and retraining
- to maintain the directory of apprenticeships in which the essential content of the vocational training relationship is to be entered
- to provide companies with training advice via training counsellors
- to conduct intermediate and final examinations
- to monitor and support stays in other countries

Also the Competent Body is required to set up a TVET committee consisting of six trade union representatives, six employer representatives, and six teachers from vocational schools to provide advice to companies and to promote high quality company-based vocational training.

The Competent Body and the company offering vocational training are regulated by the German Federal Government.

9 Further steps: introducing a company certification scheme

The previous chapters have described the important steps leading to training providers delivering high quality and need-driven RE/EE training programmes. We have seen that Occupational Standards must be in place before a training programme is developed, and that an important element of training programme development is the definition of approval criteria for evaluating training providers. These development steps can be considered to be the Preparation Phase (see Figure 9 below) in the overall process leading to improved quality in RE/EE installations. This chapter will describe what happens during the subsequent phases when a company certification scheme is introduced.

First of all, however, the next section will present two best practice examples of RE/EE certification schemes that have been set up in recent years. Experience from these and other RE/EE certification schemes (refer to Appendices 2 and 3) form the basis for the proposal for the development of a comparable scheme in the MENA Region presented in Sections 9.2 and 9.3 below.

9.1 Best practice examples of RE/EE certification schemes

The Microgeneration Certification Scheme (MCS) in the UK and the NABCEP scheme (North American Board of Certified Energy Professionals) in the USA are presented here as best practice examples since these schemes are well-established and successful, they have a good reputation and demand high standards of quality, and they are interlinked with wider structures (occupational standards, training programmes, training providers, regulators and assessors) that display comprehensive and transparent standards processes and quality assurance mechanisms.

	NABCEP	MCS
Type of certification scheme?	Individual certification	Company certification
Technologies covered	PV installation professional; solar heating installer; PV technical sales	Biomass, heat pumps, micro CHP Pitched roof mounting systems, PV, solar thermal, wind turbines
Installation size covered	Not explicitly defined.	Heat generating technologies up to 50 kW; electricity generating technologies up to 45 kW
Target group covered	Installation companies	Installers, Sales technicians
Is scheme mandatory or voluntary?	It started as a voluntary scheme, however in some US States it has become mandatory	Mandatory
Incentives attached?	In some US States certification is required to receive installer licence; in others no	Yes, government grant is only available for systems installed by MCS certified companies
Does scheme receive funding?	In start-up years scheme was supported by the US Dept. of Energy; now scheme is almost entirely self-funding	In start-up years scheme was supported by the UK Dept. of Energy and Climate Change (DECC); now scheme is self-funding

When was scheme introduced?	2002	2008
What accreditation does scheme certification have?	ISO/IEC 17024 'Certification of persons' (see Appendix 9.2 for details)	ISO/IEC 17024 'Certification of persons' (see Appendix 9.2 for details)
Who carries out accreditation?	ANSI	UKAS
When did scheme become accredited?	2013	2008
Requirements of certification	at least 1 year installation experience; proof of training and installations completed; passing a rigorous theory examination	office audit (for QM, etc.); installations audit; proof of competency of key personnel
Installation audits performed?	No, but a copy of the Electrical and/or Building Permit(s) and Final Inspection Report(s) issued by the Local Authority Having Jurisdiction (AHJ) required	Yes
Examination required	Yes	No

Table 5: Best practice examples of RE/EE certification schemes: comparison between NABCEP and MCS

9.1.1 NABCEP in the USA

The North American Board of Certified Energy Practitioners (NABCEP) is a nationally recognised, independent, voluntary certification scheme for photovoltaic (PV) and solar thermal system installers. NABCEP was originally formed in 2002 by an ad hoc board made up of manufacturers, installers, policy makers, national laboratories, educators, the Solar Energy Industries Association and the Interstate Renewable Energy Council.[7]

Initial resistance to the certification scheme from installers and manufacturers was overcome mainly due to the dedication and good reputation of the voluntary board and committee members.

The assessment of eligibility and the evaluation of examinations are undertaken by NABCEP itself (rather than be accredited certification bodies as in the MCS scheme – see below). This is manageable since the scheme is relatively small (around 300 installers become certified each year).

NABCEP offers entry level knowledge assessment, professional certification, and company accreditation programmes to renewable energy professionals throughout North America. To become NABCEP-certified, installers must have at least one year of installation experience and must document all training and installations. Installers must also pass a rigorous exam, sign a code of ethics, and take continuing education courses for re-certification every three years. Two of NABCEP's programmes (PV Installation Professional and Solar Heating Installer Certifications) have been accredited to the ISO/IEC 17024 'Certification of persons' standard by ANSI.

[7] From NABCEP (www.nabcep.org)

Note that the NABCEP scheme had already existed for 10 years before it became accredited. By that time it had already built up a strong reputation within the industry. The accreditation of certification now gives the scheme the added weight of conforming to international certification standards.

9.1.2 MCS in the UK

The Microgeneration Certification Scheme (MCS) is an industry-led and internationally recognised installation company certification scheme, supported by the Department of Energy and Climate Change (DECC). 'MCS seeks to build consumer confidence and support the development of robust industry standards. It provides confidence in the marketplace and wholly supports government policy within the microgeneration sector.'[8] An installation must be carried out by an MCS certified installation company to be eligible for the national incentive schemes and financial mechanisms.

The MCS scheme is self-funding whereby a £15 (approximately €21) fee is paid by the installation company to MCS per completed installation.

MCS certification bodies

When the MCS scheme was first established, applicants were assessed and certified by the scheme developer. As the scheme grew, multiple certification bodies were granted licenses to operate the scheme to create a competitive market and drive down costs of certification. These certification bodies are accredited by the UK Accreditation Service (UKAS) to EN ISO/IEC 17024:2012 'Certification of Persons' to ensure they deliver a high standard of service. However, the quality of the certification bodies' performance must be maintained and must therefore be continuously assessed[9].

The certification bodies are required to carry out technical installation inspections and office audits of applicants during the assessment stage. They are also required to carry out random site inspections and to respond to installation customer complaints.

The following section will describe how a certification scheme similar to these best practice examples could be introduced in phases in the MENA Region.

9.2 Steps to achieving company certification

This section will describe how a company certification scheme can be introduced once the Preparation Phase of developing RE/EE occupational standards and training programmes and setting up approved training providers has been completed. The overall process is illustrated in Figure 9 below. Note the different activities that happen in each of the three phases: Preparation, Transition and Obligation.

[8] From Microgeneration Certification Scheme (MCS) – www.microgenerationcertification.org

[9] Experience from the MCS scheme indicates that some certification bodies are not fulfilling their roles to the required degree. 'Is MCS fulfilling its potential? A Solar Trade Association Position Paper', Chris Roberts, Solar Specialist, Solar Trade Association, September 2014

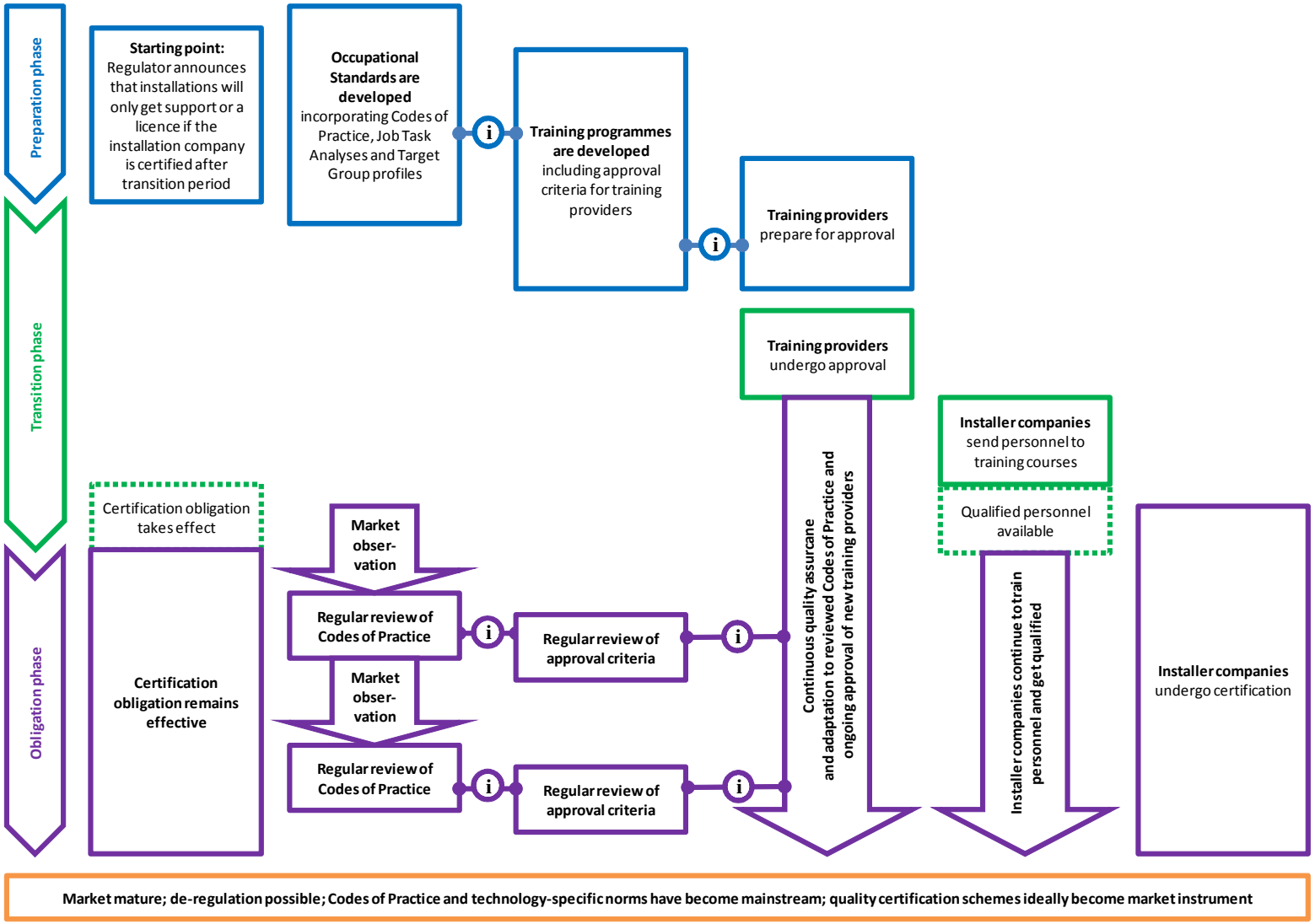

Figure 9: Overall process leading to improved quality in RE/EE system installations driven by an initially mandatory company certification scheme

The national regulator should plan a Transition Phase (see Figure 9) during which a mandatory certification scheme for RE/EE installation companies is introduced. The requirements to achieve company certification would be created during this transition phase. The critical requirements are:

- the installation company must supply proof that it is operating a robust internal quality management system;
- the installation company must supply proof that it is installing systems in accordance with the recognised Codes of Practice;
- the installation company must supply proof that key personnel have relevant competency to the required level.

At the same time, installation companies would be completing the steps towards achieving certification. These are:

- the recognised Codes of Practice compiled during the preparation phase are published and installation companies begin to adopt them,
- installation companies begin to send their employees to receive relevant training at approved training providers,
- employees begin applying their newly gained competencies in their jobs which leads to improvements in installation quality,
- trained employees begin to pass their newly acquired competencies on to their colleagues which leads to further improvements in installation quality,
- installation companies have enough proof of competency and enough installations of sufficiently high quality to apply for, and receive, company certification.

The transition phase should be long enough to allow companies to complete the steps towards becoming certified.

As soon as the first company has become certified, the RE/EE installation sector enters the Obligation Phase (see Figure 9) in which systems are installed in the knowledge that they will count towards certification. It is particularly important that the RE/EE sector is observed during this phase and that potential problems with company certification are identified. If, for example, the Codes of Practice present problems that hold the sector back, these must be rectified immediately.

If non-critical improvement measures need to be implemented, these can be scheduled to take place during the next review of the Codes of Practice. Such reviews will typically take place every few years. Here it is important that a degree of consistency is maintained in order not to unsettle the sector.

The phase of mandatory certification should not remain in force indefinitely. Certification obligation should come to an end when a large and mature market has become established. This is of course under the prerequisite that the recognised Codes of Practice have been taken up in the national regulations (as recognised norms or, in rare cases, laws) and as such have become legally enforceable.

The end of the certification obligation does not necessarily mean the end of the certification scheme. In a mature market with intense competition the certification scheme could be developed further into a market instrument that provides a ‘quality seal’ of especially high quality standards. The demand for training programmes will also continue since companies will continue to need personnel qualified to install systems in accordance with increasingly stringent Codes of Practice.

9.3 Mechanism for developing a lean yet successful company certification scheme

The mechanism for developing a company certification scheme should adhere to the following two criteria:

1. on the one hand the mechanism should be as lean as possible so that the effort, and thus the cost, is less than the benefit;
2. on the other hand the mechanism must have such a clear impact and be so binding that it leads to a widespread and noticeable improvement in installation quality.

The costs in the cost-benefit analysis are relatively straightforward to determine. The benefits on the other hand are difficult to estimate since they cannot be perceived in purely monetary terms. In some sectors industry has responded with considerable resistance to the introduction of either obligatory or voluntary quality requirements on installations. A common argument against quality assurance schemes is that they lead to considerable increases in the cost of products and services.

From this experience it is recommended that any scheme should clearly communicate to stakeholders the benefits of having certain minimum quality standards. There are many good arguments: better competition between companies, improved public confidence in the technology leading to increased sales, and access to lower cost insurance policies to name but a few.

While keeping the cost of introducing a certification scheme to a minimum, the scheme requirements should still be sufficiently high that improvements in quality are noticeable and that the 'quality seal' is not misused simply as a marketing feature.

Recommendations for new certification schemes in the RE/EE sector are:

- It is essential to communicate the benefit of a quality assurance scheme to the industry.
- The scheme should be introduced progressively: firstly, the requirements should be kept to a necessary minimum to avoid overwhelming the industry; secondly, only those technologies and work activities displaying the greatest training need should be included at the beginning. Requirements can then be progressively increased, the certification mechanism improved, and further technologies and/or work activities included.
- Training programmes and certification scheme requirement must be in-line with one another, therefore a high degree of communication between bodies must take place from the outset.

Please refer to Appendix 3.1.2 for key success criteria of certification schemes as compiled by the Qualicert project on existing RE/EE installer/installation company certification schemes worldwide.

10 Recommendations

It is envisaged that the process of improving installation quality in the RE/EE sector will be carried out in phases. The preparation phase will involve developing occupational standards and training programmes.

In order not to lose time, it is recommended in the first instance that Job Task Analyses and training programmes are developed based on internationally existing Codes of Practice. These can then be adapted to country requirements once these have been fixed.

The process leading to the definition, adoption, implementation and enforcement of quality standards and quality assurance mechanisms for RE/EE training should follow a sequential approach and be focused on the following issues in the following order:

- The occupations or work activities in the RE/EE sector with the greatest training needs must be identified. A working group of technical experts should be set up to carry out assessments of existing RE/EE installations and identify where installation quality is lacking and the reasons for this (e.g. poor design, poor installation, poor maintenance, low quality components, etc.).
- This working group should at the same time begin to develop the Job Task Analyses for the various occupations.
- Parallel to this, work should commence on the compilation and development of the recognised Codes of Practice. Improvement measures can then be implemented in existing installations in accordance with these newly developed Codes of Practice.
- As soon as the first Job Task Analyses has been completed, training programmes should be developed to address the needs of all target groups ranging from individuals with no experience through to those with academic qualifications. It is essential that training programmes are developed to incorporate a high proportion of practical, hands-on training.
- Parallel to this, existing training providers and trainers should be identified who would be suitable to deliver the RE/EE training programmes. Train-the-Trainer programmes should be conducted to prepare trainers for the new teaching demands (both technical and didactical).
- Governments should use their power to introduce a mandatory certification scheme for companies operating in the RE/EE sectors, especially where installations are co-financed with public funds.
- The company certification scheme should cover all occupation levels involved (i.e. installers, technicians and engineers).
- The scheme should be introduced progressively: firstly, the requirements should be kept to a necessary minimum to avoid overwhelming the industry; secondly, only those technologies and work activities displaying the greatest training need should be included at the beginning. Requirements can then be progressively increased.
- The phase of mandatory certification should not remain in force indefinitely. Certification obligation should come to an end when a large and mature market has become established and the certification scheme should developed into a market instrument.
- Such a certification scheme does not need to be accredited to international standards immediately but the quality management and quality assurance mechanisms should be put in place from the outset so that the possible transition to becoming accredited at a later stage runs smoothly.

The appropriate bodies and quality assurance mechanisms should be established as soon as possible so that when, in the longer term, demand (for training, for training provider approval, for company certification, etc.) grows the capacities and structures are already in place.

1 Appendix – Definitions

There is some ambiguity around the definition of terms between the many sources used in this investigation in the context of installer certification schemes and training. The definitions given here aim to provide clarity.

Accreditation	Accreditation is the formal recognition by an accreditation authority to the technical and organisational competence of a conformity assessment body to carry out a specific service in accordance to the standards and technical regulations as described in their scope of accreditation. (From the UK Accreditation Service, www.ukas.com) Accreditations play a key role in warranting the comparability of conformity assessment results and creating trust in the quality and safety of products and services. (From DAKKS, the German Accreditation Service, www.dakks.de/en/content/what-accreditation)
Accredited certification body	A body that undertakes the assessment of a product or service provider in accordance with relevant standards, and is accredited to do so in accordance with international product or personnel certification standards by an international accreditation service. (Paraphrased from the Microgeneration Certification Scheme, www.microgenerationcertification.org)
Approval	Third Party certification is sometimes referred to as 'Approval and listing'. When used correctly, the term 'Approval' should mean that certification or testing is undertaken by an independent Third Party who should have an appropriate accreditation for the activity. (From the UK Accreditation Service, www.ukas.com)
Certification	Certification is the procedure by which a third party gives written assurance that a product, process, system or person conforms to specified requirements. (From the UK Accreditation Service, www.ukas.com)
Competence	The proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development. (From European Qualifications Framework (EQF), www.eucen.eu/EQFpro/GeneralDocs/FilesFeb09/GLOSSARY.pdf)
Credentialing	Credentialing is an umbrella term used to refer to concepts such as professional certification, certificate programs, accreditation, licensure, and regulation. A ***certification*** program is designed to test the knowledge, skills, and abilities required to perform a particular job, and, upon successfully passing a certification exam, to represent a declaration of a particular individual's professional competence. In some professions, certification is a requirement for employment or practice.

	Similarly, ***licensure*** tests an individual's competence but is a mandatory process by which the government grants time-limited permission for that licensed individual to practice his or her profession. In contrast to certification and licensure, an ***assessment-based certificate*** program is an educational or training program that is used to teach learning objectives and assess whether those objectives were achieved by the student. ***Accreditation*** is the process by which a credentialing or educational program is evaluated against defined standards and is awarded recognition if it is in compliance with those standards. From the Institute for Credentialing Excellence (ICE), www.credentialingexcellence.org/p/cm/ld/fid=32)
Curriculum	A set of courses, and their content, offered at a school, college, university, etc.
Endorsement	An endorsement is a form of support or public approval.
First party certification	**First Party Certification** or 'self certification' is where a manufacturer or supplier provides its own certificate that claims compliance with a standard. The certificate provides little assurance because the assessment has not been carried out independently by a certification organisation recognised by a national accreditation body. (From BRE Global, Green Book Live, www.greenbooklive.com/page.jsp?id=191#3)
Qualification	A formal outcome of an assessment and validation process which is obtained when a competent body determines that an individual has achieved learning outcomes to given standards. (From European Qualifications Framework (EQF), www.eucen.eu/EQFpro/GeneralDocs/FilesFeb09/GLOSSARY.pdf)
Second party certification	**Second Party Certification** is where a trade body or membership organisation issues a certificate. The second party cannot claim true independence from a manufacturer or supplier, because it represents its interests in the market place. (From BRE Global, Green Book Live, www.greenbooklive.com/page.jsp?id=191#3)
Standards	Standards are published documents setting out specifications and procedures designed to ensure products, services and systems are safe, reliable and consistently perform the way they were intended to. They establish a common language which defines quality and safety criteria. Standards can be: **International standards** – developed by ISO and IEC (and others) and used directly or adopted by other standardising bodies. **Regional standards** – prepared for use in a specific geopolitical region, the best known is the European Union (EU) where EN standards are used. Joint Australian/New Zealand standards can also be considered regional standards since they apply equally in both countries. **National standards** – prepared, adopted or approved by a national standards body or other body accredited to produce national standards. For example, Australian Standard® brand Standards are either developed in Australia or are adoptions of international standards. (From Standards Australia,

	www.standards.org.au)
Syllabus	A descriptive outline and summary of topics that are to be covered in an education or training course. The syllabus will usually provide specific information about the said training course and is often drafted by the governing body or by the instructor of the course.
Third party certification	**Third Party Certification** (or 'approval and listing' as it is sometimes known) is Third Party confirmation that products, systems or persons have met and continue to meet appropriate standards (through regular audits, which usually include repeat testing). It is therefore the best and most trustworthy form of certification. The use of a Third Party is a reasonable guarantee of independence from vested interests, such as the manufacturer or supplier. (From BRE Global, Green Book Live, www.greenbooklive.com/page.jsp?id=191#3)

2 Appendix – Installer certification schemes for small-scale renewable energy installations

Many countries began developing installer certification schemes for small-scale renewable energy installations in the early 2000s in response to the marked increase in poor quality installations. These schemes aim to assure the quality and reliability of installers and/or installation companies and their installations.

Existing installer certification schemes provide credentials with different titles such as certification, qualification or label. There is no common set of definitions for these terms and so one scheme cannot be judged to be better than another purely from its title.

Existing schemes have many common features. Applicants will generally have to submit proof of experience in the field (e.g. electrician's licence) and documentation of completed installations. Some schemes require applicants to complete technical training and health & safety training and then sit an examination. Other schemes will carry out audits of existing installations and only award certification if a predefined standard is met.

Figure 10 shows how technical training can complement the scheme certification process. Note that training is an independent element and not always a requirement of certification. For example, very experienced installers will only have to submit evidence of their experience and will not necessarily need to participate in technical training.

The RE/EE installer certification schemes perform the function of assessing and certifying installers. The RE/EE training programmes, on the other hand, develop relevant training standards and qualifications from which training providers develop and deliver courses. Note that the RE/EE installer certification scheme ***certifies*** installers while the training programmes are ***accredited*** to certain quality standards by an accreditation (or awarding) organisation (for definitions of 'accreditation' and 'certification' please refer to Appendix 1 'Definitions').

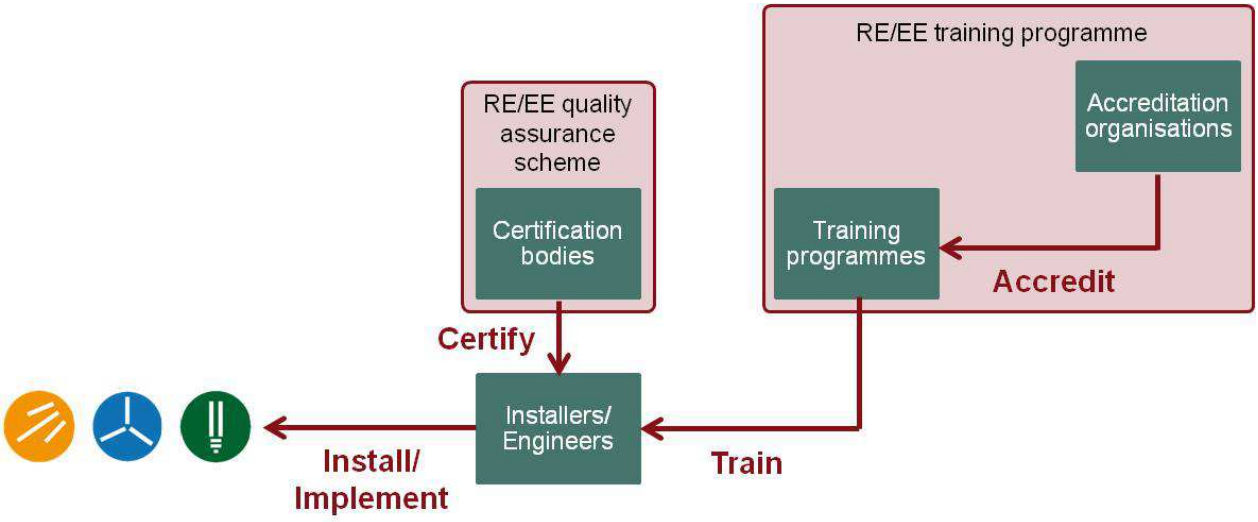

Figure 10: Typical model for installer training and certification for small-scale RE/EE installations.

Often scheme certification is awarded by independent third party certification bodies. This aims to ensure impartiality and also alleviates the administrative burden for the scheme management/administrator. The certification bodies should be accredited by an internationally recognised accreditation authority to ensure that all certification bodies deliver the same high standard of service.

Both schemes for certification of companies and schemes for certification of individuals exist and are operating successfully. The main argument for certification of companies is that the company is liable for the quality of the installation. The certification is given to one nominated 'technical referee' from the company. The main argument for certification of individuals is that the installation is always carried out by the person who has been awarded the certification.

This and the following sections draw on information gathered from the following installer certification schemes:

Country	Name of scheme	Technologies covered
Australia	Clean Energy Council (CEC) Accredited Installer	PV
Austria	Austrian Institute of Technology (AIT) training and certification scheme	PV, solar thermal, heat pumps
Belgium	QUEST Quality Centre Sustainable Energy PVQUAL Soltherm	PV, heat pumps PV solar thermal
Denmark	KSO	PV, solar thermal, biomass
France	Qualit'EnR (QualiSol, QualiPV, QualiBois, QualiPAC) Qualibat Qualifelec	solar thermal, PV, biomass, heat pumps solar thermal, biomass, heat pumps PV
Netherlands	Kiwa Nederland BV KBI	PV, solar thermal, biomass, heat pumps PV, solar thermal, heat pumps
New Zealand	Sustainable Electricity Association New Zealand (SEANZ)	PV
Spain	Professional Qualification for Installers	PV, solar thermal
UK	Microgeneration Certification Scheme (MCS) Green Deal	PV, solar thermal, biomass, heat pumps energy efficiency in domestic and commercial properties
USA	NABCEP	PV, solar thermal

Table 6: Existing RE/EE installer certification schemes investigated within the scope of this study

The following sub-sections provide examples of the most long-standing, successful and relevant installer certification schemes which have been set up in different ways. The NABCEP scheme in the USA was initiated by the stakeholders themselves and was implemented in collaboration between installers' unions and industry partners. The MCS scheme in the UK was originally set up by a private body under contract from the government department for trade and industry and was always intended to operate in conjunction with government incentive schemes. Several schemes in France operate alongside each other, some public, some private.

This section concludes with a list of the main quality assurance standards used in the schemes, and a description of how the technical installer standards are developed.

2.1 NABCEP in USA

The North American Board of Certified Energy Practitioners (NABCEP) is a nationally recognised, independent, voluntary certification scheme for photovoltaic (PV) and solar thermal system installers. NABCEP was originally formed in 2002 by an ad hoc board made up of manufacturers, installers, policy makers, national laboratories, educators, the Solar Energy Industries Association and the Interstate Renewable Energy Council.[i]

Initial resistance to the certification scheme from installers and manufacturers was overcome mainly due to the experience and reputation within the industry of the individuals who volunteered to help establish NABCEP.

The paper 'North American Board of Certified Energy Practitioners: Solar Photovoltaic and Solar Thermal Installer Certification Programs' by Peter Sheehan, the then Executive Director of NABCEP, offers useful insights into how the scheme was set up.

The essential components of a quality credentialing programme, as set forth by certification experts, are:

- Thorough needs analysis
- Industry consensus on purpose
- Independent governance
- Appropriate and supportive by-laws
- Public information dissemination
- Market and cost-driven fees for candidates and certificants
- Defensible eligibility requirements
- Valid assessment of candidates based on actual work-related standards
- Accessibility for those seeking certification
- Detailed grievance and appeals procedures
- Periodic review and maintenance of standards
- Post-credentialing procedures and internal management systems that provide quality assurance

From 'North American Board of Certified Energy Practitioners: Solar Photovoltaic and Solar Thermal Installer Certification Programs' by Peter Sheehan.

NABCEP offers entry level knowledge assessment, professional certification, and company accreditation programmes to renewable energy professionals throughout North America. To become NABCEP-certified, installers must have at least one year of installation experience and must document all training and installations. Installers must also pass a rigorous exam, sign a code of ethics, and take continuing education courses for re-certification every three years.

Two of NABCEP's programmes (PV Installation Professional and Solar Heating Installer Certifications) have been accredited to the ISO/IEC 17024 'Certification of persons' standard by ANSI. However, NABCEP, the non-profit corporation itself, is not accredited. NABCEP carries out the assessment and certification of candidates itself. There is no independent third party certification body.

NABCEP does not approve, review or offer training. The training courses that the applicant must complete to be eligible for NABCEP certification must be registered by NABCEP, unless the training institution already fulfils certain criteria (such as being accredited to appropriate standards by a nationally recognised accreditation body[10]).

The NABCEP board and committee members are voluntary and come from more than 100 companies in the renewable energy industry. The board and committee members develop the Job Task Analyses (these define knowledge, skills and abilities required and are the core documents for each certification), certification handbook, examination questions and other documentation required by the scheme.

2.1.1 Technologies covered by NABCEP

The NABCEP scheme provides the following certifications: PV installation professional, solar heating installer, and PV technical sales. It administered a small wind installer certification scheme between 2010 and 2012 but this has since been suspended.

2.1.2 NABCEP funding

NABCEP received funding from the US Department of Energy for the first years of its operation. Now over 80% of NABCEP revenues are self-generated through application and exam fees, continuing education conferences and generous contributions from a small number of industry-leading companies.

2.1.3 Some notable features of the NABCEP scheme

The NABCEP scheme is relatively small and unbureaucratic with only 17 board members and 5 staff members. On average 300 installers become NABCEP certified each year. In its first year 100 applicants took the certification examination and 62 passed. This could be of a comparable scale as envisaged for the first year of a scheme introduced in the pilot MENA countries.

The industry acceptance and success of the NABCEP scheme can be largely attributed to the dedication and good reputation of the voluntary board and committee members who develop all the certification documentation and examinations. This dedicated and voluntary core of representatives from manufacturers, installers, policy makers, national laboratories, educators, trade associations and other energy agencies must also be available in the MENA countries to ensure success of a similar scheme here.

The assessment of eligibility and the evaluation of examinations are undertaken by the NABCEP staff. This is manageable since the scheme is relatively small. The same model could be adopted for the MENA countries and could be adapted when the scheme grows (in particular across countries) to include independent third party assessors.

NABCEP does not carry out installation audits but requires the applicant to submit documentary evidence of installations to include a copy of the Electrical and/or Building Permit(s) and Final Inspection Report(s) issued by the Local Authority Having Jurisdiction (AHJ). In regions where permits and inspection reports are not issued, the applicant may submit an inspection report written by an independent qualified electrician recognised by the AHJ or an independent certified electrical inspector.

The NABCEP scheme operates mainly in the USA although there are some NABCEP certified installers in Canada and some other countries. The incentives and regulations for renewable technologies vary from state to state and can influence the number of NABCEP certified installers in a particular region. For ex-

[10] For more information on criteria for providing training, see NABCEP Continuing Education Guidelines document.

ample, some states which require NABCEP certification as a condition for participating in the incentive scheme quickly have larger numbers of NABCEP certified installers. NABCEP is an example of a scheme which operates across borders, and whose success is to an extent dependent on regulatory frameworks.

Note on contractor licensing versus certification

In the USA some states establish licensing requirements for contractors in order to protect consumers from unsafe practices and protect the reputation of the industry, as improper installation may create safety risks or result in poor equipment performance. Licensing is distinct from certification. While licensing is mandatory for certain practices, certification is a voluntary standard that installers attain to differentiate themselves from competition and to instill confidence in consumers. Certification may entail completing coursework, installing systems for a certain period of time, or taking an exam, but it is typically not required to install equipment.

From the US Database of State Incentives for Renewables & Efficiency (www.dsireusa.org)

Licensing and certification have different advantages and disadvantages. From a financial point of view, voluntary national certification is preferable to mandatory state licensing because it results in a lower cost of installation and provides greater consumer choice than mandatory licensing. In states that do not require solar contractor licensing, certification can provide a baseline level of quality. State licensing may be restrictive, as state licenses do not typically transfer, so geographic mobility is limited. However, state licensing can protect consumers from potential safety hazards and will help ensure that systems are installed properly. While both licensing and certification have drawbacks, requiring solar contractors to be licensed or certified is preferable to no quality control of system installation and will result in baseline standards being met, which will in turn lead to higher consumer satisfaction.

From 'Costs and Benefits of Practitioner Certification or Licensure for the Solar Industry', Interstate Renewable Energy Council (IREC), May 2002

2.2 MCS in UK

The Microgeneration Certification Scheme (MCS) is an industry-led and internationally recognised installation company certification scheme, supported by the Department of Energy and Climate Change (DECC). 'MCS seeks to build consumer confidence and support the development of robust industry standards. It provides confidence in the marketplace and wholly supports government policy within the microgeneration sector.'[ii] An installation must be carried out by an MCS certified installer to be eligible for the national incentive schemes and financial mechanisms (mainly Feed-in Tariff for electricity generating technologies, Renewable Heat Incentive for heat generating technologies, and Green Deal for energy efficiency measures). MCS itself is a BS EN ISO/IEC 17065:2012 (Conformity assessment – Requirements for bodies certifying products, processes and services) accredited scheme and was launched in 2008. For more information on this standard, please refer to Appendix 9.1.

2.2.1 Technologies covered by MCS

MCS certifies microgeneration products used to produce electricity and heat from renewable sources. MCS also certifies installation companies to ensure the microgeneration products have been installed and commissioned to the highest standard for the consumer. The certification is based on a set of installer standards and product scheme requirements.

MCS covers electricity generating technologies with a capacity of up to 50kW (PV, wind, hydro, CHP, fuel cells), and heat generating technologies with a capacity of up to 45kW (solar thermal, biomass, heat pumps, CHP). As of 2014, of the over 4000 PV installation companies in the UK, 2739 have been awarded the MCS certification.

2.2.2 MCS certification bodies

When the MCS scheme was first established, applicants were assessed and certified by the scheme developer. As the scheme grew, multiple certification bodies were granted licenses to operate the scheme to create a competitive market and drive down costs of certification. These certification bodies are accredited by the UK Accreditation Service (UKAS) to EN ISO/IEC 17024:2012 'Certification of Persons'. To date there are 19 accredited certification bodies operating in Britain and Northern Ireland. The certification bodies are required to carry out technical installation inspections and office audits of applicants during the assessment stage. They are also required to carry out random site inspections and to respond to installation customer complaints.

2.2.3 MCS Scheme funding

The MCS scheme administrator, Gemserv, was commissioned by the DECC to develop the MCS into a scheme that would be self-funded by the microgeneration industry whilst still supporting government policy. A £15 fee is paid by the installer to MCS per completed installation. For more information on this, see www.gemserv.com/sectors/environment/environment-case-studies/mcs-case-study

2.2.4 MCS scheme governance

Most certification schemes form working groups made up of industry experts to develop their installer standards. It is advantageous if members also sit on international standards committees. This helps to harmonise schemes with existing international standards. The scheme governance for the MCS scheme is given in Figure 11 below which shows how the technical standards developed by the working groups are ratified by the standards management group with input from the other groups. This sample governance structure also gives an indication of the different parties and numbers involved.

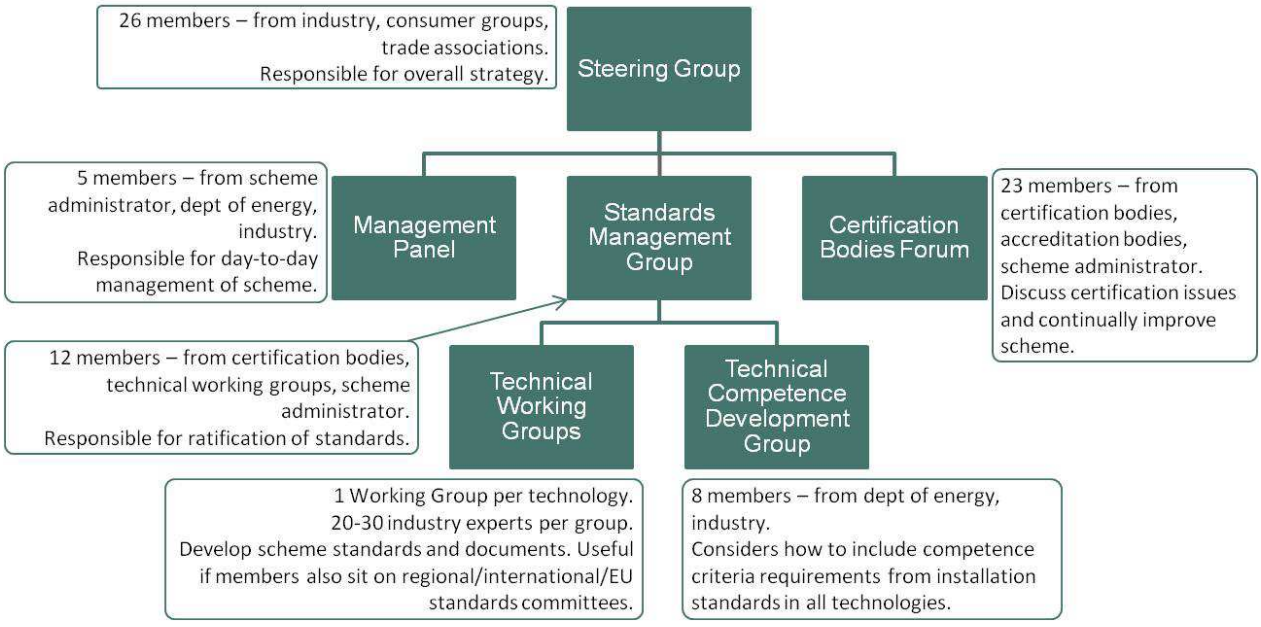

Figure 11: MCS scheme governance

Working groups will base their technology specific standards on existing national, European and/or international standards, including for example component standards, health & safety standards, quality management standards, permitting standards, building regulations and standards, grid connection codes and standards, inspection and testing standards.

2.2.5 Some notable features of the MCS scheme

The MCS scheme is linked to the UK government incentive schemes (feed in tariffs and renewable heat incentives) and its success is largely due to the fact that only MCS installations are eligible for government incentives.

The scheme governance is basically the same as for the NABCEP scheme but since many more technologies are covered, the number of technical working groups, and the level of bureaucracy in general is higher which can result in slower decision-making.

The adoption of multiple certification bodies to carry out the assessments is an advantage as the scheme grows, and encourages competition between the certification bodies which drives the cost of certification down. The certification bodies are all accredited to ensure they deliver a high standard of service. However, the quality of the certification bodies' performance must be maintained and must therefore be continuously assessed[11]. This leads to another level of regulation.

2.3 RE/EE installer certification schemes in France

In France, the most important RE/EE training body is the "Agence de l'environnement et de la maîtrise de l'énergie", or ADEME. ADEME is a public energy agency financed by the Ministry of Ecology, Sustainable Development and Energy and the Ministry of Higher Education and research. ADEME provides companies, local communities, public authorities and the general public with RE/EE expertise and advice.

ADEME plays an essential role in training. Many ADEME-financed projects are accompanied by a training phase to provide participants with the necessary tools for successful project implementation. ADEME's local branches also work with local partners: regional councils, chambers of commerce, professional organisations and education authorities.

France has a number of RE/EE quality labels some of which are described in the following sub-sections.

2.3.1 RGE

"Reconnu Garant de l'Environnement", or RGE is an 'overall' quality label which was created by ADEME and the ministries and actors from the building sector (FFB, CAPEB, Qualibat, Qualit'EnR, Qualifelec) in 2011. The purpose of this quality label is to foster high quality installations in the building sector in line with ambitious construction and renovation standards, and to help guide individuals when selecting an installer.

To date around 18,000 companies have been awarded the RGE quality label. The ADEME has launched an online directory of professionals holding the RGE quality label: www.renovation-info-service.gouv.fr. The directory is kept up-to-date by the five organisations accredited to control and award the "RGE" label: Qualibat, Certibat, Cequami, Qualit'EnR and Qualifelec.

[11] Experience from the MCS scheme indicates that some certification bodies are not fulfilling their roles to the required degree. 'Is MCS fulfilling its potential? A Solar Trade Association Position Paper', Chris Roberts, Solar Specialist, Solar Trade Association, September 2014

2.3.2 Qualit'EnR

Qualit'EnR is an association launched in 2006 by professional entities in the field of construction and renewables to assess the installation quality of RE/EE in buildings. Qualit'EnR is accredited by the French Accreditation Committee (COFRAC) to award quality labels to enterprises active in the field of renewables and energy efficiency. The goals of Qualit'EnR are to obtain recognition for independent high quality RE/EE installation companies, to promote renewable energy installation best practices, to develop related services such as consulting, after-sales service, and maintenance, and to help individual customers choose a competent, professional installer with confidence.

Qualit'EnR manages four quality labels:

- Qualisol for solar thermal
- QualiPV for grid-connected PV
- Qualibois for biomass boilers
- QualiPAC for heat pumps (air source and ground source)

To date, Qualit'EnR has 450 recognised trainers and 150 approved training centres and provides training manuals. Qualit'EnR is accredited by the French Accreditation Committee (COFRAC) to award quality labels to companies.

2.3.3 Format'eree

In 2004, a small group of educational organisations formed CLER, "Comité de liaison des énergies renouvelables" to establish quality standards for RE/EE training providers. The result of this was Format'eree. The purpose of Format'eree is to support RE/EE professional development by improving the quality of training in French territories and by monitoring training providers to ensure that they are delivering relevant and high quality training to the work force.

Format'eree is governed by six training organisations including CLER, SER and ADEME. Each year two organisations are replaced. Training organisations wishing to become approved are evaluated by other training organisations in a process of peer review.

2.4 Scheme quality standards

The main quality standards which the different certification schemes are accredited to are given here:

- The scheme operator should have a quality management system in place and should typically be accredited by an internationally recognised accreditation body to ISO 9001 'Quality management systems – requirements'.
- Bodies certifying individuals should typically be accredited by an internationally recognised accreditation body to EN ISO/IEC 17024:2012 'Certification of Persons'. Most successful 'certification of person' schemes have recently achieved this accreditation or aspire to do so in the near future.
- Bodies certifying companies should typically be accredited by an internationally recognised accreditation body to EN ISO/IEC 17065:2012 'Certification of products, processes and services'.

3 Appendix – Existing QA schemes: experiences and lessons learned (Qualicert)

This section looks at experiences and lessons learned from the Qualicert (Quality certification & accreditation for installers of small-scale renewable energy systems) project which ran from July 2009 to December 2011. The project was coordinated by the French public energy agency ADEME, and involved partners from Austria, France, Greece, Italy and Poland. It provides a list of key success criteria for the successful design and implementation of a certification scheme for installers of small-scale renewable energy systems. These criteria can be used to define a common countrywide approach to certification. Project conclusions are summarised at the end of this section.

Part of the Intelligent Energy for Europe programme, Qualicert was initiated in anticipation of the implementation of Article 14 of the Directive on the promotion of the use of energy from renewable sources (2009/28/EC)[iii], obliging EU Member States to develop and mutually recognise certification or equivalent qualification schemes[12] for installers of small-scale renewable energy systems by December 2012. Article 14 (Information and Training) and Annex IV (Certification or equivalent qualification criteria) of the Directive are shown in Appendix 9.3.

The Qualicert project researched installer certification and equivalent qualification schemes which covered heat pumps, shallow geothermal systems, biomass boilers and stoves, PV and solar thermal technologies.

Note that many of the schemes researched within the Qualicert project have developed further in the years since 2011 and now meet more of both Directive 2009/28/EC Annex IV criteria and Qualicert formulated 'key success criteria'. in fact, one of the recommendations made by the Qualicert project was that schemes should be set up as soon as possible and be upgraded step by step to satisfy all stakeholders over time.

Note further that the technology focus of many of the researched schemes was biomass boilers, heat pumps and shallow geothermal systems. None of these are within the scope of this current study, nevertheless the findings relating to the schemes themselves are very valuable and relevant.

3.1.1 Main objective: formulation of key success criteria for certification schemes

The main objective of the QualiCert project was to come up with a list of key success criteria for the successful design and implementation of a certification scheme for installers of small-scale renewable energy systems. These criteria could then be used to define a common EU-wide approach to certification and equivalent qualification. This would help EU Member States either make their existing schemes more compatible or set up schemes that would be more easily and quickly recognised at EU level.

The key success criteria were formulated by a multidisciplinary consortium (made up of national energy agencies, renewable energy industry federations, installer federations, national certifica-

[12] The Qualicert project, and the RES Directive which triggered its launch, refer throughout to 'certification or equivalent qualification schemes' since not all schemes provide certification but also other qualifications such as diplomas, titles or labels.

tion/accreditation management bodies) based on research carried out on existing schemes in Europe and worldwide.

The key success criteria were arranged into 5 categories: legal, institutional, technical, financial, communication. They covered four critical aspects of certification: obtaining initial certification, renewing certification, training, quality assurance audits. These key success criteria were reviewed by industry experts during a series of validation workshops in each of the partner countries. Political backing from partner countries and other EU Member States was to an extent received through the help of a high level steering group and national round table conferences.[iv]

According to the Intelligent Energy – Europe II Performance Report 2007-2012 published by the European Commission in April 2013, 'the [Qualicert] project has stimulated businesses and strengthened local entrepreneurship (notably in SMEs) by training and qualifying installers across the EU. It has helped to ensure higher quality installations and a more reliable and transparent market.'[v]

3.1.2 Summary of key success criteria

The key success criteria which are recommended to be included in any certification or equivalent qualification scheme according to the results of the Qualicert project are given in the Qualicert manual[vi] and are summarised in the Table 7 below.

The key success criteria should apply to *schemes for certification of companies* and *schemes for certification of individuals*. There are examples of both types of scheme which are operating with success and are meeting the required quality standards. (Examples of countries operating company certification schemes are Belgium, France, UK, Netherlands, Switzerland, USA; examples of countries operating individual certification schemes are Austria, Czech Republic, Ireland, Denmark, Germany, Portugal and USA). The main argument for certification of companies is that the company is liable for the quality of the installation. The certification is given to one nominated 'technical referee' from the company. The main argument for certification of individuals is that the installation is always carried out by the person who has been awarded the certification.

Obtaining initial certification	
Legal	• the scheme is defined by the state or by an accredited awarding body • the installer must sign a binding agreement with the awarding body • for certification schemes, the scheme is monitored by an independent and trusted third party • for company certification schemes, the company must provide the identity of the technical referee(s) and/or documentation about the company's staff and activities and/or civil liability insurance and/or documentation about the company's legal registration • the certification or equivalent qualification is mandatory as regards building regulations • for company certification schemes, the company must provide proof of compliance with tax obligations (optional)
Institutional	Parties involved in the set up, management and awarding of the scheme include representatives from: o installers o industry o technical experts

	o training institutions o public bodies o consumers (optional) o trade unions (optional)
Technical	• the installer must undergo a third party audit inspection of an installation • the installer must provide documentation of the equipment used • the company must provide proof of relevant professional training and/or relevant previous experience and/or relevant training. • the installer must provide documentation of a number of recent installations (optional)
Financial	• the quality scheme is supported by public funds • certification or equivalent qualification is linked to a subsidy scheme for consumers • the awarding body is economically independent • installers bear costs for obtaining the certification or equivalent qualification • industry provides financial support to the quality scheme
Communication	• the list of certified/qualified installers is publicly available • there is a public website about the quality scheme • the scheme is promoted to consumers via short advertising films, flyers, marketing campaign, etc. • the scheme continually informs certified/qualified installers (e.g. in the form of a regular newsletter about new regulations, technical updates, etc.) • installers have online reserved access (information about the scheme, communication tools, etc.) (optional) • installers have access to communication tools (car stickers, flyers, panels, etc.) (optional)
Renewing certification	
Legal	• the certification or equivalent qualification is awarded for a certain duration only (e.g. one year) or until a deadline • the installer must provide: o up-to-date documentation if required o the same documentation as for the initial certification
Institutional	Renewal is awarded by the same body as awarded the initial certification
Technical	• for certification schemes, the installer must undergo a third party audit inspection of an installation • the installer must provide documentation of completed installations • the installer must complete further professional training • the company technical referee must complete further professional training • the installer must provide evidence of a predefined minimum number of installations completed within the period of validity of the certification • the installer must pass an examination • the company technical referee must pass an examination
Financial	Installers and/or companies bear cost of renewing certification
Communication	Continued access to communication services
Training	

Legal	• training providers are approved by an awarding body or have received formal recognition from the state • training programmes are approved by an awarding body or have received formal recognition from the state • training providers sign a contract/convention with the awarding body
Institutional	Training is provided by: o training institutions (providing general training or specialised training in the relevant field) o guilds o federations (optional) o manufacturers (optional)
Technical	• training sessions contain practical exercises, theoretical lessons and exercises, a final examination • training standards are developed, reviewed and updated by a working group of experts • trainers must provide evidence of recent relevant experience • trainers must participate in a train-the-trainer session • trainers must continually incorporate feedback from installation audits into training schemes (to promote best practice and warn against difficulties and bad practice)
Financial	• installers bear training costs • training providers bear costs for training equipment • training providers pay fees to the awarding body (optional)
Communication	• short advertising documents to promote the role of training • promotion on website • communication with concerned stakeholders to promote training
Quality assurance audits	
Legal	• on-site audits of working installations are carried out • audit results may lead to suspension of installer/company certification or equivalent qualification • the auditing body signs a contract/convention with the certification awarding body • installer audits are based on a predefined number of installations to be audited over a certain period (e.g. one installation audit per year) or on a predefined frequency of installations (e.g. one audit every 100 installations) • the auditing body is selected following a tender process (optional) • installer audits are based on the size of the company (number of employees, turnover, etc.) (optional) • administrative audits of installations are carried out (optional)
Institutional	• the auditing body is certified or accredited • the auditing body is an independent third party
Technical	• audit standards are developed, reviewed and updated by a working group of experts • audits are carried out during the period of validity of the certification or equivalent qualification

	• audits are initiated following complaints about installations • audits are initiated based on a random selection from installation references
Financial	• installers bear audit costs • the certification awarding body bears audit costs
Communication	• promotion on website • audit results of an installation are communicated to involved stakeholders/partners • dissemination of short advertising documents to promote the role of audits • anonymous global results of audits are publicly available (e.g. number of non-compliant installations) • audit results of an installation are communicated to the installer's client (optional)

Table 7: Key success criteria as formulated by the Qualicert multidisciplinary consortium and which are strongly recommended to be part of any company or individual certification scheme. If all countries were to adopt these key success criteria in their schemes then these would form the common basis which would allow certification schemes from different countries to be recognised and valued equally.

3.1.3 Project conclusions

The Qualicert project made the following conclusions.

- **Context sensitivity is a key success factor**: any certification or equivalent qualification scheme needs to be embedded in the national training and quality framework of the country. Therefore, the development of one scheme that could be applied to all countries is inappropriate.
- **Facilitating stakeholder cooperation through private/public partnership**: installers, manufacturers and representatives from the training sector should be involved in the set up and management of the scheme. The acceptance of the scheme by all stakeholders is absolutely necessary for effective market implementation. The fact that all actors have something to gain from the scheme should lead to effective technical and possibly financial cooperation. Public authorities play a prominent role in bringing together relevant parties, providing initial financial and political support, linking with existing training structures, pushing to harmonise existing schemes, and ideally aiming to link the scheme with existing subsidies or building codes.
- **Working towards integration and possibly harmonisation of schemes**: it is recommended that if several national schemes exist, these are brought together into one centrally managed scheme. This scheme should be linked to any other qualification schemes for construction professionals. A common management structure for all technologies would reduce the administrative burden and cost to the installer. Communication about the scheme would be made easier and this would simplify consumer access to a network of qualified professionals.
- **Ensuring quality through audits**: it is widely agreed that audits (particularly on-site audits) are an essential part of a scheme. These can effectively increase the scheme's credibility and guarantee the quality of installations. Financial barriers due to the costs of audits can be overcome by adjusting the number of audits conducted (e.g. random selection).
- **Highlighting the crucial importance of communication tools**: the importance of communication, both towards customers and installers, should not be underestimated. The major role of a certification (or equivalent qualification) scheme is to provide reliable information to the market, and it should thus include sufficient means to do so, especially during the first years of the scheme.

- **Ensuring the mutual recognition of a scheme**: a certification (or equivalent qualification) scheme issued in one country should also be recognised in a different country. The QualiCert work shows that a large number of central features of a certification (or equivalent qualification) scheme obtain general consensus. These can be used by each country to develop or adapt national schemes with a common objective and approach. Moreover, a "European Transparency Platform" such as the one existing on the National Renewable Energy Action Plans, should be built for certification (or equivalent qualification) schemes for small-scale renewable energy installations which would encourage an exchange of information, and thus, facilitate the implementation of common features.

  The European Commission launched the Build Up Skills initiative in 2011 to improve qualifications of construction workers (see Appendix 8.3).

4 Appendix – CPD training programmes complementing installer certification schemes

In countries with installer certification schemes, Continued Professional Development (CPD) training programmes should complement the schemes: the competences required for training and certification should be consistent, and they should interact to ensure high quality standards for both. Gaps in installer skill and knowledge identified during installation audits should be addressed by training programmes.

CPD training for RE/EE systems may be offered by a range of training providers depending on the training infrastructure in the country. Training providers may, for example, be public or private TVET colleges, private training companies, federations, guilds or chambers of industry and commerce. Therefore there will often be an overlap and a lack of coherence between the different training structures.

This section outlines the kinds of CPD installer training programmes for small-scale renewables typically offered, and provides two examples of how such programmes are developed within the context of different training infrastructures – one where the RE training programmes are integrated into the existing vocational training structure, the other where the RE training programmes are set up by organisations established for that purpose. This section concludes by presenting an example of how a base of trainers equipped to deliver high quality training can be built up.

4.1 Typical CPD training courses for small-scale renewable energy technologies

The training courses that are described here are all short CPD courses varying in length from 3 to 5 days. Some courses are offered in online format where a 5 day (40 contact hour) attendance course becomes a 6 week online course.

Almost every well-recognised, well-reputed accredited training programme demands a high entry level standard from its applicants.

4.1.1 CPD training course example: QualiPV

QualiPV is one of the French Qualit'EnR[vii] quality labels. The QualiPV training programme cover grid-connected PV systems with roof integrated modules. It has a duration of 3 days with half a day of practical hands-on training.

Cost:	approximately €1000
Entry level requirements:	qualified electricians with basic roofing skills and working at height training
Duration:	3 days
Course content:	PV market, components, building integration, health & safety, installation and sales and administrative procedures.
Assessment:	multiple choice test requiring 83% pass mark

For further information, refer for example to Autan Solaire Énergies Positives[viii].

4.1.2 CPD training course example: Residential and Commercial PV Systems Certificate

This is an IREC accredited training programme offered by Solar Energy International. The programme is made up of 7 modules, 5 of which must be successfully completed in order to obtain the certificate.

Cost:	full programme costs $4175 (approximately €3500)
Entry level requirements:	No entry level requirements specified. It is however a selective admissions

	programme requiring each candidate to submit an application
Duration:	see Table 8 below
Course content:	Topics covered include installation applications, commercial photovoltaic design and grid-connected residential. Participants receive comprehensive theoretical material with a strong emphasis on the National Electricity Code and job-site safety considerations. The programme is nationally recognised and satisfies the requirements for the NABCEP Entry Level Exam and the NABCEP PV Certification Exam
Assessment:	final online exam requiring 70% pass mark; 100% attendance for hands-on practical training element

Training progression towards receiving the certificate is:

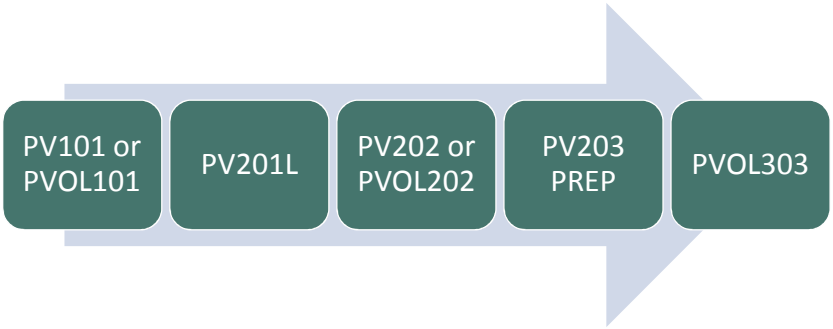

Table 8 summarises the full training programme content.

Course title	Course description	Course duration
PV101 – Solar Electric Design and Installation (Grid-Direct)	Fundamentals of grid code compliant design and installation of residential grid-connected PV systems	PV101 PREP + 5 Day Workshop: 50 contact training hours
PVOL101 - Solar Electric Design and Installation (Grid-Direct) – Online	Online course – content as for PV101	6 weeks online access
PV201L – Solar Electric Lab Week (Grid-Direct)	Hands-on practical experience with grid-connected PV systems	1 week in-person workshop: 40 contact training hours
PV202 – Advanced PV System Design and the NEC (Grid-Direct)	Application of National Electric Code (NEC) standards and industry best practices to residential and commercial grid-connected PV systems	1 week in-person workshop: 40 contact training hours
PVOL202 - Advanced PV System Design and the NEC (Grid-Direct) – Online	Online course – content as for PV202	6 weeks online access
PV203 PREP – Battery-based PV System Fundamentals – On Demand	Fundamentals of battery-based PV systems	18 contact training hours or 6 weeks online access

PVOL303 – Advanced Battery-based PV System design: Series I – Online	3 course series in advanced design and installation of battery-based and grid-connected PV systems	6 weeks online access

Table 8: Course content of Solar Energy International Residential and Commercial PV Systems Certificate training programme

For further information, refer to Solar Energy International[ix].

4.1.3 CPD training course example: Installing and testing domestic PV systems

This is a City & Guilds accredited course, one of the UK's leading Awarding Organisations.

Cost:	£1195 (approximately €1500)
Entry level requirements:	QCF (Qualifications and Credit Framework) Level 3 electrician. This is equivalent to the EQF[13] (European Qualifications Framework) Level 3 and corresponds to a full time theory and practical course of at least 16 weeks duration. Levels 1 & 2 must be completed prior to Level 3. To become a fully qualified electrician with NVQ (National Vocational Qualification) requires gaining and documenting on-site installation experience.
Duration:	5 days (30 Guided Learning Hours)
Course content:	Topics covered include systems and components, standards and regulations, health & safety, approvals, installations, commissioning and testing, customer care. Practical hands-on training includes installation, labeling, grid-connection, commissioning and testing, fault diagnosis, operational inverter testing
Assessment:	participants must pass a written and a practical examination

For further information, refer to 'Certificate in Installing and Testing Domestic Photovoltaic Systems (2372)' Qualification Handbook[x] and, e.g. Trade Skills 4 U[xi].

4.2 Integrating renewable energy CPD training programmes into existing vocational training structures

The following is a description of how renewable energy CPD training programmes are developed and integrated into the existing vocational training structure. The example illustrated in Figure 12 is for the UK but the four basic steps – developing standards, developing qualifications, developing courses, assuring quality – are also applied in other countries.

[13] The European Qualifications Framework (EQF) attempts to standardise qualifications across Europe so that a qualification achieved in one European country will be understood and recognized in another. Refer to Section 8.5 for more information.

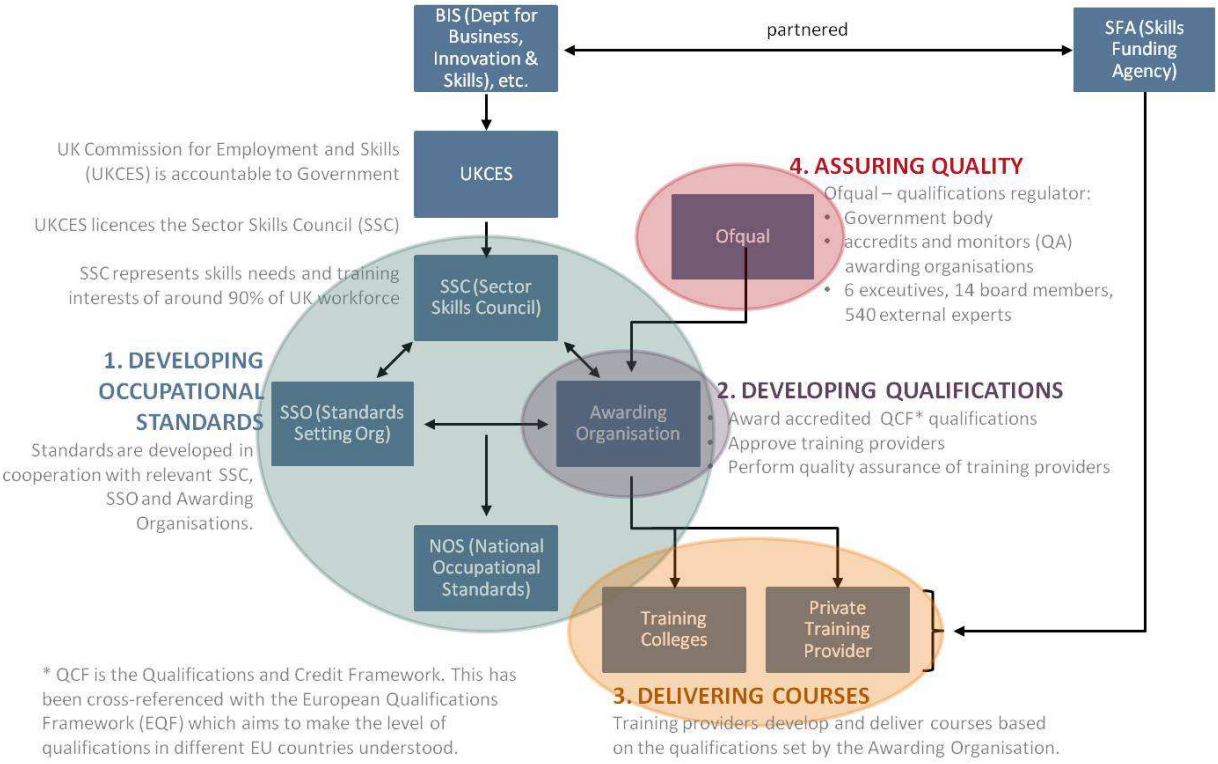

Figure 12: structure for developing renewable energy CPD training programmes in the UK

The four steps to developing and implementing renewable energy CPD training programmes are:

1. Developing occupational standards:

   In the case of the UK, National Occupational Standards (NOS) are developed with the collaboration of the relevant Sector Skills Councils (SSC)[14], Standard Setting Organisations (SSO) and Qualifications Awarding Organisations.

2. Developing qualifications:

   Qualifications Awarding Organisations develop qualifications (including course assessment criteria, course equipment requirements, course syllabus) based on the National Occupational Standards (NOS). They approve assessment centres and send out external verifiers to ensure that all candidates are assessed fairly and consistently.

3. Developing courses:

   Training providers can compare their current courses against the relevant National Occupational Standards (NOS) to identify gaps in provision and update material accordingly. They can also develop entirely new courses, basing the syllabus on the units of competence that make up the NOS. Any new courses that a training provider proposes must approved by the relevant Awarding

[14] Sector Skills Councils and Bodies are independent, employer led UK wide organisations. They aim to develop high quality skills standards with employers which support productivity and profitability growth and enhance competitiveness in UK and overseas markets. There are 18 Sector Skills Councils and 5 Sector Skills Bodies who work with over 550,000 employers to define skills needs and skills standards in their industry. For more information, refer to the Federation for Industry Sector Skills & Standards, www.fisss.org

Organisation. The quality of the courses as delivered by the training provider is monitored and assessed by the Awarding Organisation.

4. Assuring quality:

   Ofqual (Office of Qualifications and Examinations Regulation) carry out Quality Assurance of the Awarding Organisations. The Awarding Organisations in turn carry out quality assurance of their approved training providers. Only Ofqual registered qualifications are eligible for public funding.

In the case of the UK, the qualifications development structure is accountable to, and licenced by, the government. The Skills Funding Agency provides funding to colleges, training organizations and employers to help people with low skill levels achieve the skills they need.

4.3 Developing a new structure for renewable energy CPD training programmes

The example presented in this sub-section is of IREC (Interstate Renewable Energy Council), the RE/EE training credentialing body established in 1982 as a non-profit organisation. Figure 13 shows the link between NABCEP, the installer certification body, and IREC. We see from this figure that NABCEP applicants must complete relevant technical training (as developed by IREC) and health & safety training as well as submit documentation of experience in order to be eligible to sit the NABCEP certification examination.

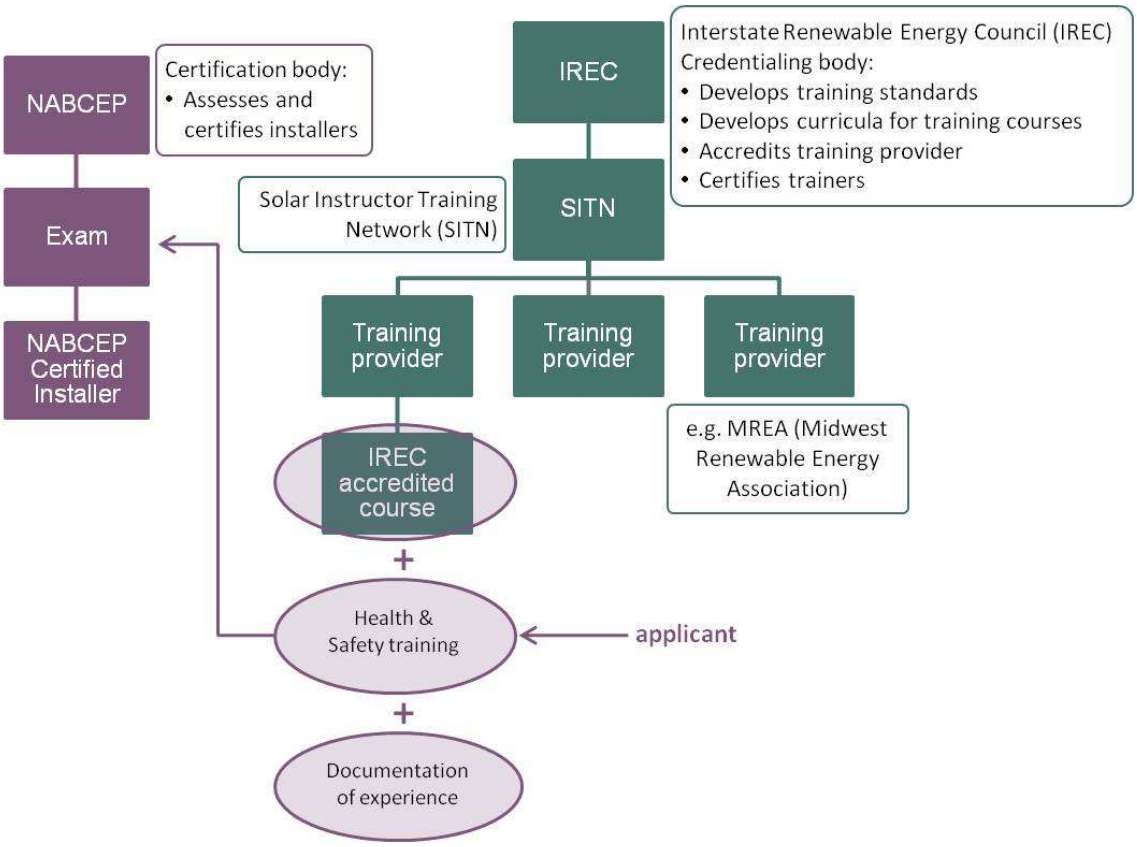

Figure 13: Link between installer certification body (NABCEP) and training credentialing body (IREC) in the US

IREC, in collaboration with a diverse group of industry experts, has developed a set of standards for clean energy technologies which have been awarded ANSI accreditation[xii]:

i. IREC Standard 14732 provides general requirements for Renewable Energy & Energy Efficiency Certificate programmes;

ii. IREC Standard 01023 provides general requirements for the accreditation of Clean Energy Technology training;
iii. IREC Standard 01204 provides general requirements for the certification of Clean Energy Technology Instructors and Master Trainers.

IREC develops training curricula in accordance with its ANSI-accredited IREC standards. IREC itself can accredit training providers, and can certify trainers and training programmes according to the IREC standards listed above. It assesses instructional quality through credentialing programmes. To date there are 143 IREC credential holders (either trainers or training providers) across the USA. Of these, 11 offer online training programmes.

In 2009 the US Department of Energy established the Solar Instructor Training Network (SITN). SITN will be described in more detail in Appendix 4.4. IREC became the National Administrator of the Solar Instructor Training Network in 2010 and as such serves as the national point of contact for the network, conducting outreach to disseminate its products and best practices.[xiii]

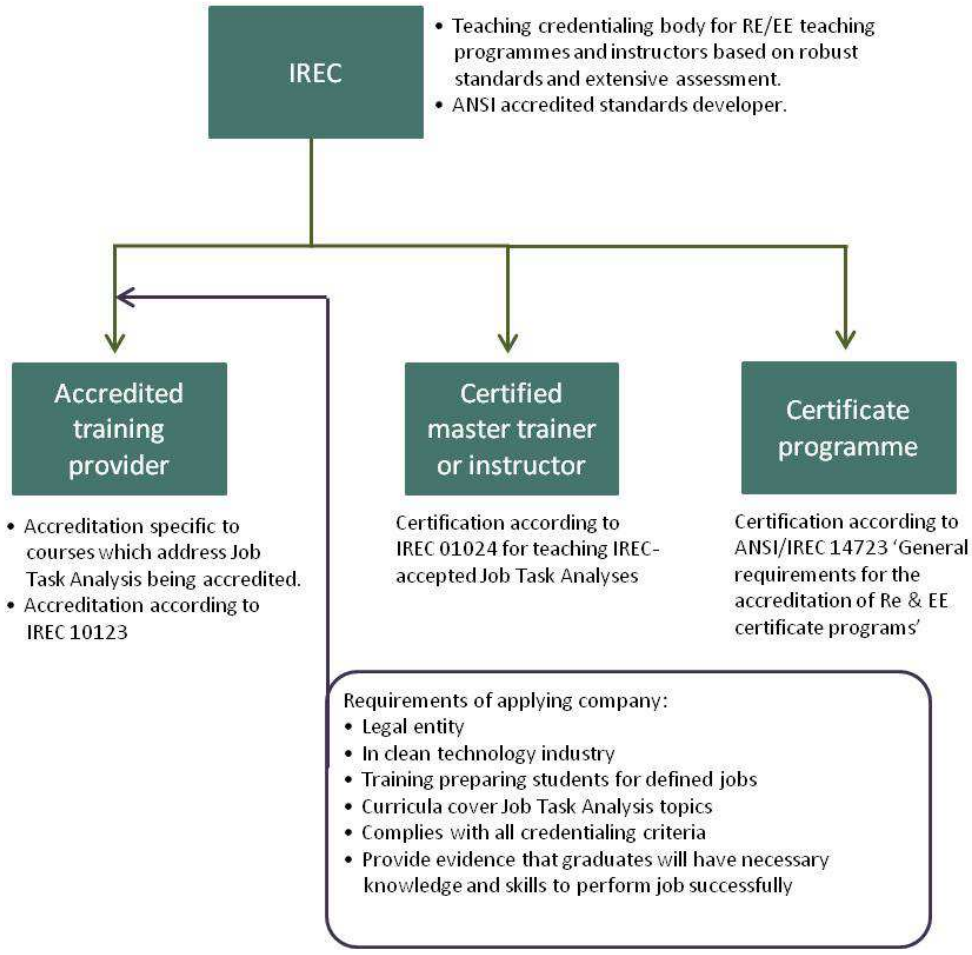

Figure 14: Structure of the IREC programme. IREC develops standards and provides credentialing for RE & EE training.

The IREC structure is illustrated in more detail in Figure 14. IREC standards and Job Task Analyses are freely available for download from the IREC website, www.irecusa.org. Also IREC has published a seven-series Solar Energy Education and Training Best Practices[xiv]. The series is comprised of the following seven topics:

1. Becoming an effective teacher
2. Curriculum & program development
3. Developing a quality course
4. Solar content integration
5. Exemplary solar education & training programs
6. Textbooks, references & other instructional resources
7. Photovoltaic labs

4.4 Solar Instructor Training Network, SITN: provider of instructor training

The Solar Instructor Training Network[xv] was launched by the US Department of Energy, Office of Energy Efficiency & Renewable Energy, in October 2009 to address a critical need for high-quality, local, and accessible training in solar system design, installation, sales, and inspection. Nine regional resource and training providers[xvi] support the professional development of trainers and instructors of PV and solar heating and cooling technologies across the country by providing train-the-trainer workshops, training equipment and tools for instructors. They develop curricula with the support of IREC, identify career pathways, share labour market data and resolve issues relating to solar training and workforce development

The SITN offers instructor training programmes in an effort to help integrate solar technology into TVET college curricula. Instructors with relevant technical teaching experience are competitively selected to participate in the programme. The selected instructors are required to commit to a two year training programme made up of a combination of several 4-8 week online training modules and at least six weekend attendance sessions. Finally they are assessed whilst delivering training at their own training colleges.

For more information, refer for example to 'Kennebec Valley Community College Northeast Provider of Solar Instructor Training Program Curriculum'[xvii].

5 Appendix – RE/EE CPD training programmes independent of installer certification schemes

This section gives examples of CPD training programmes that have been developed (or are in the process of being developed) to fulfil a training need independently of any installer certification scheme.

Some of these training programmes are also accredited to EN ISO/IEC 17024:2012 'Certification of Persons' and as such are approved to award certificates to participants who have successfully completed the training programme. There is a significant and important difference between this kind of certificate and a simple certificate of attendance which carries no quality guarantee.

5.1 Solarteur in Germany, Austria, Switzerland, South Africa

Note on Germany: Germany does not have a certification scheme for small-scale renewable energy systems in the same way as in many other countries. The assumption here is that installers receive the required training through the traditional vocational training routes – in particular that of the very highly regarded dual vocational education system – and therefore an extra installer certification scheme is superfluous and even not desired from the traditional trades

The foundations for the Solarteur standardised training and certification programme[15] were set with the help of European funding (via the Leonardo da Vinci programme) between 1996 and 1998. The aim was to create an internationally recognised qualification.

The Solarteur installer qualification covers PV and solar thermal (and in some cases also biomass boilers and heat pumps). In 2012 Solarteur received accreditation to EN ISO/IEC 17024. Only individuals with 3-4 years prior qualification in their field (e.g. qualified electricians or plumbers) are eligible to receive the Solarteur certificate after successful completion of the training programme.

Around 3000 installers in Germany have received the Solarteur certificate. During the PV boom years in Germany (2008-2012) there were an estimated 36,000[16] full-time PV installers which equates to less than 10% having the Solarteur certificate. The Solarteur programme was not such a great success in Germany because of significant resistance from the traditional trade associations who feared that the quality of their trades (for example, electricians and plumbers) who hold a very high standing in German society would suffer through the influx of 'under-qualified' Solarteurs.

Currently there is a small number of training providers offering the Solarteur training programme in Germany, Austria (3) and Switzerland (4). A Solarteur training course is currently being offered at the ELIDZ Master Artisan Academy in East London, South Africa, in cooperation with the Bundestechnologiezentrum for Electricity, Information and Energy (BFE) in Oldenburg, Germany.

Cost:	€2500-€5000 depending on where the course is being taken
Entry level requirements:	In Germany, applicants must have completed their journeyman qualifica-

[15] Note here that it is the training programme itself which awards certificates, and not a installer certification scheme. The Solarteur programme received accreditation to EN ISO/IEC 17024 'Certification of persons' in 2012.

[16] Estimate from the Bundesverband für Solarwirtschaft (BSW), the German Solar Industry Association

	tion (3-5 years) in a relevant field such as plumbing, electrician, HVAC, roofing, or completed 3-4 years of vocational training in a relevant field. Other applicants must provide proof of fulfilling the requirements.
Duration:	200-250 Guided Learning Hours (1 GLH is 45 minutes) depending on where the course is being taken. The programme is offered as full-time, part-time attendance, and/or online.
Course content:	Curriculum includes photovoltaics, solar thermal, heat pumps health & safety, roof and walls, heating systems, electrical systems, energy-environment-markets
Assessment:	Participants must pass a written and a practical examination after each block
Qualification received:	Solarteur certificate, or in some cases the Solarteur module can contribute towards a full vocational qualification such as the Solar PV Project Manager at the Energieakademie Toggenburg in Switzerland

5.2 Renewables Training Network (RTN) in the UK

The RTN was set up by RenewableUK (the wind, wave and tidal energy trade association) in the UK in 2011 to tackle the shortage of skilled workers in the renewable energy sector. The RTN aims to create 2000 places on renewable energy training courses by working with employers, universities and colleges. For example, RWE npower are supporting 5 of its apprentices to complete the two year intensive wind training course at Coleg Llandrillo's specialist renewable energy centre in Wales.

50% of start-up funding for RTN was provided by industry and 50% by government (Department for Business, Innovation and Skills).

Industry leaders (such as Vestas, Siemens, Garrad Hassan, Maersk) offer short training courses in specialist areas such as maintenance plans for company-own wind turbines, onshore and offshore wind health & safety.

The RTN has developed a quality standard[xviii] for all training provided by, or on behalf of, the RTN. This sets out a framework against which training providers can develop and implement compliant quality systems, and provides a benchmark against which training can be evaluated and best practices implemented.[xix]

5.3 Solar Energy Training Network (SETNET), India

The National Institute of Solar Energy (NISE), an autonomous centre of excellence of the Government Ministry of New and Renewable Energy (MNRE)[xx] has identified training for solar energy professionals as its key focus area. Towards this end, it has in 2014 designed the Solar Energy Training Network (SETNET)[xxi] in collaboration with the Indo-U.S. bilateral Partnership to Accelerate Clean Energy Deployment Technical Assistance (PACE-D TA) Program. SETNET will provide MNRE with a structured platform for technical and business training in the solar field.

Specifically, the objective of SETNET is to ensure the availability of a skilled workforce to meet the solar deployment target for 2019. SETNET guiding framework includes

- Prioritisation of training needs to keep up with new industry developments
- Standardised curricula and content delivered by accredited trainers

- Training delivery through a range of partner organisations

SETNET will deliver a range of technical and business training courses at its learning and knowledge hubs which it will set up at the Aryabhatta and Suryan partner campuses.

- Aryabhatta Certificate for planning, designing and installing small- and large-scale PV systems. This programme will be open to engineers with some experience in the solar sector. The curriculum will focus on both technical and business (policy, regulation & finance) aspects. Training will be delivered through a combination of online and classroom learning, study tour and laboratory experience. Fee paying participants must pass an online test to receive the certificate. 1000 Aryabhatta certificates are expected to be awarded each year for the next 5 years.
- Suryan IOM Professional for installing, operating and maintaining small-scale PV and solar thermal systems. Training courses will be offered for household applications (lanterns, home-lighting systems and cookers); rooftop, street -light & charging stations; micro-grids; ground-mounted; solar water heater, inverters and batteries, performance assessment of panels, etc.
- Bhaskar Certificate, business programs, will largely consist of specialised 1-3 day courses on different business aspects such as Policy & Regulation, Business Models, Finance, Appraising Solar Projects, Supply Chain Management, Solar Entrepreneurship Development, Microfinance. Training will be classroom-based.
- Konark Graduate Engineer course will be a specialised course designed to train graduate engineers seeking employment in the solar sector. The curriculum will focus on both technical (design and implementation) and management (O&M, contracting, site challenges and solutions) aspects. These will be short, classroom-based courses.

Technical support from NISE

- The National Institute of Solar Energy (NISE) will prepare standardised curricula and course content that will be passed on to the SETNET partners to deliver the training.
- NISE will also support the partners by conducting train-the-trainer workshops for the various partner organisations.
- NISE will perform regular quality monitoring of training delivered by the partner organisations.

5.4 Danish Wind Power Academy in Denmark

The Danish Wind Power Academy (DWPA)[xxii] is recognised as the premier, independent industry-training organisation within the wind turbine industry. Typical clients are owners and operators, third party service providers, sub-suppliers, turbine manufacturers.

DWPA provides 2-5 day training on all the top manufacturers' turbines, turbine operation & maintenance, plant commissioning, trouble-shooting, main components.

Neither the academy nor the courses have any national or international accreditation but are well-recognised and well-regarded within the industry.

5.5 Center for Research and Development in Renewable Energies (CIDER) in Costa Rica

CIDER was established at the Earth University in Costa Rica in 2011 within the scope of the REN@EARTH project carried out in conjunction with the Renewables Academy AG (RENAC) and supported by the International Climate Initiative (IKI). CIDER is a training centre located on the Earth University campus with

facilities to conduct high quality capacity building training and workshops in the renewable energy technologies biogas, PV, solar thermal and hydro. A strong focus is laid on practical, hands-on training in design, installation, operation and maintenance of renewable energy systems.

CIDER, a training hub for the whole of Central America, conducts training for students, trainers, government decision makers, community leaders and the renewable energy private sector from Costa Rica, Guatemala, Hondura, El Salvador, Nicaragua and Panama. Local trainers themselves took part in REN@EARTH train-the-train seminars as well as teaching during twinning seminars (local trainers and trainers from Germany delivering training together) before now delivering training themselves. In this way a trainer network is gradually being built up for the whole region.

CIDER, the Earth University and RENAC are currently developing a Masters-equivalent qualification in renewable energy, Especializacíon, due to begin in Autumn 2015. This will be an online course taking place over 3 Cuatrimestres, each 15 weeks long, with two week-long attendance seminars covering practical hands-on training.

5.6 Centre for Energy Development at the University of Antofagasta, Chile

The Centre for Energy Development Antofagasta (CDEA), part of the University of Antofagasta, with support from the Chilean Government, local mining companies, as well as solar equipment manufacturers, plans to establish a platform for solar energy ("Plataforma solar del Desierto de Atacama PSDA ") in Antofagasta.The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), as part of the project objectives of the Energy Programme 4e Chile, plans to assist with the development of a training centre within the framework of the solar platform in Antofagasta. A capacity needs assessment of relevant occupational groups in Chile (institutions, private sector, etc.) has been carried out to assess the interests and capacities of relevant stakeholders that would be involved in the establishment of such a solar centre. Based on the needs assessment, project partners Renewables Academy AG and Eviva will design a detailed concept for an international training centre for vocational training and continued professional development of technicians, engineers and decision-makers in order to meet the demand for local solar technology experts.

5.7 MAXX-Solar Academy

The maxx-solar Academy is a non-profit training centre for solar energy established in 2011 by the German Solar Energy Society, DGS, and the maxx solar energy PTY Ltd., South Africa. It has four locations operated by local partners. However, all maxx-solar academy courses are centrally managed and quality assured by the maxx-solar academy team.

The maxx-solar academy runs a series of PV off-grid and grid-connect courses ranging in length from 1 to 5 days. There are no entry level requirements. On successful completion of the course, participants receive DGS certificate of participation. The maxx-solar academy is currently in discussions with the Energy Sector Education and Training Authority (ESETA) regarding course accreditation.

5.8 RENAC-OASIS Solar Academy Egypt (ROSAE)

ROSAE was established as a Public-Private-Partnership (PPP) in 2014, with the German Society for International Cooperation (Deutsche Gesellschaft für internationale Zusammenarbeit - GIZ) representing the public sector and the Renewables Academy AG (RENAC) and OASIS representing the private sector. The main objective of this PPP is to build up sustainable and high quality training structures in small- and large-scale solar thermal and photovoltaics in Egypt.

OASIS Renewable Energy (ORE) is the training and capacity building arm of SEDA. Based in Cairo, ORE was founded in 2010, comprising the expertise of energy professionals and engineering professors operating in the renewable energy field. ORE provides education and training in the field of renewable energy, covering topics for decision makers, consultants, engineers, installers, technicians, undergraduates and schools.

The Egyptian solar market needs technical experts such as installers, technicians and engineers who can design, install, operate and maintain photovoltaic or solar thermal systems, as well as other professionals with the skills to release this potential.

ROSAE has been established to provide high quality and practical-oriented trainings for target groups along the solar value chain, as well as for potential investors. ROSAE offers courses for engineers, installers, investors and other professionals with an interest in solar electricity (off-grid and grid-connected) and large-scale solar thermal systems. Besides lectures and workshops, practical exercises constitute a key element of the courses. All courses are SEDA-approved, guaranteeing the quality of the courses and the adaptation of the contents to the local conditions and needs.

5.8.1 Train-the-Trainer seminars

One of the barriers against a sound market development of solar energy is the lack of trainers that can conduct practical-oriented training programmes. To overcome this deficit and to provide courses in Arabic, ROSAE has implemented train-the-trainer seminars followed by twinning seminars (Egyptian trainers and RENAC trainers deliver courses together) on photovoltaics and solar thermal. Future ROSAE courses will be delivered by the Egyptian trainers who have successfully completed the train-the-trainer and twinning seminars.

6 Appendix – Longer RE/EE TVET programmes contributing to full professional qualifications

This section looks at longer RE/EE TVET programmes (ranging in duration from three months to two years) which contribute to full professional qualifications. Several of the examples presented in this section are for programmes based in Germany or stemming from German experience.

This is because Germany is a world leader in vocational education, and has a long standing and excellent reputation especially with its dual vocational education model[17]. This along with Germany's extensive experience in the field of renewable energy and energy efficiency creates an appealing renewable energy TVET model for partner countries to adopt.

Coupled with this, it is one of the ten objectives of the education strategy of the German Federal Ministry for Economic Cooperation and Development (BMZ) to substantially expand TVET, especially in the renewables sector. Two approaches are being employed: one to integrate green skills into existing vocational training courses and continuing professional development within Germany, the other to support BMZ partner countries to develop skill profiles for independent environmental professions.[xxiii]

For more information on the TVET system in Germany and in other countries, refer to the UNESCO-UNEVOC World TVET Database.[xxiv]

6.1 Bremerhaven Wind Centre BFW (TVET College)

The Bremerhaven Wind Centre[xxv] has been offering vocational training in wind power since 2004. It contributes wind power modules to the 3.5 year 'Electrical Service Engineers' vocational qualification run by the Bremerhaven Vocational Education (Berufliche Bildung) College. [xxvi]

The three main wind power modules which the Bremerhaven Wind Centre offers are:

- Service technician for wind energy systems (onshore and offshore) –

  Duration: 8.5 months including 1.5 month internship

  Entry level requirement: vocational qualification in metal or electrical work

  Qualification: BFW certificate of attendance; BZEE certificate of completion; upon passing an exam, certificate from the relevant Chamber of Industry and Commerce

- Wind energy system (onshore and offshore) installer –

  Duration: 3.5 months

  Entry level requirement: vocational qualification in metal or electrical work, or equivalent experience, or job offer in a relevant field

  Qualification: BFW certificate of attendance; certificate for skilled electrician for specified activities

- Wind energy system assembly technician –

  Duration: 4.5 months including 3 week internship

[17] Germany's dual vocational education model combines on-the-job training via apprenticeships with college-based learning.

Entry level requirement: technician in metal or electrical work, or at least 3 years experience in a relevant field, or completion of 4 week suitability assessment

Qualification: BFW certificate of attendance; BZEE certificate of completion

6.2 BZEE Training Centre for Renewable Energy (Bildungszentrum für Erneuerbare Energien)

BZEE[xxvii] was established in 2000 by the German Wind Energy Association, wind energy companies and the Chamber for Industry and Commerce as an industry initiative to close the skills gap facing the German wind industry. Today BZEE's portfolio comprises a comprehensive competency-driven training programme for key assignments in the international wind energy sector. The BZEE Global Training Partnership delivers wind energy skills at 29 locations worldwide, including at the Bremerhaven Wind Centre, and has produced over 2600 highly qualified wind energy technicians.

The BZEE Academy delivers the BZEE training programme as well as the train-the-trainer programme from its training facility in Hamburg and Husum. It offers 80 training modules and courses ranging in length from a few days up to several months. In addition, it develops curricula and teaching material, provides teacher training, carries out audits of courses and examinations, and provides certification recognised by the Chamber of Industry and Commerce. This counts as a quality guarantee.

6.2.1 BZEE internationally

BZEE in cooperation with BFW Bremerhaven recently delivered a 3 month 'wind turbine technician' training programme to 11 South African technicians in South Africa. The project was funded by the GIZ and SAGEN (South African German Energy Programme).[xxviii]

6.3 China Wind Power Center

The China Wind Power Center project, commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ), was originally developed between 2005 and 2010 in partnership with GIZ, China Guodian Corporation (CGDC) and State Grid Corporation of China (SGCC). The project was extended from 2010-2014 where it received further support from the Ministry of Education of the People's Republic of China.

The impulse for the project came from the need for qualified staff for wind farms, wind farm developers, turbine manufacturers and transmission system operators (TSOs), and the fact that wind energy training was lagging behind anticipated growth in the sector.

The implementing organisations are China Long Yuan Electric Power Group (CLYPG) and China Electric Power Research Institute (CEPRI). CEPRI provides training and consulting services on wind resource assessment, wind turbine prototype IEC-testing, wind-grid engineering solutions and regional grid wind power penetration. CEPRI is the only institute in China which has been successful in obtaining accreditation to the IEC 61400 set of standards for wind turbine testing and has become a member of MEASNET, the international network for harmonised and recognised measurements in wind energy.[xxix]

Training is supplied for technicians, engineers, planners and developers in the Suzhou Longyuan Bailu Wind Power Training Centre (operating since 2007) where regular training courses on wind resource assessment and wind power integration take place.

Standardised curricula for vocational training and continued professional development for wind farm O&M personnel have been developed in association with BZEE Husum, BFW Bremerhaven, and the Eckener School[xxx] in Flensburg. These have been based on the vocational training material that was devel-

oped within the scope of the IMWatT[xxxi] and Windskills[xxxii] projects. The package included technical, practical and didactical training (both in Germany and in China from German experts) of 100s of TVET teachers and principals as well as 1400 TVET staff from vocational training colleges from all over China.

The curricula in the form of wind operation and maintenance teaching modules are being integrated into existing 4 year technical vocational qualifications. A pilot class has been taking this course since October 2013. No evaluation data for the class is available to date. The curricula and qualification have been approved by the Chinese qualification accreditation body.

The Wind Power Training Centre has also become a certified examination location.

The SARETEC wind power centre in Cape Town, South Africa (see Appendix 6.4), has been developed in close cooperation with partners and experts involved in setting up the China Wind Power Centre.

6.4 South African Renewable Energy Technology Centre (SARETEC)

The South African Renewable Energy Technology Centre is a national centre for renewable energy training and education located in Cape Town. The project has received funding from the Department of Higher Education and Training (DHET) and substantial support from the German Ministry for Economic Cooperation and Development through the South African-German Energy programme (SAGEN), implemented by GIZ, the South African National Energy Development Institute (SANEDI) and GreenCape. The project has received support from, and enjoys collaboration with, many education and training institutions both locally and internationally, including the BFW Bremerhaven Wind Centre in Germany and the China Wind Power Centre (see Appendices 6.1 & 6.3).

SARETEC is instrumental in the creation of renewable energy curricula (building on curricula developed in previous initiatives) tailored to industry needs. SARETEC currently has two long-term formal qualifications under evaluation by the Quality Council for Trade and Occupations (QCTO): Wind Turbine Service Technician, and Solar PV Service Technician. Both these courses require an entry level of NQF Level 4[18] in a relevant technical subject (e.g. electro-mechanics, mechanical or electrical engineering, mechatronics).

6.5 Greening TVET Colleges initiative in South Africa

The Greening Colleges initiative was launched in 2013 in cooperation with the GIZ and as part of the German Federal Ministry for Economic Cooperation and Development's (BMZ) wider education strategy to use TVET to green the economy[xxxiii]. It currently involves 7 colleges around South Africa in the pilot phase. It encompasses the greening of the college campus (reducing the overall carbon footprint), introducing green curricula (for example by developing new qualifications for PV and solar thermal), carrying out green research, reaching out to the local community and raising awareness about green issues, and introducing a green culture of green and ethical values and attitudes.

As well as educating their students, the colleges also offer (or plan to offer) vocational training evening classes to interested individuals. In this way, more people can make use of the college facilities and gain skills, and the colleges have an additional income stream from course fees.

To date a series of train-the-trainer courses have been carried out where German experts have delivered PV and solar thermal theoretical, practical and didactical training to electrician and plumbing teachers

[18] The European Qualifications Framework (EQF) attempts to standardise qualifications across Europe so that a qualification achieved in one European country will be understood and recognized in another. Refer to Section 8.5 for more information.

from the pilot colleges to prepare them for the introduction of PV and solar thermal modules to the national curriculum as of 2015. In line with this, curricula have been developed and approved by the South African Qualifications Authority (SAQA).

Figure 15: Participant presentations and assembling a simple solar hot water system. Source: M. Schnauss

6.6 'Sustainable designer & installer of grid-connected PV systems' TAFE NSW, Australia

This sample course, 'Designer/Installer of Grid Connected PV Systems' is one of many offered by the-Technical And Further Education (TAFE) colleges in Australia[xxxiv].

The successful completion of this course results in a nationally recognised AQF[19] (Australian Qualifications Framework) Certificate III which is approximately equivalent to the EQF Level 3.

For a full list of the 73 renewable energy course currently available (as in 2014) in Australia, please refer to the 'RENEW 2014 RENEWABLE ENERGY COURSES GUIDE'. Course duration ranges from a few hours (Continued Professional Development) up to 4 years (for a full academic degree).

Cost:	AUS$2195 (approximately €1500)
Entry level requirements:	Electrical licence or holds the Competency Standard Unit: UEENEEG105A Verify compliance and functionality of low voltage general electrical installations
Duration:	126 nominal hours over 3-6 months
Course content:	Curriculum includes installing, setting up and commissioning interval metering, solving basic problems in PV apparatus and systems, designing grid-connected PV systems, installing, configuring and commissioning LV grid-connected PV systems.
Assessment:	Participants must pass a written and a practical examination
Qualification received:	AQF Certificate III

[19] The Australian Qualifications Framework (AQF) has 10 levels as opposed to the 8 Levels of the EQF. For further information refer to documents, 'Strengths, benefits and challenges of alignment[19] between the Australian Qualifications Framework and the European Qualifications Framework', and 'Alignment of the AQF with the New Zealand Qualifications Framework and the European Qualifications Framework: consultation paper'

7 Appendix – Schemes and training programmes in energy efficiency

There are a very large number of schemes and training programmes available in the field of energy efficiency (both in buildings and in industry) around the world. This section presents a small selection of these.

7.1 Green Deal, UK

The Green Deal is a UK government initiative managed by the Department of Energy and Climate Change (DECC). Its purpose is to help domestic and commercial property owners save energy and money in their properties with no upfront costs. It is a financial framework that enables the provision of fixed improvements to the energy efficiency of households and non-domestic properties. Funds come from levying a charge onto energy bills.

7.1.1 Green Deal Installer

Only an authorised Green Deal Installer can install energy efficiency improvements under the Green Deal finance mechanism. Additionally, only authorised installers will be able to identify themselves as 'Green Deal Installers' and use the Green Deal Quality Mark.

The requirements to becoming a Green Deal Installer are similar to those for becoming a small-scale renewable energy installer under the MCS scheme:

- The installation company must be certified by a Certification Body to meet the Publicly Available Specification (PAS) 2030[xxxv] to install the specified energy efficiency measures;
- The installation company must comply with the requirements as detailed in the Green Deal Code of Practice[xxxvi];
- The installation company must keep clear records of work done and allow monitoring of installation work when requested.

7.1.2 Green Deal Provider

Green Deal Providers arrange Green Deal Plans, provide finance, and arrange for the installation of the agreed energy efficiency improvements through an authorised Installer. They must establish a long term relationship with the customer which can last up to 25 years. They have ongoing obligations in relation to Green Deal Plans, including handling customer complaints and providing information when a new bill payer moves into a property with a Green Deal.

Green Deal Providers must operate to a high standard, and organisations will need to be authorised and abide by certain requirements to operate. They may choose to undertake the assessment and supply of goods and installation using their own employees, or they may choose to sub-contract.

7.1.3 Green Deal training

There are a number of Green Deal training providers in the UK. They offer a range of 2 to 8 day courses in becoming a domestic or commercial building energy advisor and assessor.

7.2 EUREM training programme

EUREM (European Energy Manager) was started in 1999 by the Chamber of Commerce & Industry in Nürnberg, Germany. It is a high quality and standardised training programme and network for energy

managers, to date operating in 27 countries worldwide (14 in the EU and 13 in other countries). The EUREM Consortium was formed in 2009 from training providers from 10 countries. The EUREM Consortium is represented by the EUREM Steering Committee which meets at least biannually and counts amongst its tasks updating training material, quality assurance and licensing of new partners. The EUREM Steering Committee is financed by licence fees and candidate training fees.

An important factor about the EUREM programme which is relevant to this project is that it operates internationally with a standardised set of training materials which are adapted for and to each country by energy experts from that country.

Also interesting is the process by which new countries join the EUREM programme: EUREM has developed a licensing model whereby a training provider from a new member country signs a licence agreement giving it the right to provide the EUREM training exclusively in that country. The training provider then also becomes a partner in the rapidly growing EUREM Community. The new partner commits to maintaining the high EUREM quality standards, and can show that the know-how and infrastructure to achieve these are available. If other training providers in that country now also want to provide the EUREM training, they can apply to become regional partners of the main country Licensed Partner. This model has proven to be successful in Germany with 36 training providers, Austria with 3 training providers, and Brazil also with 3 training providers.

EUREM is not based on any standards as such and is not accredited or certified but is guaranteed by the Nürnberg Chamber of Commerce & Industry, the German Chamber of Commerce & Industry, and the German Chamber of Commerce & Industry Educational Service.

The EUREM training programme is taken part-time and typically takes 6-8 months to complete. It is internationally successful and has a widespread reputation largely because key personnel from member countries (for example, employees of energy agencies, energy regulators and other energy institutions) have themselves completed the training and have EUREM certificates.

Course title	EUREM
Training provider	First training provider was the Chamber of Commerce & Industry in Nürnberg, Germany
Type of institution	Usually run by the local Chamber of Commerce & Industry
Target audience	Professionals from industry and services sector
Technology	Energy Management
Accreditation	EUREM guaranteed by Nürnberg Chamber of Commerce & Industry, the German Chamber of Commerce & Industry, and the German Chamber of Commerce & Industry Educational Service
Government funded	EUREM has received European funding via Intelligent Energy Europe, EUREM.net and EUREMplus schemes. Most EUREM projects in the different countries are self-funding.
Number of similar training institutions	There are 36 training providers in Germany. Each other country has at least one training provider.
Trainers' qualifications	There are up to 25 trainers available at each training location. The trainer team is interdisciplinary and highly qualified. Trainers come from industry.

Quality assurance by…	EUREM Steering Committee checks quality of joining training providers through a standardised application procedure. Each year the EUREM Steering Committee performs the 'EUREM Quality Assurance' of each EUREM training provider. Each country has an expert jury, who oversea the candidate assessments, made up of previous EUREM certificants from well-reputed organisations such as energy agencies, energy regulators, other energy institutions within the country.
Pre-requisites	No entry level requirements
Qualification received	Internationally-recognised EUREM certificate
Learning method	Combination of attendance and online carried out part-time typically over 6-8 months
Cost	€2000-€3600 - fees vary from country to country
Course curriculum	Energy efficiency and renewable energy in buildings and industry; energy managment in buildings and industry

7.3 National Cleaner Production Centre (NCPC), South Africa

The National Cleaner Production Centre of South Africa[xxxvii] (NCPC-SA) is a national government programme that promotes the implementation of resource efficiency and cleaner production (RECP) methodologies to assist industry to lower costs through reduced energy, water and materials usage, and waste management. It is hosted by the CSIR[xxxviii] (Council for Scientific and Industrial Research) on behalf of the Department of Trade and Industry.

The NCPC offers two courses, one on Energy Management Systems (based on the SANS/ISO 50001 standard), the other on Energy Systems Optimisation. The courses are offered either as 2-day technical user courses, or 9-12 month expert level courses which combine in-company practical modules with theory. The expert level courses result in the internationally-recognised UNIDO energy expert certification.

7.4 Energy Training Foundation (EnTF), South Africa

The Energy Training Foundation (EnTF) offers a series of 2-4 day courses on renewable energy and energy efficiency. These courses are approved by the Engineering Council of South Africa (ECSA), the engineering professional regulator and accreditor of engineering programmes.

8 Appendix – Initiatives to standardise RE/EE qualifications internationally

This section looks at initiatives that attempt to standardise qualifications across countries and create international linkages so that a qualification achieved in one country will be understood and recognised in another.

Although skills needs, skills mix and skills infrastructure vary from country to country, it is considered that technical skills requirements for renewable technologies are fairly uniform internationally. Therefore it is considered to be meaningful to establish international linkages between qualifications in renewable energy.[xxxix] The benefits are:

- qualifications between countries become recognisable and understandable. This facilitates international mobility among workers and allows international employers to assess local skills in unfamiliar countries;
- good practice in education and training spreads. Existing training institutions can learn from their peers. New training providers have access to internationally recognised training programmes and curricula allowing them to provide high quality training faster.

Some examples are presented in the following sub-sections.

8.1 EUREM

The European Energy Manager programme (EUREM) operates internationally with a standardised set of training materials which are adapted for and to each country by energy experts from that country. The EUREM programme was described in more detail in Appendix 7.2.

8.2 Windskill

The Windskill project[xl], co-financed by the EU's Intelligent Energy Europe programme, ran from 2006 to 2009 in partnership with the German Wind Energy Association, APER, CLER/FE and TU Delft and in close cooperation with the EWEA and an international network of over 100 stakeholders. The Windskill project was initiated to meet the skills gap in the expanding wind industry through the development of a flexible European qualifications structure: instead of many fragmented training courses, the Windskill project aimed to develop a series of training modules leading to standardised qualifications to meet the skills and career paths required by the industry. The focus was put on operation and maintenance for both onshore and offshore installations.

The EU's Lifelong Learning agenda in the field of vocational education was implemented and the European Qualifications Framework was deployed to make the qualifications understandable and recognisable across Europe.

Towards the end of the project the training programme was tested and evaluated at a number of European training locations. This also aided in building up a training infrastructure.

Training programmes, curricula and teaching materials used by BZEE, BFW Bremerhaven, the Wind Energy Technology Insititute of the Flensburg University of Applied Sciences, the China Wind Power Centre (CWPC) and the South Africa Renewable Energy Technology Centre (SARETEC) all build on the work done in the Windskill project.

8.3 Build Up Skills

The Build Up Skills initiative was launched in 2011 under the Intelligent Energy Europe programme to boost continuing or further education and training of craftsmen and other on-site construction workers and system installers in the building sector. The initiative addresses skills in relation to energy efficiency and renewables in all types of buildings.[xli]

Build Up Skills has two phases. The first phase, which ran until the end of 2013, required each participating country to develop a detailed analysis of the national status quo of the building industry. The aim was to assess and quantify supply and demand in the building sector up to 2020 and beyond, and to identify specific skills shortages by craft occupation as well as key barriers. Each country should set up national qualification platforms and roadmaps to meet the building sector renewable energy and energy efficiency targets for 2020 and beyond.

The second phase is to facilitate the introduction of new and/or the upgrading of existing qualification and training schemes (Pillar II) based on these roadmaps. For example, a consortium in Germany has been developing the Qualitrain programme since the end of 2013. This aims to implement the most important measures as identified during the Phase 1 national analysis. The Qualitrain programme is due to run until mid 2016 and will include further training and train-the-trainer elements.[xlii]

8.4 European Training Foundation (ETF)

The European Training Foundation is an EU agency, based in Turin, Italy, and operational since 1994, that helps transition and developing countries to harness the potential of their human capital through the reform of education, training and labour market systems in the context of the EU's external relations policy.

The European Training Foundation performs a wide range of activities in the vocational education field. For example, the ETF supports countries in designing and developing their education systems and links development in partner countries to EU initiatives and wider international developments. It works with partner countries in developing quality assurance within the vocational education training sector as well as helping to introduce more work-based learning in vocational education.[xliii]

8.5 European Qualifications Framework (EQF)

The European Qualifications Framework (EQF) is a European-wide qualifications framework adopted by the European Parliament and Council in April 2008. The EQF aims to establish a common reference framework as a translation device between different qualification systems and their levels. This framework comprises general, higher and vocational education and training, and should lead to better transparency, comparability and portability of citizens' qualifications (e.g. diplomas, certificates etc.)

The EQF is an 8-level lifelong learning framework and covers all types of qualifications ranging from those acquired at the end of compulsory education (Level 1) to the highest qualifications such as Doctorate (Level 8). The EQF is focused on the outcome of learning and the person's actual knowledge and skills rather than the amount of study needed to complete the qualification programme.

The EQF is voluntary and the member countries are not obliged to cross reference their frameworks. So far only a minority of member countries has done this but the number of completed cross references is expected to increase in the near future.[xliv]

9 Appendix

9.1 Information on Standard EN ISO/IEC 17065:2012

From http://www.beuth.de/en/standard/din-en-iso-iec-17065/153760501

Title (english): Conformity assessment - Requirements for bodies certifying products, processes and services (ISO/IEC 17065:2012); German and English version EN ISO/IEC 17065:2012

Document type: Standard

Publication date: 2013-01

Overview:

This standard contains principles and requirements for the competence and impartiality of certification of products (including services) and processes as well as bodies offering those services; certification bodies operating to this future standard need not offer all types of product, process and service certification. Certification of products, processes or services is a means to ensure that they correspond with specified requirements in standards and other normative documents. The overall aim of product, process or service certification is to give confidence to all interested parties that a product, process or service fulfils specified requirements. The value of certification is the degree of confidence and trust that is established by an impartial and competent demonstration of fulfilment of specified requirements by a third party. Parties, for example, the clients of the certification bodies, the customers of the organizations whose products, processes or services are certified, governmental authorities, non-governmental organizations and consumers and other members of the public can expect or require the certification body to meet all the requirements of this standard as well as when relevant, those of the certification scheme. Some product, process or service certification schemes may include initial testing or inspection and assessment of its suppliers' quality management systems, followed by surveillance that takes into account the quality management system and the testing or inspection of samples from the production and the open market. Other schemes rely on initial testing and surveillance testing, while still others comprise type testing only. This document can be used as a criteria document for accreditation or peer assessment or designation by governmental authorities, scheme owners and others. The general requirements specified here may have to be amplified when specific industrial or other sectors make use of them, or when particular requirements such as health and safety have to be taken into account. This document does not set requirements for schemes and how they are developed. Furthermore, it is not intended to restrict the role or choice of scheme owners. However, scheme requirements should not contradict or exclude any of the requirements of this document. While this document is concerned with third parties providing product, process or service certification, many of its provisions may also be useful in first- and second-party product conformity assessment procedures. The underlying International Standard ISO/IEC 17065:2012 corresponds with the revision of ISO/IEC Guide 65:1996, which has been adopted as DIN EN 45011:1998-03 into the German body of standards. The revision has been carried out in Working Group WG 29 of ISO/CASCO, in collaboration with Technical Committee CEN/CENELEC/TC 1. Regarding the German collaboration, Subcommittee NA 147-00-03-29 UA "Produktzertifizierung" ("Product certification") in Working Committee NA 147-00-03 AA "Zertifizierungsgrundlagen (Grundlagen zur Konformitätsbewertung)" ("Basic principles for certification (Basic principles for conformity assessment)") of NQSZ is responsible.

Language: German, English

Replaces: DIN EN 45011:1998-03

9.2 Information on Standard EN ISO/IEC 17024:2012

From http://www.beuth.de/en/standard/din-en-iso-iec-17024/151077583

Title (english): Conformity assessment - General requirements for bodies operating certification of persons (ISO/IEC 17024:2012); German and English version EN ISO/IEC 17024:2012

Document type: Standard

Publication date: 2012-11

Overview:

This standard contains principles and requirements for a body certifying persons against specific requirements. This includes requirements for the development and maintenance of a certification scheme for persons. Certification of persons can only occur when there is a certification scheme. The certification scheme is designed to supplement the requirements included in this document and include those requirements that the market needs or desires, or that are required by governments. The requirements specified in this document ensure that certification bodies for persons operating certification schemes for persons operate in a consistent, comparable and reliable manner. Accreditation of the certification body for persons is a means to provide additional trust for the performance of the certification body. The underlying International Standard corresponds to the revision of ISO/IEC 17024:2003. The International Standard ISO/IEC 17024 has been developed with the objective of achieving and promoting a globally accepted benchmark for organizations operating certification of persons. Certification for persons is one means of providing assurance that the certified person meets the requirements of the certification scheme. Confidence in the respective certification schemes for persons is achieved by means of a globally accepted process of assessment and periodic re-assessments of the competence of certified persons. In contrast to other types of conformity assessment bodies, such as management system certification bodies, one of the characteristic functions of the certification body for persons is to conduct an examination. It uses objective criteria to measure competence and scoring. While it is recognized that such an examination, if well planned and structured by the certification body for persons, can substantially serve to ensure impartiality of operations and reduce the risk of a conflict of interest, additional requirements have been included in this International Standard. The underlying International Standard ISO/IEC 17024 has been prepared by Working Group 30 of ISO/CASCO in collaboration with Technical Committee CEN/CENELEC/TC 1. Regarding the German collaboration the responsible committee is Subcommittee NA 147-00-03-30 UA "Personenzertifizierung" ("Certification of persons") at Working Committee NA 147-00-03 AA "Zertifizierungsgrundlagen (Grundlagen der Konformitätsbewertung)" ("Basic principles for certification (Basic principles for conformity assessment)") of NQSZ.

Language: German, English

Replaces: DIN EN ISO/IEC 17024:2003-10

9.3 Article 14 and Annex IV of Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources

Article 14

Information and training

1. Member States shall ensure that information on support measures is made available to all relevant actors, such as consum-ers, builders, installers, architects, and suppliers of heating, cooling and electricity equipment and systems and of vehicles compatible with the use of energy from renewable sources.

2. Member States shall ensure that information on the net benefits, cost and energy efficiency of equipment and systems for the use of heating, cooling and electricity from renewable energy sources is made available either by the supplier of the equipment or system or by the national competent authorities.

3. Member States shall ensure that certification schemes or equivalent qualification schemes become or are available by 31 December 2012 for installers of small-scale biomass boilers and stoves, solar photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps. Those schemes may take into account existing schemes and structures as appropriate, and shall be based on the criteria laid down in Annex IV. Each Member State shall recognise certification awarded by other Member States in accordance with those criteria.

4. Member States shall make available to the public information on certification schemes or equivalent qualification schemes as referred to in paragraph 3. Member States may also make available the list of installers who are qualified or certified in accordance with the provisions referred to in paragraph 3.

5. Member States shall ensure that guidance is made available to all relevant actors, notably for planners and architects so that they are able properly to consider the optimal combination of renewable energy sources, of high-efficiency technologies and of district heating and cooling when planning, designing, building and renovating industrial or residential areas.

6. Member States, with the participation of local and regional authorities, shall develop suitable information, awareness-raising, guidance or training programmes in order to inform citizens of the benefits and practicalities of developing and using energy from renewable sources.

ANNEX IV

Certification of installers

The certification schemes or equivalent qualification schemes referred to in Article 14(3) shall be based on the following criteria:

1. The certification or qualification process shall be transparent and clearly defined by the Member State or the administrative body they appoint.

2. Biomass, heat pump, shallow geothermal and solar photovoltaic and solar thermal installers shall be certified by an accredited training programme or training provider.

3. The accreditation of the training programme or provider shall be effected by Member States or administrative bodies they appoint. The accrediting body shall ensure that the training programme offered by

the training provider has continuity and regional or national coverage. The training provider shall have adequate technical facilities to provide practical training, including some laboratory equipment or corresponding facilities to provide practical training. The training provider shall also offer in addition to the basic training, shorter refresher courses on topical issues, including on new technologies, to enable lifelong learning in installations. The training provider may be the manufacturer of the equipment or system, institutes or associations.

4. The training leading to installer certification or qualification shall include both theoretical and practical parts. At the end of the training, the installer must have the skills required to install the relevant equipment and systems to meet the performance and reliability needs of the customer, incorporate quality craftsmanship, and comply with all applicable codes and standards, including energy and ecolabelling.

5. The training course shall end with an examination leading to a certificate or qualification. The examination shall include a practical assessment of successfully installing biomass boilers or stoves, heat pumps, shallow geothermal installations, solar photovoltaic or solar thermal installations.

6. The certification schemes or equivalent qualification schemes referred to in Article 14(3) shall take due account of the following guidelines:

(a) Accredited training programmes should be offered to installers with work experience, who have undergone, or are undergoing, the following types of training:

(i) in the case of biomass boiler and stove installers: training as a plumber, pipe fitter, heating engineer or technician of sanitary and heating or cooling equipment as a prerequisite;

(ii) in the case of heat pump installers: training as a plumber or refrigeration engineer and have basic electrical and plumbing skills (cutting pipe, soldering pipe joints, gluing pipe joints, lagging, sealing fittings, testing for leaks and installation of heating or cooling systems) as a prerequisite;

(iii) in the case of a solar photovoltaic or solar thermal installer: training as a plumber or electrician and have plumbing, electrical and roofing skills, including knowledge of soldering pipe joints, gluing pipe joints, sealing fittings, testing for plumbing leaks, ability to connect wiring, familiar with basic roof materials, flashing and sealing methods as a prerequisite; or

(iv) a vocational training scheme to provide an installer with adequate skills corresponding to a three years education in the skills referred to in point (a), (b) or (c) including both classroom and workplace learning.

(b) The theoretical part of the biomass stove and boiler installer training should give an overview of the market situation of biomass and cover ecological aspects, biomass fuels, logistics, fire protection, related subsidies, combustion techniques, firing systems, optimal hydraulic solutions, cost and profitability comparison as well as the design, installation, and maintenance of biomass boilers and stoves. The training should also provide good knowledge of any European standards for technology and biomass fuels, such as pellets, and biomass related national and Community law.

5.6.2009 EN Official Journal of the European Union L 140/51

(c) The theoretical part of the heat pump installer training should give an overview of the market situation for heat pumps and cover geothermal resources and ground source temperatures of different regions, soil and rock identification for thermal conductivity, regulations on using geothermal resources, feasibility of using heat pumps in buildings and determining the most suitable heat pump system,

and knowledge about their technical requirements, safety, air filtering, connection with the heat source and system layout. The training should also provide good knowledge of any European standards for heat pumps, and of relevant national and Community law. The installer should demonstrate the following key competences:

(i) a basic understanding of the physical and operation principles of a heat pump, including characteristics of the heat pump circle: context between low temperatures of the heat sink, high temperatures of the heat source, and the efficiency of the system, determination of the coefficient of performance (COP) and seasonal performance factor (SPF);

(ii) an understanding of the components and their function within a heat pump circle, including the compresor, expansion valve, evaporator, condenser, fixtures and fittings, lubricating oil, refrigerant, superheating and sub-cooling and cooling possibilities with heat pumps; and

(iii) the ability to choose and size the components in typical installation situations, including determining the typical values of the heat load of different buildings and for hot water production based on energy consumption, determining the capacity of the heat pump on the heat load for hot water production, on the storage mass of the building and on interruptible current supply; determine buffer tank component and its volume and integration of a second heating system.

(d) The theoretical part of the solar photovoltaic and solar thermal installer training should give an overview of the market situation of solar products and cost and profitability comparisons, and cover ecological aspects, components, characteristics and dimensioning of solar systems, selection of accurate systems and dimensioning of components, determination of the heat demand, fire protection, related subsidies, as well as the design, installation, and maintenance of solar photovoltaic and solar thermal installations. The training should also provide good knowledge of any European standards for technology, and certification such as Solar Keymark, and related national and Community law. The installer should demonstrate the following key competences:

(i) the ability to work safely using the required tools and equipment and implementing safety codes and standards and identify plumbing, electrical and other hazards associated with solar installations;

(ii) the ability to identify systems and their components specific to active and passive systems, including the mechanical design, and determine the components' location and system layout and configuration;

(iii) the ability to determine the required installation area, orientation and tilt for the solar photovoltaic and solar water heater, taking account of shading, solar access, structural integrity, the appropriateness of the installation for the building or the climate and identify different installation methods suitable for roof types and the balance of system equipment required for the installation; and

(iv) for solar photovoltaic systems in particular, the ability to adapt the electrical design, including determining design currents, selecting appropriate conductor types and ratings for each electrical circuit, determining appropriate size, ratings and locations for all associated equipment and subsystems and selecting an appropriate interconnection point.

(e) The installer certification should be time restricted, so that a refresher seminar or event would be necessary for continued certification.

[i] From NABCEP – www.nabcep.org
[ii] From Microgeneration Certification Scheme (MCS) – www.microgenerationcertification.org
[iii] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC
[iv] Qualicert Publishable Report, Quality certification & accreditation for installers of small-scale renewable energy systems
[v] Intelligent Energy – Europe II Performance Report 2007-2012, European Commission, April 2013
[vi] Qualicert Manual 'A common approach for certification or equivalent qualification of installers of small-scale renewable energy systems in buildings' www.qualicert-project.eu
[vii] Qualit'EnR, http://www.qualit-enr.org/
[viii] Autan Solaire Énergies Positives, http://www.autan-solaire.fr/formation-solaire.html
[ix] Solar Energy International, http://www.solarenergy.org/sei-solar-professionals-certificate-program
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[xi] Trade Skills 4 U, http://www.tradeskills4u.co.uk/courses/city-guilds-2399-course
[xii] Interstate Renewable Energy Council, IREC – www.irecusa.org
[xiii] Solar Instructor Training Network, http://energy.gov/eere/sunshot/solar-instructor-training-network
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[xx] Ministry of New and Renewable Energy (MNRE), www.mnre.gov.in
[xxi] Solar Energy Training Network (SETNET), http://www.mnre.gov.in/file-manager/advertisement/EoI-NISE-SETNET.pdf
[xxii] Danish Wind Power Academy - http://www.danishwpa.com
[xxiii] From 'Ten Objectives for Education'BMZ Education Strategy 2010-2013, 'Zehn Ziele für mehr Bildung' BMZ-Bildungsstrategie 2010-2013
[xxiv] UNESCO-UNEVOC World TVET Database, www.unevoc.unesco.org/go.php?q=World+TVET+Database
[xxv] Bremerhaven Wind Zentrum, www.windzentrum-bremerhaven.de
[xxvi] Berufliche Bildung Bremerhaven, www.bb-bremerhaven.de
[xxvii] BZEE Bildungszentrum für Erneuerbare Energien, www.bzee.de
[xxviii] BZEE internationally www.bzee.de/en/news/117-from-husum-to-the-cape-of-good-hope
[xxix] MEASNET, www.measnet.com
[xxx] Eckener Schule Flensburg, www.eckener-schule-flensburg.de/fstug/windenergietechnik.html
[xxxi] IMWatT project (2006-2008) www.wak-sh.de/imwat.html
[xxxii] 'The Windskill Initiative, A Systematic Approach to Wind Energy Qualifications,' Intelligent Energy Europe, European Wind Energy Skills Network
[xxxiii] 'TVET for a Green Economy', 'Berufsbildung für die Grüne Wirtschaft', GIZ, BMZ
[xxxiv] TAFE NSW, www.tafensw.edu.au
[xxxv] PAS 2030:2012 Improving the energy efficiency of existing buildings
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[xxxvii] National Cleaner Production Centre of South Africa, ncpc.co.za
[xxxviii] Council for Scientific and Industrial Research, www.csir.co.za
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[xli] For further information on Build Up Skills, refer to www.buildupskills.eu
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[xliii] For further information on the European Training Foundation, refer to www.etf.europa.eu
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