IRENA REPORT

IRENA

International Renewable Energy Agency

International Standardisation in the Field of Renewable Energy

March 2013

About IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future, and serves as the principal platform for international cooperation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity. www.irena.org.

Acknowledgements

The production of this report was led by Gideon Richards of Consulting With Purpose Ltd (CWP) and supported by Kyung-Jin Boo of the Seoul National University (SNU). The paper benefitted from internal IRENA reviews, discussions with participants at the workshop on international standardisation for renewable energy hosted by IRENA on 24 October 2012, as well as the valuable comments by Gabriel Barta and Françoise Rauser of the International Electrotechnical Commission (IEC), and Müge Dolun of the United Nations Industrial Development Organization (UNIDO).

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EXECUTIVE SUMMARY

The International Renewable Energy Agency (IRENA) supports Member Countries by providing a framework for technology policy aimed at accelerated renewable energy development and deployment. Standardisation for renewable energy technologies is a particularly relevant instrument to achieve this goal. Standardisation plays an important role throughout the entire technology life cycle, from R&D stages through to the commercialisation and diffusion of technology. Sound standardisation processes can support innovation in renewable energy technologies by documenting and spreading information on state-of-the-art technologies, levelling the playing field for innovative products, allowing more focused R&D efforts built upon best technology, and closing the gap between R&D and marketable products. When well designed, standardisation also provides an effective framework for the commercialisation and diffusion of technologies by harmonising information flow, understanding technical product design for interoperability of components, manufacturing and service requirements, as well as establishing common rules and quality requirements.

In recent years, there has been a rapid and steady growth in the deployment of renewable energy technologies which account now for the majority of power generation capacity additions. Standardisation has supported the penetration of renewables into the energy regime, and may contribute to their further growth, through a number of benefits, as witnessed in other economic sectors. These include decreasing product costs; reduced transaction costs through simplified contractual agreements and use of standardised components; common language and understanding of what a product or service is and is not; and increased levels of quality and safety for consumers. Together these factors have resulted in higher consumer confidence in, and acceptance of, renewable energy technologies and reduced liability for manufacturers and service providers.

Nevertheless, when poorly designed, standardisation may inhibit innovative solutions, create administrative burdens, increase costs and inhibit trade. It is therefore important for policy-makers, researchers, industry, project developers and end-users to understand and make the best use of standardisation, thereby assuring robust and well-functioning markets for renewable energy technologies.

Through this study, IRENA aims to improve the understanding of the landscape of standards and to assess the needs and gaps for standardisation of renewable energy technologies, with a focus on international standardisation. Particular emphasis is placed on a needs assessment in the area of standardisation for renewable energy; and a gap analysis for the inventory of renewable energy standards, to identify where further work, promotion or other activities related to standards would add value to the deployment of renewable energy globally.

The report also shows policy-makers how the standardisation process can be an effective way of supporting national legislation and regulation for renewable energy. National legislation may refer to appropriate standards, either through direct compliance with the legislation, or by providing an effective mean of demonstrating compliance with compulsory regulations. By referencing standards, requirements for compliance in the legislation are consistent and updated without having to go through the legislative framework each time changes are needed. At the same time their use permits legislation to benefit, in many cases from the latest practices documented in the standards, and from the creation of a competitive market for renewable energy technologies based on proven quality and safe products and services.

An inventory has identified more than 570 standards relevant to renewable energy technologies. The majority of these are manufacturing and product standards, including test methods and performance evaluation. With the increasing importance of globalisation in renewable energy trading and deployment, the finding from the gap analysis that identified fewer standards developed at a national level in contrast to those developed at an international level is not surprising, since more and more countries are considering adopting regional and international standards. The analysis also observed that where organisations or trade bodies develop their own specific standards, they are often based on regional or international standards.

Standards development in the field of renewable energy appears to have a strong focus on ensuring a harmonised approach to laboratory and analytical performance of the materials and products that make up the technologies.

There is a larger volume of standards for the more mature technologies and they are typically more in-depth. It would also appear that involvement in the standards-making process is strongest when there are financial incentives, as illustrated by the case of standards for solar photovoltaics. Furthermore, the inventory also shows that while certain aspects concerning post-installation of renewable energy equipment, such as operation, maintenance and repair, are included in some standards, there is still potential for their further development.

As technologies develop, standards may not always keep up with the scales and variations in product design. For example, at present, standards are already being used for large-scale wind turbines, although they may be restrictive or not fully appropriate for the medium-scale wind market. International standards for small wind turbines are available, but it is often claimed that they do not necessarily reflect the specific technical aspects associated with smaller wind turbines and their placement. This failure to keep pace with technology design also impacts on the testing and certification schemes for equipment, as certification schemes require conformity to relevant standards which, as already mentioned, may not be available or fully appropriate for all scales of a particular technology. Furthermore, testing and certification of renewable energy equipment for small-scale or off-grid applications presents the challenge of balancing robustness with the related costs for setting up and being certified under such schemes. Establishing the national institutional and infrastructure requirements for operating a robust testing and certification scheme might be expensive and resource-intensive, resulting in major challenges for many developing countries. However, without testing and certification schemes, including verification and auditing, it is not feasible to understand whether the products or services are in conformance with the required standards.

The report also underlines how standards provide an important element in protecting consumers, particularly where they have little or no choice in what they are offered. Many rural communities in developing countries do not have the luxury of being able to compare features and select their supplier or product from facilities such as the Internet. In such cases standards and quality assurance mechanisms can ensure that whatever product or service is available performs as specified, is reliable, durable and safe.

It also emerged from the inventory exercise that the data collection for existing standards for renewable energy and those under development is particularly difficult, as there is no uniform format or repository for collecting the required information. Issues such as different numbering systems and information portals displaying information in different formats do not contribute to gaining a comprehensive global view of which standards are available. There is scope for a more structured information platform that allows interested actors to get access and be guided to the relevant standards at international, regional and national levels.

The technology synopsis of the gap analysis showed areas where further development on standards is still needed, even for more mature technologies. This is particularly true in areas such as environmental impact, and health and safety. Issues such as fire safety of PV systems installed on-roof, and non-harmonised standards for particulate emissions from biomass combustion equipment, are some of the examples presented in this report.

The importance of understanding the inter-relationship between different standards is also illustrated, as is the need to pay increased attention to those inter-relationships in the future so that both the connectivity from standard to standard and their relationships across different sectors can be easily understood. This issue also has a significant impact on the costs related to accessing all standards relevant for a specific application. Some applications require the purchase of not one, but an entire set of standards that cover all the aspects of technology required for the application.

A key message from this study is that if standards are to remain of global relevance then the international standardisation route should support all regional, demographic, technical development, societal and environmental aspects of their use. This is particularly relevant in developing countries, where issues of cost, capacity or resource availability limit their involvement in the whole international standards development process. Consequently, international standards may not always consider specific issues relevant to some regions, such as specific climate conditions, infrastructure development or skills available for implementing renewable energy systems. It is therefore important to make use of existing mechanisms, and develop new ones, to ensure the engagement of all stakeholders, particularly in developing countries, in the international standardisation process. This engagement is especially relevant if those stakeholders are to be involved in competitive and inclusive global trade. Examples of such existing mechanisms include the ISO-DEVCO and the IEC-Affiliate Country Programme. Furthermore, participation in the standardisation process also facilitates a voluntary

cooperation of public and private actors and the transfer of knowledge. Efforts must therefore continue to explore new options for increasing the participation and contribution of developing countries in the international standards development process.

Throughout its sections this report presents key findings and provides some recommendations for consideration by stakeholders. The recommendations have been grouped into four categories, with the aim of setting the main issues concerning standardisation for renewable energy in some order and providing guidance on how they might be addressed. These categories are: promotion and knowledge dissemination; support for broader stakeholder engagement in standardisation; strategic framework for standardisation in the renewable energy sector; and specific projects related to standards development. Chapter 6 of this report provides a full list of recommendations and a detailed discussion of them, some of the key recommendations are outlined below.

- » *Mechanisms, such as an overview forum, that may facilitate a strategic framework for standardisation in renewables need to be explored.*

- » *Engagement by developing countries in programmes that may support their involvement in the international standardisation process for renewables is crucial.*

- » *Access to standards and an understanding of the inter-relationship between standards needs to be facilitated.*

- » *Post-installation aspects of renewable energy system requirements need to be evaluated and documented.*

- » *Further assessment and implementation of activities specifically supporting policy-makers and legislators are required in order to reduce common globally occurring barriers.*

The key message from this report is that it is crucial to ensure a strategic pathway in standardisation for renewable energy technologies, taking into account the requirements and priorities of all involved stakeholders. The report shows that there are important opportunities to implement new thinking and support mechanisms to address the issues identified in this study. It also shows the need to further analyse, in cooperation with international standards organisations and collaboratively with other key organisations, what the external stakeholders' needs are in terms of standards development, and what the structure of standardisation should be in order to ensure that it remains fit for purpose.

ABBREVIATIONS

AFSEC	African Electrotechnical Standardisation Commission
ANSI	American National Standards Institute
ARE	Alliance for Rural Electrification
BSI	British Standards Institution
CEM	Clean Energy Ministerial
CEN	European Committee for Standardisation
CENELEC	European Committee for Electrotechnical Standardisation
CNIS	China National Institute of Standardisation
DNV	DNV Kema Energy & Sustainability
EE	Energy Efficiency
EN	European Norm
GHG	Greenhouse Gas
GL	Germanischer Lloyd Group
IAF	International Accreditation Forum
IEC	International Electrotechnical Commission
IEC NC	National Committee of the IEC
ILAC	International Laboratory Accreditation Cooperation
IRECO	International Renewable Energy Certification Organisation
IRENA	International Renewable Energy Agency
ISO	International Organization for Standardisation
ISO SAG-E	ISO Strategic Advisory Group on Energy Efficiency and Renewable Energy
ISP	Institute for Sustainable Power Inc.
KATS	Korean Agency for Technology and Standards
MCS	Microgeneration Certification Scheme
NRE	New and Renewable Energy
NREL	National Renewable Energy Laboratory
NSB	National Standardisation Body(ies)
PK	Pine Kernel
RED	European Commission Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, commonly known as the Renewable Energy Directive
RSB	Roundtable on Sustainable Biofuels
RSPO	Roundtable on Sustainable Palm Oil
SAFA	Standards Access for All
TBT	Technical barriers to trade under the WTO
WTO	World Trade Organization

GLOSSARY OF TERMS

Accreditation
Third party attestation related to a conformity assessment body conveying formal demonstration of its competence to carry out specific conformity assessment tasks. [1]

Certification
Third party attestation related to products, processes, systems or persons. [1]

Conformity assessment
Demonstration that specified requirements relating to a product, process, system, person or body are fulfilled. [1]

Consensus
General agreement, characterised by the absence of sustained opposition to substantial issues by any important part of the concerned interests, and by a process that involves seeking to take into account the views of all parties concerned and to reconcile any conflicting arguments. Consensus need not imply unanimity. [2]

Harmonised standards
Standards on the same subject approved by different standardising bodies that establish interchangeability of products, processes and services, or mutual understanding of test results or information provided according to these standards. [2]

Harmonised technical regulations
Technical regulations on the same subject approved by different authorities that establish interchangeability of products, processes and services, or mutual understanding of test results or information provided according to these technical regulations. [2]

Product
The result of a process, i.e., a set of interrelated or interacting activities which transforms inputs into outputs, of which four generic categories are services, software, hardware and processed materials. [3]

Standard
A document, established by consensus and approved by a recognised body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context. Note: Standards should be based on the consolidated results of science, technology and experience, and aimed at the promotion of optimum community benefits. [2]

Technical regulation
A document that lays down product characteristics or their related processes and production methods, including the applicable administrative provisions with which compliance is mandatory. It may also include or deal exclusively with terminology, symbols, packaging, marking or labelling requirements as they apply to a product, process or production method. [4]

Testing
Determination of one or more characteristics of an object of conformity assessment, according to a procedure. Note: "Testing" typically applies to materials, products or processes. [1]

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1 Source: ISO/ IEC 17000:2004, Conformity assessment – Vocabulary and general principles.
2 Source: ISO/IEC Guide 2:2004, Standardization and Related Activities – General Vocabulary.
3 Source: Adapted from ISO 9000:2005, Quality management systems – Fundamentals and vocabulary.
4 Source: ISO/IEC Guide 59: 1994, Code of good practice for standardization.

1. INTRODUCTION

With the world open to trade through global commerce, global manufacturing, advanced communications, easier distribution of goods and services, governments increasingly collaborating in clean energy technology research and development, promotion and deployment, it is recognised that standards and a harmonised approach to renewable energy, along with certification, is an important aspect of developing and increasing the uptake, awareness and confidence in the market, which in turn supports the climate change mitigation agenda.

"Technologies that fail due to poor quality or poor execution create a negative association in the minds of consumers and damage the market." This is the opening sentence on the chapter on standards, in the recently published United Nations Foundation, Energy Access Practitioner Network report – Towards Achieving Universal Energy Access by 2030.

Well written standards have an important role to play in supporting communication and understanding, trade and commerce, legislation and regulation, environmental protection, enhanced resource efficiency and confidence in the products and services provided.

However, standards can also potentially be barriers to the above if written poorly, biased to one set of stakeholders' requirements, or if their requirements restrict the ability to innovate or deploy and trade the technologies or services.

As standards are usually established on a consensus and broad stakeholder basis, in some cases they may represent minimum, or even sometimes sub-optimum, quantitative or qualitative thresholds (e.g., quality, performance, and sometimes safety) rather than the maximum threshold.[5] However, what are considered minimum thresholds in one region or sector may be too high or low for another. Therefore it is generally very difficult to establish appropriate global standards that meet all the push-and-pull of different stakeholder needs. This is especially true if the engagement process has been limited to a few individuals or stakeholder groups.

Therefore, how well standards are integrated into renewable energy activities across different sectors is of critical importance. It is also important to note that standards in themselves may or may not be adhered to, and if no certification, verification or auditing process is in place, it may be difficult to determine if the standards have made any significant impact.

Much of the discussions in the political arena about standards appear to be about setting "minimum requirements", or "a standard", or in some cases "avoiding setting minimum requirements". These requirements are possibly more effectively described as "threshold values or criteria"[6]. By setting threshold values or criteria, a product's performance, an organisation's service(s), amounts of energy used and hence energy saved, carbon emissions, or other metrics, can be measured and evaluated over time. Many standards will incorporate thresholds or methods for determining a quantitative or qualitative threshold value.

Where standards are to be used in regulation or legislation, the actual threshold *values* are often not established. This enables legislators and regulators to determine their own values. What standards do provide in such cases is a common methodological approach to demonstrate compliance with the threshold limit or value set by others.

It would appear that countries are increasingly looking to set legislation and regulation using standards as the route to demonstrating compliance. In many ways this approach facilitates issues such as commerce and environmental protection, while ensuring that trade barriers and restrictions to technology deployment are reduced.

5 Ottinger, R.L., Experience with Promotion of Renewable Energy: Successes and Lessons Learned – Parliamentarian Forum on Energy Legislation and Sustainable Development, Cape Town, South Africa.

6 For further discussion and examples of how threshold values have been used, see section – How standards are used.

These issues make the development and maintenance of harmonised international standards more important. They also mean that the standards have to stand up to rigorous scrutiny and be truly "fit for purpose". Without these issues being taken into consideration, the standards will lack credibility. This also highlights the importance of having a really good understanding of who the target audience is for the standards and how they are primarily going to be used.

However, standardisation is not only important for policy-makers; standards can support or hinder trade and commerce depending on how they are written. Standards have the ability to ensure that all products and services are harmonised and so allow an open market approach to trade and commerce. These aspects can be seen in the standards through – for example – operating to similar performance calculation methodologies; manufacturing products to the same standards; having common safety and environmental protection features; and harmonised measurement methodologies.

Standards, when well written, also ensure that there is a common understanding of what is being offered by a product or service, or what is being required of it. By stating clear requirements, instructions, methodologies and specifications, standards can bridge barriers of language and interpretation.

There are currently many organisations developing and maintaining standards. Some of them are directly involved in the development of standards affecting renewable energy technologies and energy efficiency (e.g. ISO, IEC, CEN, CENELEC, ANSI, CNIS and KATS) while others (e.g. MCS, ISP, GL, DNV, NREL) support the development of renewable energy standards through scheme requirements, either by referencing standards directly, or through scheme documents that reference standards within the renewable energy sector.

The report's findings are also based on more than ten years of direct experience with standardisation by the lead authors who have played an active role at national, regional and international standards development. Both lead authors sit on the ISO Strategic Advisory Group on Energy Efficiency and Renewable Energy (SAG-E) and are engaged in the development and implementation of standards on a daily basis. Many of their observations are a direct consequence of working with the standards and networking with other standards-makers over this period.

Discussions at all levels of standards-making and with those engaged in using the standards — manufacturers, installers, consumers and regulators – are reflected in this report. Many of these discussions have taken place during international meetings attended by representatives from across the world, including developing countries. The result of these discussions and observations has been synthesised to form the basis for the recommendations. The data used in the report has been gathered through access to standards databases at an international and regional level and information in the public domain.

1.1. Objectives and scope of this report

The objective of this report is to improve understanding of the status of standards, test procedures and good practices for renewable energy equipment and operational practices, and to assess the needs and gaps for standardisation of renewable energy technologies.

The renewable energy technologies included in this report have been classified based on IRENA's Article III definition that includes bioenergy, geothermal, hydropower, ocean energy (including *inter alia* tidal, wave and ocean thermal energy), solar energy, and wind energy.

Wherever practical the report has identified other documents relating to renewable energy, such as best practice guidelines and codes of conduct that are often used as if they were standards.

The report has a particular emphasis on:

- » A needs assessment in the area of standardisation for renewable energy, which will contribute towards defining a possible role for IRENA in this area of work; and

- » A gap analysis for the inventory to identify areas where further standards, additional work, promotion, or other activities will add value to the deployment of renewable energies globally.

Data has been identified and collected from a wide range of sources, including standards databases, regional standards organisations' websites, other more generic searches, and discussions with colleagues working in standardisation for renewable energy.

All data collated from databases are either in the public domain or have been supplied by the data owners.

The analysis has been carried out on renewable energy standards. However, it has not considered the many direct and indirect relationships with other standards, such as specifications for pumps, invertors, quality of steel and welding, fuel handling devices, building performance standards, energy management etc., as they are outside the scope of this report. The report and inventory have identified a few examples of these standards to allow the reader to understand the large degree of inter-connectivity between many standards.

Our primary focus has been on international and regional standards as analysis has shown that they are more readily accessible and invariably adopted by national standards bodies (NSB). Other standards have been included where they have been identified as helping provide a fuller understanding of the sector.

1.2. Target readers

This report addresses significant issues across various stakeholder groups, which can broadly be identified as follows:

Policy-makers, regulators and legislators should read this report in order to understand how standardisation works; how standards can support their efforts to develop policy mechanisms for renewable energy deployment; how they can support decarbonising energy requirements and climate change mitigation; and the implications of not having a balanced, consistent and harmonised approach to standards. This report also illustrates areas where these stakeholders can add value by facilitating change and improvements in the standardisation process and help standards develop in a more harmonised way.

Standards-makers and technical experts should read this report to understand the current situation in the field of standardisation across all renewable energy technologies

Figure 1: Stakeholders requirements from standards

and related sectorial issues. The report also demonstrates how standards support and benefit commerce and trade, through confidence and trust in products and services. Furthermore, for those new to standardisation, the report provides a good insight into how the structure and interrelationship of standards organisations works, along with areas which could help support technical experts new to the field of standardisation in engaging and significantly contributing to the development of standards.

Project developers, including manufacturers and installers, should read this report to ensure that they have an insight into the benefits of being within the development process and ensure that the technologies they provide are supported with appropriate standards. It demonstrates how standards, when written well, can smooth trade; reduce costs; provide consistent products and systems or services; lay down common performance requirements and provide a common language between the parties trading or using the standards. The report will provide developers with an understanding of what the other stakeholders require from standards and allow them to consider these issues during the development and amendment cycles. Furthermore, the report's inventory and the discussions on finding standards may be helpful for manufacturers and installers, as well as those new to the field.

Investors and fiscal support providers should read this report to understand how the combination of renewable energy standards and verification and auditing provides confidence and trust in what is being invested in. Organisations, such as multilateral development banks and investment banks, looking to establish support mechanisms, particularly in developing countries, will find that the report demonstrates how and why standards, verification and auditing can support broader development goals.

Verifiers and auditors will gain insights into how standards are developed; an understanding of their implications in the development process as well as in the audit and verification process. The report also identifies why verification and auditing is important to other stakeholders, particularly policy-makers, legislators and regulators. Furthermore, it highlights the need for these stakeholders to engage in the standards development process at an early stage to ensure that standards are auditable and verifiable.

End-users of standards should read this report to help understand where to access standards; how they can provide confidence and trust in the renewable energy technologies and services, even in the remotest areas of developing countries; what aspects of the technologies they should be looking at, including, design, manufacturing, installation, safety and environmental protection. End-users will also find that the report demonstrates some of the benefits of standards and also some of the hurdles still to be overcome to support their use, such as the cost implications.

2. STANDARDS

2.1. What are standards?

A standard is a repeatable, harmonised, agreed and documented way of doing something. Standards contain technical specifications or other precise criteria designed to be used consistently as a rule, guideline, or definition. They help to make life simpler and increase the reliability and the effectiveness of many of the goods and services we use. [7]

Standards result from collective work by experts in a field and provide a consensus at the time when the standards are developed. As standards in the international arena are established on a consensus and broad stakeholder basis, they represent what can be agreed upon. A published standard is therefore the harmonised synthesis of what the group is prepared to publish. In terms of international and regional standardisation, this is even more important than at the national level: the importance of consensus is critical because of large and diverse stakeholder groups and needs. Ultimately this may mean that a standard might lack some of the clarity, detail or specific criteria certain stakeholder groups or individuals would have preferred. [8]

Standards do not necessarily have to be developed by standardisation bodies, such as ISO or the IEC. Any organisation can establish standards for internal or external use. However, to be truly called a standard, the requirements stated above must be met.

2.2. What are standards for?

Standards are an important way of protecting consumers. While consumer protection is often visible through government policies or consumer protection organisations, standards create an extra protective environment that lies behind the perception of most consumers. This is particularly true where consumers have little or no choice in what they are offered. In rural communities in developing countries, consumers do not generally have the luxury of comparing features and selecting their suppliers or products from the Internet. Therefore it is incumbent on the standards to ensure that whatever product or service is provided is fit for purpose, safe and has value. An important aspect of this protection is to ensure the product or service delivers as claimed, performs as specified, and is reliable, durable and safe.

In many cases renewable energy standards and conformity assessment can be the catalyst in providing alternatives to systems which are sometimes unsafe, operate with low efficiency, and use fossil fuel energy with possible detrimental effects on health. This is achieved by providing confidence and trust in renewable energy products and those who provide energy-related services. Standards also have the ability to allow those not typically trained in these energy sources to reach a level of understanding that allows them to provide, install or operate systems for themselves or under reduced supervision. This is achieved by providing guidance and best practice in designing, specifying, installing and maintaining the systems. A good example is the set of international standards for rural electrification.

Standards also provide an effective framework for harmonising information flow, understanding technical product design, manufacturing and service requirements, as well as establishing common rules and requirements. Standards should enable all these functions to take place while ensuring there is flexibility for the product, service, system provider and user.

Additionally, the standardisation process can be shown to be an effective way of supporting legislation, regulation, trading, performance and environmental improvements. However, standardisation can be seen sometimes as a complex, bureaucratic, slow and time-consuming process.

The key to reducing the legislation and regulation for legislators by using standards is the ability to signpost the standards either through i) direct compliance with the legislation or ii) its use as an effective mean of demonstrating compliance with compulsory regulations. This type of use of standards allows for changes in compliance to be accommodated without the need to go through the legislative framework each time changes are required. It is also important to note that referencing standards can be used

7 Amended from BSI website – What is a standard? < http://www.bsigroup.com/en-GB/standards/Information-about-standards/what-is-a-standard/>

8 For further discussion on this important aspect of standardisation see also the section– How Standards Are Used.

as one way of demonstrating compliance, but it is not the only route.

The use of standards provides a number of key advantages for traders and economic operators, which can be broadly put into the following categories:

- Facilitation of common language and understanding of what the product or service is and is not;
- Facilitation of trade and contractual arrangements;
- Facilitation of compliance to environmental requirements;
- Facilitation of regulation and auditing;
- Stakeholder confidence; and
- Enhanced resource efficiency.

Standards are developed to meet many differing stakeholder requirements. The types of standards developed depend on these requirements, which can include whether there is global relevance, regional mandates or support required for legislation and regulation, or whether the standard is intended to support national or stakeholder deployment.

Example of the adoption of policies for standards by national standards bodies

When European standards are published by organisations such as CEN or CENELEC, any existing national standards that conflict with the European standards must be withdrawn at the same time. However, if it is only European Technical Specifications that are being published, the national standards bodies can decide if they wish to publish them or leave existing national standards in place.

Whatever the reason for developing standards, adhering to them is voluntary; i.e. countries, organisations, and individuals are not legally obliged to follow them. However, if particular standards are referenced in regulation, legislation, contract law, or as part of a referenced certification requirement (as normative references), they then operate in a context that is no longer voluntary, even though the standards themselves remain voluntary (i.e. the compulsory instrument cannot be called a "standard").

The development of standards is based on consensus, which often means that compromise has to be sought. Typically this can, but does not always mean achieving very high requirements or optimised standards. However, the development of standards by consensus can present a risk of bias towards a specific company's technologies or group of technologies. The development of standards can also be affected or affect a number of external aspects, such as environmental protection, performance, geographic requirements, regulation or legislation, and sustainability.

It will therefore be increasingly important, where standards are being used to support aspects such as regulation and legislation, environmental protection and sustainability, to ensure that the functionality of the standards being employed supports the goals of the original purpose for developing those standards.

While the process used by different standards-making bodies for developing standards is similar in many aspects, there are various different requirements and structures for the different types of standards. These requirements and structures, which include the relationship of different standards in terms of publishing and implementation, need to be understood.

The status and implementation requirements for standards vary depending on who has developed them, the type of standard being published and its hierarchical status. This status, which is not necessarily linear or obvious across standardisation organisations, is explained in Annex 1 to this report.

2.3. Standards-making bodies

Standards and scheme documents can be developed and published by anyone who has a need or requirement to establish a set of formal parameters to work within. However, for standards to be accepted in the market, they need to come from a credible body, which can demonstrate that the standards have been developed with due diligence and on a consensus basis. This is why most countries and regions have official standards bodies.

Globally there are effectively four levels of standards bodies: international, regional, national, and standards-developing organisations. The international standards bodies relevant to renewable energy are the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

While in many respects the development processes and structures for ISO and IEC cover different technologies, many agreements and thorough on-going cooperation have meant that the two organisations operate in similar ways.

The international standardisation organisations are member-driven organisations. Their members are the national standards organisations (bodies) at ISO, and national committees at IEC – one per country.

There are 163 members in ISO [9] divided into three categories – Member body, Correspondent member and Subscriber member. The IEC family consists of 82 members [10] and 81 affiliate countries, which participate in IEC's free programme for developing countries. During the development of standards the Member bodies can elect whether to be participating or observing members of the standards development process.

Regional and national standardisation bodies have multilateral agreements and standards development processes similar to those in the international organisations. Table 1 below shows the standardisation bodies involved in the global development of standards.

In addition to the multilateral agreements there are active programmes that support the engagement and participation of developing countries. For example, ISO has a specific 2011 – 2015 action plan for developing countries. This plan includes the encouragement of twinning and/or partnership arrangements between ISO members in developing and developed countries. Resources are also available to support participants from developing countries to attend meetings.

Where standards are recognised as being of global relevance ISO and CEN have the option of developing the standards in partnership according to a collaborative process. This process is governed by the Vienna Agreement [11] which lays down the principles for technical cooperation between the organisations and provides guidelines for the technical committees developing the standards. Similarly, the IEC and CENELEC have the Dresden Agreement, where the large majority of European standards in the electrotechnical area are identical adoptions of international standards.

The predominant organisations are presented in Table 1.

2.3.1. International standards

ISO and IEC appear to provide a good coverage of standards, either developed or under development, for products covering most current renewable energy technologies. These standards are developed in technical working groups whose composition depends on those wishing to engage in the standards development process. Their composition is therefore subject to many variables, including what standard is being developed, how important the subject is as seen by the various stakeholder groups, and the benefits or impacts of the standard as perceived by those who may need to use them.

However, according to the gap analysis in this report, some renewable energy technologies and product or process aspects are better served than others. There are gaps in the standards coverage, for example, in relation to the scale of technology in the market, or specific aspects of the technologies within the sector.

What is more noticeable is the low level of standards aimed at the installation of renewable energy systems. This has a high potential to allow poor design and installation of the technology in question.

The lack of installation standards for some technologies is understandable as the technology is still developing and installation is part of the development process. However, where more established technologies are concerned, there are opportunities to provide support through consolidated high-level best practice examples.

While regional and international standards may take longer to develop and implement than national standards, it is important to understand the context in which the regional and international standards are developed. By providing harmonised standards, issues such as avoiding trade barriers, environmental issues, and best practice can be addressed in a consistent and holistic manner.

Therefore, while short-term gains can be made through the development of national standards, there should be encouragement wherever possible for standards to be adopted or developed at the regional and international level. This also has the advantages of supporting

9 ISO Members are listed on the ISO website at http://www.iso.org/iso/about/iso_members.htm.

10 IEC refers to Full (60) and Associate (22) Members. The full list of members and affiliate countries can be viewed at www.iec.ch/dyn/www/f?p=103:5:0 and www.iec.ch/dyn/www/f?p=103:9:0

11 Details of the ISO CEN Vienna Agreement can be found at - http://www.iso.org/iso/standards_development/processes_and_procedures/cooperation_with_cen.htm.

Table 1: Levels and organisations in standardisation

Level	Geographic coverage	Standards-making organisations potentially involved in renewable energy and energy efficiency
International	Global	ISO – International Organization for Standardization (Members = 164) IEC – International Electrotechnical Commission (IEC Family: 82 Members + 81 Affiliates)
Regional	Europe	CEN – European Committee for Standardization (National Members = 31) CENELEC – European Committee for Electrotechnical standardization (National Members = 32 plus 11 National Committees)
	African Continent	ARSO – African Organisation for Standardisation (Members = 29) SADCSTAN – Southern African Development Community Cooperation in Standardization (Members = 15) AFSEC – African Electrotechnical Standardization Commission (Members = 18) AFRAC – African Accreditation Cooperation (Members = 8)
	Asia Pacific	PASC – Pacific Area Standards Congress ASEAN – Consultative Committee for Standards and Quality
	Euroasia	EuroAsian Interstate Council for Standardization, Metrology and Certification
	Americas	COPANT – Pan American Standards Commission AMN – Asociación Mercosur De Normalización CROSQ – CARICOM Regional Organization for Standards and Quality CANENA – Council for Harmonization of Electrotechnical Standards in the Nations of the Americas
	Middle East	Regional Center for Renewable Energy and Energy Efficiency (RCREEE)
National	National standards bodies / National committees affiliates	164 NSBs globally are members of ISO and listed on ISO website 82 National Committees Members of the IEC and 81 Affiliate Countries are listed on IEC website
Others, national and international	Standards-developing organisations	There are many independent standards development organisations, such as, ASTM, FSC, PEFC, RSB, RSPO, Bonsucro, etc.

transboundary trading (even between areas with different local environments) and reducing the proliferation of multiple similar, but actually different, standards which can lead to difficulties in trading and compliance.

It would be helpful for international or regional standards to be adopted whenever possible adding, if necessary, national annexes to address local issues. This would provide an easier route to harmonisation at a later date.

On one hand, there is a call for international standardisation bodies to continue their efforts to accelerate the development process of standards as much as possible. On the other hand, if there is a patent need for standards to be developed at the national level, then it is important that consideration and support in the context of broader standardisation concepts, such as consistency, harmonisation and global best practice, are adopted. While it is appreciated that the local environment, demographics and immediacy of addressing an issue can sometimes lead to a need for quick solutions, this report demonstrates that most technologies already have standards developed or are in the process of developing them. Dialogue with the relevant standardisation bodies should therefore take place before local standards are developed.

2.3.2. Regional standards

Many renewable energy standards are developed to meet a specific need in the market, such as to comply with legal directives and regulation. A good example of this would be the CEN's standards for the sustainability of biofuels in Europe, which are specifically being developed to support compliance with the elements that the European Commission suggested would be helpful under the Renewable Energy Directive.

The European standards development programmes, in CEN and CENELEC, are more advanced than in other regions. However, even in CEN and ISO there appears to be a lack of synchronisation between development at the European and international levels. Some, but not all, of this is due to the timing of regulatory requirements. There are also still strong suspicions that international standards will not take local requirements fully into consideration.

With both European and international standards, more focus is placed on the products to be manufactured than on evaluation of the project, design and installation of the technologies.[12]

Established competencies for the delivery of installations, which would fundamentally support quality installations, are also lacking. The EU Renewable Energy Directive includes requirements for installers to be certified. Although work is progressing in establishing common transboundary acceptability for the necessary certification,[13] there appear to be difficulties in establishing common competency criteria. Standardisation, by providing consistent and harmonised competency criteria for installers, can significantly support the deployment of quality renewable energy systems.

In certain circumstances, particularly prevalent in Europe, regional legislative bodies or organisations request the provision of standards that directly support legislation and regulation. These are sometimes called Mandated Standards, and in the EU[14,15], may be requested by organisations such as the European Commission (EC) and/or the European Free Trade Association (EFTA) Secretariat. The mandates are generally considered as falling into three types:

- » Standardisation mandates: to develop and adopt European standards within a given time;
- » Programming mandates: to elaborate a standardisation programme; and
- » Study mandates: to check the feasibility of European standardisation in a specific field or for a certain subject.

The request for a mandate can, however, be initiated by an external interested party (e.g. the European standardisation bodies) or by the EC itself. The request could be made for various reasons; however, a typical example would involve the integrity of the EU markets. Standards could also be proposed to support the operational aspects of an EU directive, to remove barriers to trade, or to assist in research and development.[16]

Mandates are issued for various reasons including the promotion of technologies, environmental issues, safety/consumer protection, requests from industry, harmonisation of national legislation, EU directives, or CE marking (EU).

The use of mandates is a particular aspect of collaboration between the European Union and standards-making bodies and could be easily replicated in other regions where political collaboration takes place.

What might be even more useful from a trading point of view, and would facilitate global trading, would be to use formal international standards as the leading documents setting product requirements.

For legislators, the ability to have standards developed by experts under a consensus process means that the acceptance of a particular directive's compliance routes can be deemed to have been stakeholder-driven. This is a very effective way of having quality compliance mechanisms and tools, which all stakeholders have had an opportunity to help shape.

It was not clear during the development of this report if the European model is being replicated in other regions, or if it will be replicated as co-operation between regulators and standards-makers increases. However, it would seem unlikely on the basis that most of the regions investigated have only a fragmented or limited regional system of standardisation and there is no apparent close association on this aspect between countries in other regions. However, work is ongoing to encourage the acceptance of international standards as support for legislation and regulation.

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12 The Inventory analysis shows 60% of the standards are product-oriented.

13 Quali-Cert in Europe is looking at transboundary acceptance of installer skills, knowledge and competencies.

14 Details of the CEN Business Operations Support System (BOSS), guidance documents and mandates, can be found under "Supporting Material" on the CEN BOSS website www.cen.eu/boss /Pages/default.aspx

15 EC Enterprise and Industry website: A standardisation request (mandate) is a demand from the European Commission to the European standardisation organisations (ESOs) to draw up and adopt European standards in support of European policies and legislation. European standards, even when developed under a mandate and for European legislation, remain voluntary in their use

16 At the European Commission, on 4 October 2012 the Council adopted the new Regulation on European standardisation. This Regulation aims at modernising and improving the European standardisation system. The Regulation applies from 1 January, 2013 (http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/intm/132723.pdf).

2.3.3. National standards

All developed countries, and a significant number of developing countries, in the world have their own national standardisation body or bodies (NSB).[17] These bodies develop and implement, or in some cases (e.g. ANSI), approve standards either at a national level or by providing the experts to engage in the development process of standards.

NSBs can become members of both the International and Regional Standards Bodies. As already mentioned, ISO has three categories, Full members, Correspondent members and Subscriber members, while the IEC has two membership categories, Full and Associate. Both organisations publish detailed descriptions of membership and members' rights on their websites.

Many countries have developed their own standards as well as either adopting or publishing regional or international standards as they become available. Where there are evident conflicts between standards, the national standards are generally withdrawn in favour of regional or international standards. However, this depends on the country in question and the status of the standard.

2.3.4. Organisation's standards

Organisation's standards, scheme documents, codes of conduct and guidance are often developed to meet a specific need within the organisation(s) they concern or for the management of a scheme operated by the organisation(s). These documents will typically be established by the experts in the organisation(s) or by external experts for the organisation with a specific task.

For initiatives for a broader audience, such as Bonsucro, RSB, RSPO, a consensus approach to the development of the documents is often sought. Where experts have been involved with formal national, regional and international standards, it is common to see the standards document structured according to a typical international standards framework.

Unless the documents are referencing regional or international standards there may be no relationship to other standardisation bodies.

Some examples of organisation's standards, scheme documents, codes of conduct and guidance have been included in the standards inventory of this report to illustrate how standards and scheme documents are developed for organisational purposes. A number of examples are also shown in the box below. It should also be noted that when there are conflicting standards in the market, it is difficult for the user to establish which are the most appropriate, especially when they are not in synchronisation with the international or regional standards.

The issue of wind turbines and bird strikes is typical of the aspects of renewable energy that are of global concern. Working towards globally or regionally agreed standards and assessment methodologies would greatly support addressing such types of issues. The same principle could also be addressed for other environmental concerns, such as for the protection of bats. In addition to the environmental impact of renewable energy, planning is increasingly becoming an issue, especially in areas where planning policies are well established and lobby groups can articulate their objections on visual amenity, or impact on historic landscapes.

Global standards and protocols written by standards-makers working in close collaboration with government policy-makers on what would be the standardised approach, assessment criteria, methodologies and guidelines for the assessment and acceptance for renewable energy technologies in a particular geographical location, would be very useful tools to increase deployment of technologies. They would be particularly useful in places which are increasingly becoming more sensitive to the impact of renewable energy installations.

However, for these standards and protocols to succeed, participating members would have to agree on up-front principles and commit to adopt the standards, protocols or guidelines and implement them within legislation wherever possible. Reaching this consensus would be an additional task to the development of the standards and protocols.

The recommendation 1 (page 19) is not new. IEC[18] and other organisations have made similar recommendations, although it seems that their recommendations have not yet been addressed in a timely manner.

17 ISO members list - http://www.iso.org/iso/home/about/iso_members.htm; IEC members list - http://www.iec.ch/dyn/www/f?p=103:5:0. ISO and IEC only allow one member per country. However some countries, such as Japan, have more than one standardisation organisation.

18 IEC MSB (Market Strategy B oard) White Papers – www.iec.ch/whitepapers.

Examples – Organisation's Standards or Scheme Documents

Det Norske Veritas AS (DNV) has developed a number of standards and documents for the support of shipping and renewable energy. A recent example is DNV-OS-J101 Design of Offshore Wind Turbine Structures: Principles, technical requirements, and guidance for offshore wind turbine structures and Life-cycle approach covering design principles through decommissioning, Sept 2011. DNV is also coordinating work on increasing the reliability of large offshore wind turbine blades. This work may lead to updated or additional DNV standards or global standards in the future. DNV also currently has DNV-DS-J102 Design and manufacture of Wind Turbine Blades, Offshore and Onshore Wind Turbines: Detailed interpretation of the basic requirements for blades including design, manufacturing, and testing, Oct 2010.

MCS (the UK's Microgeneration Certification Scheme) has developed scheme documents to support the certification of renewable energy products and installation companies. The MIS3003 Design and installation of wind turbines has been based on the Energy Saving Trust's CE72 Installing small wind-powered electricity generating systems. The MCS document was developed because there was no international standard to base the certification of microgeneration wind turbines on (up to 50 kW).

Bonsucro, formally the Better Sugarcane Initiative, has developed its own Production Standard against which companies can be certified. This is an organisation's standard and, while it was developed by a group of experts and was consulted upon, it is not a national, regional or internationally recognised standard by the NSBs.

In 2011 Birdlife South Africa and Wind Energy Specialist Group (BAWESG) developed the Best Practice Bird Monitoring Guidelines for Southern Africa. The document was written for environmental practitioners with the intention of standardising the approach to monitoring across wind projects. This collaboration shows a good utilisation and acceptance between differing stakeholders on a harmonised approach to an issue. By providing this monitoring standardisation the stakeholders can be confident that the data provided should be acceptable, if carried out to the standards.

Along with the Bonsucro standard and the guidance on monitoring birds, there are many other documents that either reference international or regional standards or are stand-alone documents that may be useful to be referenced in one place.

Recommendation 1 – Further assess and implement activities specifically supporting policy-makers and legislators in their efforts to reduce common globally occurring barriers

There is scope for investigating and promoting the development of standards and/or guidance for globally occurring issues that may require international frameworks. These standards and guidance, when implemented via international or regional standards, would eliminate existing barriers to the trading and deployment of renewable energy technologies. Such barriers might include environmental concerns, such as bird and bat assessment methodologies and visual amenity assessment protocols.

2.4. Certification, verification and auditing

Certification against standards is provided through a verification and auditing process based on benchmarking against criteria and scheme documents. Verification and auditing can be established internally within an organisation (i.e. first party) or by second-party conformity assessment organisations that provide an independent, but not necessarily accredited, process of conformity assessment. Finally, third-party conformity assessment is often carried out by independent certification, inspection and laboratory accreditation organisations where the certification body, inspection body or laboratory is in itself "accredited", for the particular testing schemes it offers, by an accreditation body operating under international standards and agreements.[19] Quality results are sometimes achieved by a process of peer assessment, used in place of conformity

19 The International Accreditation Forum (IAF) is the world association of Conformity Assessment Accreditation Bodies and other bodies interested in conformity assessment. Within the IAF there are Multilateral Recognition Arrangements (MLA) between its accreditation body members in order to contribute to the freedom of world trade. IAF states that: " its primary function is to develop a single worldwide programme of conformity assessment which reduces risk for business and its customers by assuring them that accredited certificates may be relied upon. Accreditation assures users of the competence and impartiality of the body accredited." www.iaf.nu

assessment by bodies that have International Accreditation Forum (IAF) accreditation.

The advantage of the last two options is that they offer a verification, audit and conformity assessment process throughout the certification process. Advantages of the IAF conformity assessment include the fact that certification and inspection bodies or laboratories can demonstrate consistency across processes and organisations; and, where the verification and auditing can be delivered by more than one body or laboratory, the certification or inspection bodies or laboratories can be audited to provide verification of consistency between the organisations. This process also offers the strong advantage of having its results recognised globally through the Multilateral Recognition Arrangements (MLA).

Figure 2 demonstrates how a typical conformity assessment process can be achieved. The conformity assessment may be carried out through a formal third-party independent certification or through other verification and auditing routes. The conformity assessment process establishes that the product, process, service, management system, etc., meets the requirements clearly laid down in the appropriate scheme, standards or other documented system.

Using a formal accredited conformity assessment process under the Multilateral Recognition Arrangements (MLA) of the IAF and ILAC[20] should make policy-makers, legislators and regulators confident that a consistent and harmonised level of compliance is being achieved. This is done through conformity against international standards for conformity assessment, as well as any other documents and requirements necessary for achieving conformity.

Accreditation is not necessarily a requirement for all aspects of conformity assessment (hence the dotted line between the Accreditation and Conformity Assessment boxes in Figure 2). Conformity assessment of products, services, management systems, etc. can be carried out in the same way as performed by accredited organisations, but by bodies without formal accreditation. However, formal accreditation does allow a level of confidence that whatever product or service is being conformity assessed, (e.g. certified, type-tested, etc.) the assessment is being carried out by an organisation that has had to demonstrate its competence to do the conformity assessment.

This last point is important for legislators and regulators, who are ever increasingly looking to conformity assessment as a route to compliance with the law or with renewable energy support mechanisms.

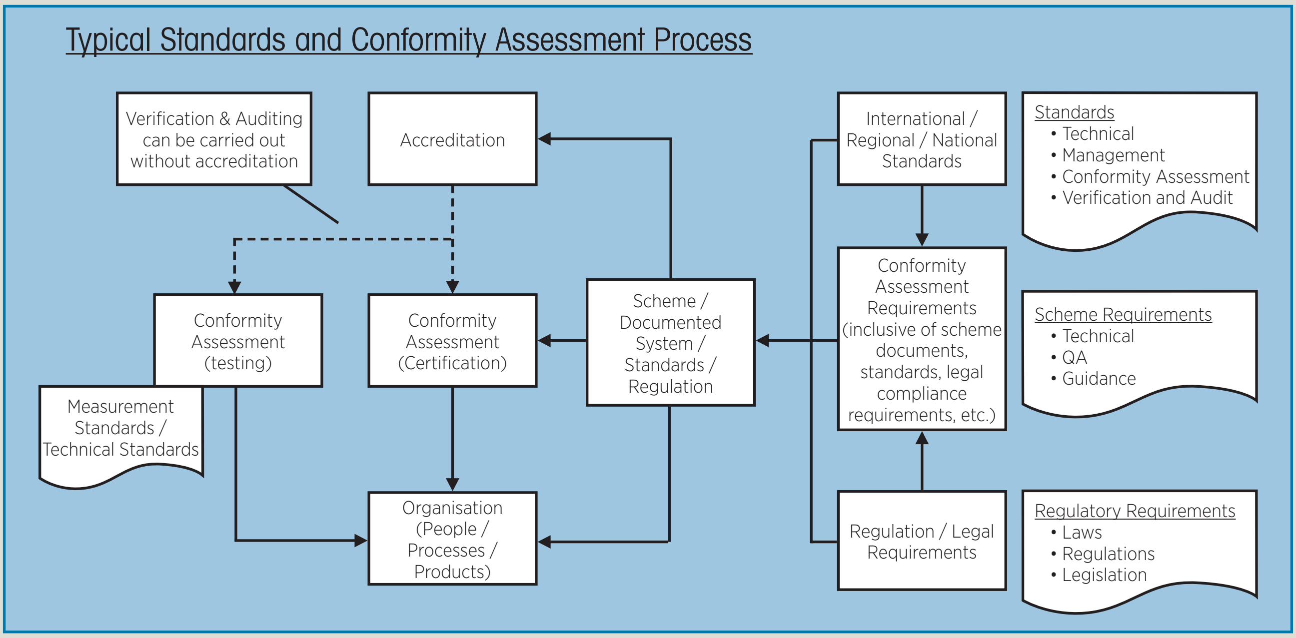


FIGURE 2: TYPICAL STANDARDS AND CONFORMITY ASSESSMENT PROCESS

20 ILAC – the International Laboratory Accreditation Cooperation – is an international cooperation of laboratory and inspection accreditation bodies, which operates in a similar way to IAF. In many cases the cooperation partners are the same. www.ilac.org

In many cases when legislators and regulators use standards and certification as a demonstration of compliance, they need to demonstrate that there are no trade barriers by offering “or equivalence” statements in legislation. Accredited conformity assessment routes provide such confidence.

It is important that the conformity assessment is appropriate to the level of confidence required. Therefore company-to-company or department-to-department assurance that a process is being followed for a specific project may need less conformity assessment than when assessing compliance against regulation. These aspects of the conformity assessment process are managed through the requirements, in scheme documents, determined by those looking for conformance.

Third-party independent certification, inspection and laboratories activities are typically based on ISO/IEC standards. This provides a framework that enables accreditation bodies to provide consistency through a common approach. However, unlike many standards, such as product standards, conformity assessment standards allow interpretation by the certification and inspection bodies and laboratories as the standards are designed as a framework within which certification, inspection and laboratory testing operate. This usage is more closely aligned to management standards, which also provide a framework within which operators establish their procedures and processes.

Third-party independent certification also falls under a number of types of certification process. A detailed description of the types of certification scheme is shown in Annex 4. However, they fall broadly into Product Certification [21] (e.g., ISO/IEC Guide 67 & ISO/IEC Guide 65 [22]), Personnel Certification (ISO/IEC 17024), Laboratory Testing (ISO/IEC 17025), Management Systems Certification (ISO/IEC 17021).

ISO/IEC Guide 67:2004 (Conformity assessment – Fundamentals of product certification) sets out the types and context for the certification while also categorising the requirements for providing the appropriate level of assessment, e.g. whether or not the certification requires a quality management system to be evident. [23]

Figure 3 [24] is useful for the purposes of a) illustrating the processes carried out in certification, verification and auditing, and b) explaining the differing requirements dependent on what the certification scheme is to be used for.

Standards cannot require certification as part of the standard. However, standards can be written so that others can use them for certification. The difference between these statements means that when developing standards, standards-makers have to ensure that the requirements of the standards do not force organisations into a certification route. However, if a standard is likely to be used for certification or another type of conformity assessment there needs to be careful consideration during the development of the standard of how the clauses can be verified and audited.

The World Trade Organization (WTO) has expressed its concern that the development of certification schemes can be protectionist. The WTO, under its Technical Barriers to Trade (TBT) Agreement, states:

Conformity assessment procedures

“Conformity assessment procedures are technical procedures — such as testing, verification, inspection and certification — which confirm that products fulfil the requirements laid down in regulations and standards. Generally, exporters bear the cost, if any, of these procedures. Non-transparent and discriminatory conformity assessment procedures can become effective protectionist tools.”

This is particularly important when the standards are being developed for compliance with Directives, such as EU Directives, as the tendency is to make them robust by requiring third-party certification.

In developing countries, the testing and certification of renewable energy equipment for off-grid or small-scale applications faces key challenges. If additional conformity assessment is required in the region, the establishment of the required institutional framework to operate a certification scheme, as described above, would require resources and funding to make it sustainable. Testing facilities would probably also be required, and might be built locally or

21 Within standardisation, ISO and IEC define product within certification as “product”, “process” or “service”, except in those instances where separate (provisions) are stated for “processes” or “services”. Definitions of product, process and service are given in ISO/IEC 17065.

22 ISO/IEC Guide 65 is in the process of being revised and will be published as ISO/IEC 17065.

23 ISO/IEC Guide 67 does not specify what the Quality Management System (QMS) should look like. It is up to the accreditation body, certification body or organisation operating under the certification to provide evidence that the system provides a sufficiently robust process to deliver against the standards.

24 ISO/IEC Guide 67, Table 1 on Page 5 illustrates the elements of a product certification system.

Table 1- Building a product certification system

Elements [a] of product certification system	Product certification systems [b,c,d]							
	1a	1b	2	3	4	5	6	*N*[e]
1) Selection [f] (sampling), as applicable	x	x	x	x	x	x		
2) Determination [f,g] of characteristics, as applicable, by:	x	x	x	x	x	x	x	
a) testing (ISO/IEC 17025)								
b) inspection (ISO/IEC 17020)								
c) design appraisal								
d) assessment of services								
3) Review [f,g] (evaluation)	x	x	x	x	x	x	x	
4) Decision on certification Granting, maintaining, extending, suspending, withdrawing certification	x	x	x	x	x	x	x	
5) Licensing (attestation [f]) Granting, maintaining, extending, suspending, withdrawing the right to use certificates or marks		x	x	x	x	x	x	
6) Surveillance, as applicable by:								
a) testing or inspection of samples from the open market			x		x	x		
b) testing or inspection from the factory				x	x	x		
c) quality system audits combined with random tests or inspections						x	x	
d) assessment of the production process or service				x	x	x	x	

a Where applicable, the elements can be coupled with initial assessment and surveillance of applicant's quality system (an example is given in ISO/IEC Guide 53) or initial assessment of the production process. The order in which the assessments are performed may vary.

b A product certification system should include at least the elements 2), 3) and 4).

c An often used and well-tried model for a product certification system is described in ISO/IEC Guide 28; it is a product certification system corresponding to system 5.

d For product certification systems related to specific products, the term "scheme" is used (see 3.2, Note 2).

e Reference [16] mentions system 7 (basic testing) and system 8 (100 % testing). These may be considered product certification systems if at least the elements of system 1a are included.

f See ISO/IEC 17000 for definitions.

g In some systems, evaluation means determination, and in other systems it means review.

Figure 3: Example of elements in a product third-party independent certification system

for a region. These facilities would require buildings and specialist equipment, which may have to be provided from further afield. The World Wind Energy Association, for example, calls for international standards for small wind turbines that include testing procedures specifically designed for small-scale turbines, which are transparent, practical and affordable.[25] A few examples of partial solutions are already available at the international level, such as the PV GAP programme from the IEC's IECEE system.

2.5. How standards work

In most cases the use of standards is voluntary. The only area where this is different is when the standards are used for regulations, legislation, or within legal contracts.

This is an important issue for publishing the standards, because while standards are developed on a consensus basis, their introduction into the National Standards Bodies

25 World Wind Energy Association (2012) Small Wind World Report 2012. Bonn, Germany.

(NSB) depends on a number of criteria, including the relationship between the relevant standardisation bodies. This is particularly the case in Europe were NSBs will be required to publish the documents depending on the status of the standard. Annex 1 describes the relationships between NSBs in more detail.

Example of relationship between European regional and national standardisation bodies

European Standards developed by CEN and CENELEC require that NSBs within the European Union and those signed up to the European standards agreement adopt the full European (EN) standards and publish them. However, NSBs are not obliged to publish Technical Specifications, which they may adopt or not as they feel appropriate.

Where a standard may have an impact on international trade it also has to be notified to a defined body (Code of Good Practice for Standardisation of the WTO TBT agreement [26]).

Standards establish the specifications and processes that provide a consistent product, service, management system, etc. to operate under. This allows for a harmonised approach and hence compatibility and comparability between those products or services operating under the standards. Here, it is also important to consider regional or national mandated standards because when standards are developed for a specific market region, they may conflict with other regions or aspects of trade. For example, bioenergy resources produced in Asia or Africa for export into Europe will have to comply with European requirements, although other regions may have different compliance requirements, as might the country of origin.

To increase the global tradability and compatibility of products and services, it is important that, wherever possible, standards are harmonised globally to ensure they are truly trans-boundary. There are many examples of regional standardisation that have improved trading. A particularly good example is the harmonisation of electrical sockets, where just six profiles now cover the majority of the world.

It is also necessary to understand that the setting of threshold values or criteria (e.g. on quality or performance of equipment) in itself is not necessarily "the standard". For instance: The threshold value may be for a product to have an operational life of 10 years, but how is the value of 10 years set, and to what methodology?

For threshold values and criteria to be valid they invariably need to be based on some underlying "requirement", "scheme document" or "standard" that is measurable or quantifiable. While many formal standards have minimum requirements, such as the thickness of steel, the way a weld is constructed, the efficiency of a boiler to be classified within a certain band, these are effectively the operating boundaries. Where standards are used to support policy mechanisms, the standardisation bodies prefer to establish standards that provide the framework to measure against while leaving the thresholds to be provided by others. [27]

The distinction between "threshold values and criteria" and "standards" is important because standards lay the foundations and, when formally developed by standards-making bodies, they can be recognised and utilised as the established requirements.

Scheme and standards documents within a certification scheme typically supply the threshold values and criteria requirements, and how these are established or demonstrated. The scheme documents may be a standard in their own right, such as Energy Management (ISO 50001), or Management Standard (ISO 9004), or a collection of requirements to be demonstrated. In the latter case conformity to certain standards may be part of the scheme documents – the MCS [28] (Microgeneration Certification Scheme) in the UK is a good example of this.

Standards are typically written with either specific requirements within the standard, or definitions of upper and lower thresholds.

Thresholds are the boundaries within which the requirement or characteristic complies, such as when a product is banded, i.e. its characteristics fit within certain parameters. In the illustration in Figure 4, classes of boilers have

26 WTO, Agreement on Technical Barriers to Trade, Annex 3: Code of Good Practice for the Preparation, Adoption and Application of Standards - www.wto.org/english/docs_e/legal_e/17-tbt_e.htm#annexIII

27 Examples of policies referencing standards include, but are not limited to: FiT, RHI, RHPP, Air Quality from Biomass Combustion, ROC – demonstration of compliance for the biodegradable fraction of SRF.

28 MCS is the UK Certification Scheme for Microgeneration products (electricity 45 kW and heat 50 kW) and the microgeneration installer companies. The MCS is a third-party independently assessed certification scheme based, wherever possible, on internationally or European developed standards. See www.microgenerationcertification.org

Example – Thresholds and specific requirements

The example below, although from Europe, would be applicable for any standard that has upper and lower threshold values.

Currently the European Standard for heating boilers, EN 303-5:1999, has three classes, based on boiler efficiency and nominal heat output. The class of a particular boiler is determined using strict laboratory methods and is represented in the standard with a chart from which the boiler's class can be read.

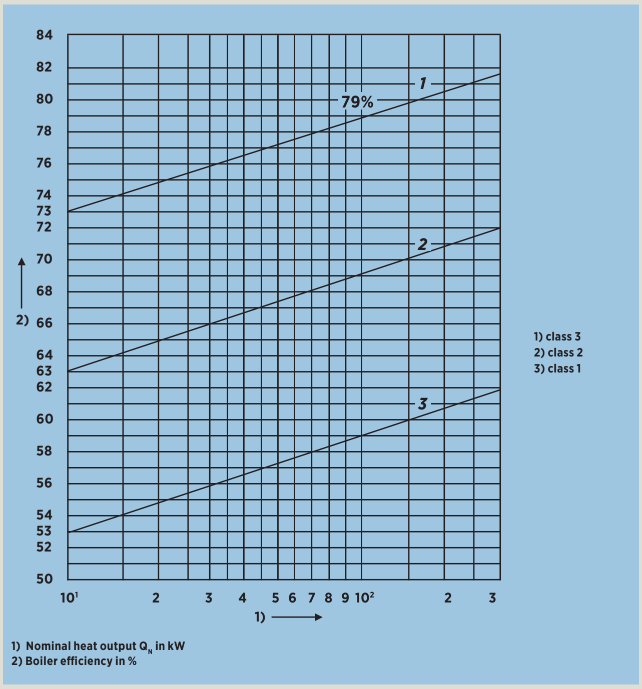


Figure 4: Example from the EN 303-5:1999 standard for heating boilers on threshold values setting

The upper and lower threshold values for each class would have been determined at the time of the standard's publication as being good boundaries for the technology at the time. However, these classes are somewhat arbitrary, i.e. they could have been established at any agreed values and the threshold values could change over time as technology improves.

Regulators who require assurance that the solid biomass resource is being used effectively and efficiently can specify either a minimum efficiency number, e.g. >65%, or that a boiler is in Class 2 or a higher class. Specifying the latter (i.e. a class) reduces possible barriers to trade, as any product falling within the class thresholds is acceptable. If the minimum number is specified, the producers of products on the lower threshold may feel discriminated against and have difficulties selling their products.

Positive discrimination can be a good way of increasing the efficiency of products or other product specifications. However, at the time the lower efficiency threshold may have been set at a level where the majority of the products on the market were positioned.

been established using efficiency and nominal heat output within EN 303-5:1999. Including threshold parameters, or the ability to set consistent threshold parameters against the standard, ensures that the standards provide measurable outcomes that can be used for demonstration of compliance.

Another issue that is raised by having standards with multiple routes or methodologies for compliance is the potential of unintended consequences arising when consensus is not reached and national annexes are included in the standards. When consensus cannot be achieved and different routes to compliance are accepted, there needs to be a duty of care to provide round-robin verification and testing of methodologies in order to ensure that harmonisation can be achieved.

2.5.1. Harmonisation of standards

Standards function best when they are harmonised. This is recognised by the majority of stakeholders, including governments around the world. As stated previously, standards are typically voluntary, and therefore the selection of which standards to adopt is at present up to each user of the standards.

Investigation into which standards are utilised in a particular area appears to show that there is no consistency in the selection of the standards. This causes issues around implementation and conformity in a field with different standards operating in the same region. This may create barriers to trade as the economic and technology thresholds may be different.

Since standards are inextricably linked to trade, commercial opportunities and political alliances, the ability for

countries and regions to offer support in the deployment of renewable energy technologies is greatly enhanced if the standards used in other national or regional areas support the ability to promote conformant products. By using this "gaming"[29] approach to renewable energy deployment and standards, the underlying commercialism of the market can be nurtured.

> "Conflicting national / regional standards create opportunities for early entrants and market confusion for clients" *a BSI Manager*

Similar to the politics of developing standards discussed above, there is also a potential for using standards to support a developing country or market. If the standards are harmonised from an international source, the ability to support competitive advantage through the selection of standards giving an advantage to one set of technologies over another is diminished.

Until a truly harmonised approach to standards is established, it will be difficult to address this issue. However, developing stronger regional standardisation organisations[30] that adopt harmonised approaches to standards, as has been achieved with the European model, may be a good starting point. This has already been attempted in APEC, where it was found to be more difficult in areas with differing standards engagement commitments, e.g. Australia, Canada, China, Korea, Japan, Malaysia and USA, who are all more engaged in international standardisation and find less necessity for regional standards. While the European model does not resolve all the issues, it does provide a framework into which others can integrate.

To achieve harmonisation it will be necessary to ensure that standards are developed with a true focus on global relevance wherever possible. This also applies to the identification of standardisation needs during the establishment of new work items (i.e. proposals for new standards, submitted to the standardisation body).

In the case of existing standards, the inventory indicates a considerable amount of cross-over between development bodies. There may therefore be a need for greater consolidation of the standards. Extending the current renewable energy inventory and gap analysis to determine whether consolidation of the standards is appropriate could be a good start in this process.

There could also be better liaison between the current standardisation bodies in the field of renewable energy to ensure that a more coordinated approach is taken to standards. This could potentially require closer management of New Work Item (NWI) proposals between standards-making bodies to ensure that standards are developed in the most appropriate arena and only produced once.

To ensure that new work items and the updating of standards address the harmonisation issues listed above, it is probably necessary to review the way in which standards development and updating is carried out. An example of how this could be addressed is shown in Figure 5 and has already been partially suggested by SAG-E within ISO. While there are some activities which work on addressing these issues, such as the IEC-CENELEC cooperation, the agreements between ISO and IEEE, and those between the IEC and IEEE, there is still further work to be done to ensure that full harmonisation of issues, including regional and international aspects, are covered adequately, or to ensure that cross-sectorial issues, that may not have been included, are considered in the future.

It is proposed that further criteria be developed within ISO in relation to renewable energy, and used so that any ISO new work items can be assessed by proposers or evaluated by the central secretariat.

It would be even more useful to have this review process across all the standards bodies. However, extending the review across standards organisations would require some form of panel, perhaps elected by the different standards-making bodies, to carry out the evaluation of proposals.

The benefit of having such a panel would be that aspects outside the group that receives the proposal may stimulate other important issues that need consideration. For example, the implications of a new work item for a standard for fire fighting and protection in buildings may be proposed – understanding of the implications on electric generating technologies, such as PV, may also affect the safety system. This approach may also be valid for the review of policy direction or other aspects (in relation to standardisation) that may impact on the deployment of renewable energy.

An additional issue that was highlighted in the APEC report is the fact that most experts engaged in the standardisation

29 Gaming – in this context means gambling or playing a game of chance i.e. the ability to play the odds and gain competitive advantage.
30 APEC 21st Century Renewable Energy Development Initiative (Collaborative VI): Adoption of Renewable Energy Standards Phase II report, 2006 illustrates how a collaborative approach can support a region.

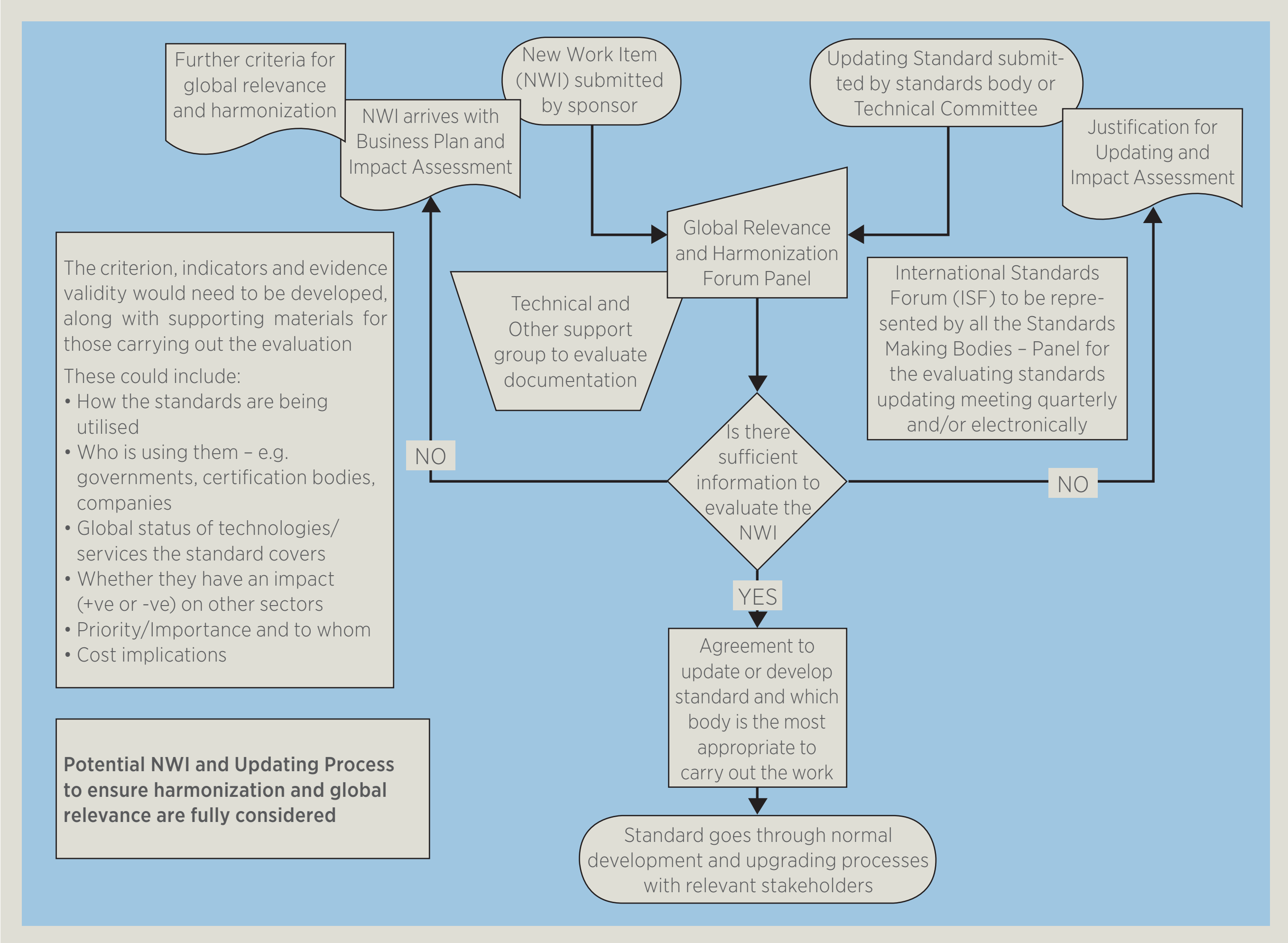


Figure 5: Process proposed for new work items in standardisation bodies

process do so in addition to their day job, which restricts the time they have available. A lack of funding often means that there are significant peaks and troughs in how often the experts can engage in the development of standards.

However, most experts are firm believers in the value of standardisation and dedicate an inordinate amount of time (often to the detriment of other projects) to developing and maintaining standards; they should be highly commended for their efforts. Without this invaluable effort, there would be no standards. Unfortunately time and funding issues mean that standardisation is sometimes a hostage to fortune, in terms of the efforts that can be devoted to it. In most cases everyone finds the time in between their other activities, although due to the increasing demands and development of the renewable energy sector, finding that time, effort and financial support is becoming even more difficult than was identified in the APEC 2006 report.

> "I can't afford a week out of my office on unpaid work and even if I could the costs are prohibitive"
>
> *a common comment from experts*

Some of the time constraints for international meetings are the length of the meetings, as they typically stretch up to a week or more, and although they may only be held once or twice a year and coordinated to allow engagement in multiple working group activities, they have major cost implications.

While the standards-making bodies are increasingly turning to electronic forms of working, such as webinars and conference calls, these are still not as effective as face-to-face meetings. The limitations of electronic communication technologies and the time differences often make it difficult to achieve full participation.

While every nation supports standardisation in different ways, it is important that governments ensure that those supporting the standards development process are recompensed in an appropriate way. Although in many cases

Example – Costs of engagement for technical experts

In the UK the government, through BSI, contributes towards the costs for experts to attend standardization meetings abroad. The contributions have significantly decreased over the past five years due to financial pressures. It is recognised globally that BSI and the British government are perhaps one of the more generous funding organisations when it comes to contributing to experts' travel costs. Also the BSI, unlike other national standards bodies, does not charge for membership and engagement in national committees. However, the costs are still significant.

For travel to anywhere in Europe the contribution provided is GBP 370 (approximately USD 595). However, the cost of travel, hotel accommodation, food, rail fares, buses, taxis, etc. for a three-day meeting can be in the order of three times that figure.

This shows that the costs of attending meetings are significant, even for experts from affluent countries. For those travelling further afield from less affluent countries the costs can be prohibitive, especially for technical experts without the backing of large organisations and trade associations.

a company will pay for one of their experts to attend, this can create an issue around who can afford to engage in the standardisation process and who cannot. For others the finance often comes out of the company's income, which means there is less to invest in other activities. These funding issues occur across the board, and are not confined to developing countries.

Due to the global economic crisis, companies and individuals are increasingly withdrawing from engaging in the standardisation process, which inevitably means there are fewer experts trying to manage the same workload.

If international governments believe that standardisation is an important aspect of deploying renewable energies, then a new emphasis also needs to be placed on supporting the technical experts in providing harmonised standards.

Recommendation 2 – Mechanisms to support experts' involvement in standardisation are essential

A review should be undertaken of resources available to support the development of standardisation, with a specific focus on technical expert engagement, the barriers and how the governments could better support this process. Mechanisms to support the experts with their related costs should also be explored. Additionally, where technical expertise is limited, or is not available, it is necessary to provide an understanding of what needs to be established to enable technical engagement in standardisation. For example, a bursary scheme for technical expert engagement could perhaps be established, with a particular emphasis on developing countries' experts; a list of experts who could be engaged to support a particular field could also be developed.

2.5.2. ISO strategic advisory group on energy efficiency and renewable energy

The ISO Strategic Advisory Group on Energy Efficiency and Renewable Energy (SAG-E) was created following the ISO Council Taskforce 2007 report, which established the group to carry out a strategic review of standardisation in these two fields. SAG-E spent three years reviewing the work of the Technical Committees in ISO and proposed a number of new work items, which are now progressing. At the group's final meeting in Pretoria in January, 2011, it was agreed that while SAG-E had carried out good work, it needed to focus on a more externally engaging strategic mapping exercise to ensure that ISO's activities in the fields of renewable energy and energy efficiency remained appropriate over time. The group also identified areas that SAG-E had still not considered fully, such as how other sectors were impacted by, and impacted on, renewable energy and energy efficiency, and how standards impacted on developing countries.

ISO SAG-E has submitted and has had accepted a proposal by the ISO Technical Management Board (TMB) to carry out such a strategic mapping exercise which will, as part of its remit, look outside the typical standards development environment and its stakeholders to better understand broader stakeholder needs and requirements and so ensure that standardisation remains fit for purpose in the future. Harmonisation of standards and how they should be adopted should form part of the strategic thinking. A two-year work programme, which will include an outreach programme of workshops, questionnaires and other engagement activities, has been proposed for this work.

The SAG-E mapping exercise would be the start of a more value-added review process to support standards development and strategic direction in the future. This may include a permanent review and oversight body for the fields of energy efficiency and renewable energy.

The IEC's Strategic Group 1 (SG 1), *Energy Efficiency and Renewable Energies*, has now been redefined to deal only with energy efficiency, since the technical committees dealing with renewables are deemed by IEC to be following adequate strategies. In order to examine whether this finding covers the whole renewables field, the IEC has put a temporary group in place.

Recommendation 3 – Stakeholders' engagement in the ISO SAG-E and support of the strategic mapping exercise is important

Pathways should be established to connect standards users and the ISO SAG-E team working on the strategic mapping exercise. There are valuable opportunities to create a forum for engaging with the ISO SAG-E team, particularly as part of its mapping exercise, and making feedback from stakeholders available to the team.

2.6. How standards are used

Standards are an important aspect of ensuring that products and services are delivered in a harmonised and consistent way, while providing consumers and users with the confidence that whatever products and services they are using deliver to specification. Many of the standards identified provide this support by ensuring that, for example:

- The characteristics of a particular component are measured, calculated or evaluated in a consistent way – typically these may be the determination of chemical and physical properties.
- The ability exists to demonstrate the performance of the product, such as a solar photovoltaic panel or a wind turbine, against an established measurement protocol or criteria.
- Sampling and sample reduction is carried out in the same repeatable manner, e.g. the sampling of solid biofuels, which have historically had wide variance in quality, even though the products were manufactured to apparently specific tolerances.

However, other standards are used to allow the facilitation of trade, or compliance with regulations and legislation, by ensuring that declarations or certificates provided for a product or service are communicated and accepted as being to a consistent and harmonised quality or specification.

In addition to the above, there are standards that provide a consistent and harmonised approach to management systems, environmental management, energy management, conformity assessment and certification.

While third-party independent certification or conformity assessment cannot be required within product and service standards, many standards are used to demonstrate compliance within certification schemes.

As stated in the introduction to this report, this approach to regulation and legislation is being increasingly used by governments looking for consistency when delivering against policies and in particular when these policies are supporting fiscal incentives, such as Feed-in Tariffs, Renewable Obligations Certificates, Green Certificates, Renewable Portfolio Standards, etc. See the example of the MCS [31] below.

Over the last two years the Solar America Board for Codes and Standards (Solar ABC) has been calling for stronger integration of reliability standards and qualifications for PV modules into legislation based on the IEC standards. This call is aimed at ensuring that quality PV products are installed in the USA with a minimum defined standard.

The recently published report "Towards Achieving Universal Energy Access by 2030" [32] produced by the United Nations Foundation highlights:

"Without proper standards, energy products have the potential to be unsafe, perform poorly, and /or fail quickly in a fledging market. A regularly cited example of this in the U.S. solar thermal industry of the 1970s, where the lack of standards for equipment and installation is often blamed for a multi-decade setback in the widespread deployment of solar technology in the U.S."

31 MCS (Microgeneration Certificate Scheme) – www.microgenerationcertification.org
32 United Nations Foundation, Energy Access Practitioner Network – Towards Achieving Universal Energy Access by 2030, 2012

Example – Standards being used to reduce the burden of regulation

In the UK, where there are significant planning laws, the government has used the MCS as a way of lightening the process burden. With the rapid uptake of microgeneration technologies, there was a fear that there would be a significant impact on communities and neighbours' amenities from noise and flicker from wind turbines or heat pumps installed in inappropriate places. However, to aid deployment and to reduce the burden on installing the microgeneration technology, the government sought to provide a simpler approach to meeting planning rules, so that it was no longer necessary to submit a planning application to the local authority every time an installation was planned.

This was achieved by allowing "permitted development" status to wind and heat pump technologies that comply with an MCS standard on planning compliance.*

** Permitted development allows the authorities the ability to accept the development (in this case wind turbines and heat pumps) as being approved by the planning authority subject to meeting certain criteria. For more information on the UK's permitted development regulation see www.planningportal.gov.uk/permission/responsibilities/planningpermission/permitted*

While the solar thermal market was embryonic at the time, had there been stronger emphasis on a standardised quality delivery, solar thermal uptake might have been considerably higher in the US over the last 40 years.

Other areas of regulation that use standards to support policy include compliance with building regulations, where the building regulations directly reference standards that have to be used in order to be compliant with the regulation. This adherence to standards and certification has positively reduced the burden of compliance to regulation.

The use of standards is proving particularly important in the field of renewable energy and energy efficiency since, in an emerging and fast-growing market, the harmonised approach provides confidence in what is being installed.

Standards are also being used in the renewable energy sector to support best practice and regulation in areas such as health and safety. A recent gap analysis survey carried out by the Solar American Board for Codes and Standards [33] highlighted the need to establish harmonised approaches to fire prevention for photovoltaic systems, which have had a history of recent fires.

Establishing standards for fire system design – including fire protection incorporated into the products along with installer training – will reduce the risk of fires occurring. This harmonised approach can be achieved for different building integrated systems and can hopefully be replicated around the world.

Best practice with pragmatism through the standardisation process will ensure that cross-border trading of system components and installation can continue to grow, and will provide confidence to both consumers and policy-makers. Conformity assessment, and potentially certification, against the development of the harmonised standards will provide assurance that the safety elements of the standards (e.g. fire) are being complied with.

Promotion of the work being developed on fire and solar PV appears to be at a relatively early stage even though a lot of work has been carried out already. However, further promotion would be an important way of providing confidence and demonstrating that the issues are being resolved. It would also demonstrate that the industry and fire rescue community can work together to:

- Work with the stakeholders to find solutions that are appropriate for the technology, fire and rescue organisations and consumers;
- Take consumer safety seriously;
- Provide the policy-makers, legislators and regulators with solutions to issues within the existing frameworks, where standards are already used for compliance;
- Provide opportunities for those not already using a standards approach to compliance to use a support mechanism, which is easy to implement; and
- Provide manufacturers and installer companies clear guidance on how to achieve safe installations.

33 Solar American Board for Codes and Standards, 2010 Gap Analysis Final Report, July 2012.

Example – Standards being used as a basis for support of government policies

The MCS is a multi-stakeholder partnership between government (who own the scheme documentation and logo), the microgeneration industry and other interested parties. The MCS provides confidence to both consumers and the UK government that any installed microgeneration technologies under 45 kW for heat and 50 kW for electricity, and the companies installing those technologies, meet minimum competencies. Up to the scales indicated, the UK's Feed-in Tariffs (FiT), Renewable Heat Premium Payment (RHPP), Green Deal and Renewable Heat Incentive (RHI) all require the products and companies to be third-party independently certified through MCS in order to be eligible for payment.

The MCS has based its scheme documents wherever possible on international and regional standards, to ensure that compliance can be met by the broadest of stakeholders. The scheme was approved by the Standards Directorate in the European Commission before being allowed to operate. The MCS establishes a minimum competency and quality requirement, which is reviewed and changed following evidence-based evaluation (such as field trials) as and when necessary. Many of the experts in the MCS technology working groups already engage in the regional and international standards development process, which ensures that the flow of information is two-way. One example of this working well has been in the wind sector where the MCS scheme documents are based on IEC standards. After a component failure and investigation through a certification body, it was identified that an IEC standard calculation methodology needed to be amended. As the standard was under review at the time, this was immediately brought to the Technical Committee's attention.

The MCS was established as a result of the direct need for appropriate quality assurance of installations, after the previous scheme, Clearskies, was considered inadequate. Clearskies allowed self-declaration of products, which were then included on a technology list. The failure rate of projects was deemed to be high and the confidence in the technologies was not enhanced by the experience. Clearskies also allowed access to UK grant funding through the government. Through the Feed-In Tariffs, and therefore by direct result of having certification based on scheme documents based on standards, the MCS scheme has registered over 350 000 installations (mostly in solar photovoltaic) in three years, from a base of just a few thousand.

MCS has enabled many products from across the world to engage in the UK's microgeneration sector.

Another area of environmental concern that is being supported through the use of threshold values and standards is the emissions from solid biofuel boilers (particulates [PM_{10}, $PM_{2.5}$] and nitrogen oxides [NO_x]).

The use of standards and the way in which they are developed have a particularly close relationship. Being involved with the development of standards allows organisations to have an input into shaping the final standard. This approach is generally positive and provides a broad stakeholder engagement and respect for the published standard(s). However, this approach can also pose dilemmas for the following reason.

The ability to influence the standards in a way that suits a particular stakeholder group or company's needs has been intensifying due to the closer relationship of the standards to regulatory and legislative deployment of renewable energy technologies, services and products, along with increasing global trading.

Depending on the dynamic of the group developing the standard(s) and the purpose of the standard (e.g. technical aspects or sustainability), the output of the standard may provide limited requirements on what can actually be agreed through the consensus approach. In most cases this is not an issue, as additional requirements to standards can be added for specific stakeholders' needs. However, in some circumstances (such as for commercial issues or politics), it could also mean that if the balance of the development group is not correct, the output of the standard could bias or impact on the ability to deploy the technologies.

It is therefore very important that the engagement process within standards development:

- » Is very clear about the scope and objectives of the standard;
- » Provides the appropriate stakeholders actively working on the standards;
- » Has the right balance within both the technical committees and their subcommittees; and
- » Has a strong leadership, with the best intentions from a global perspective.

2.6.1. Legality of standards

Adherence to standards is voluntary, unless they are a requirement of legislation or regulation, or are incorporated as part of a formal contract.

Standards are increasingly being used as compliance tools, whereby the compliance to the legislation, regulation, or contract is demonstrated by verification or self-declaration against the relevant standards.

The WTO Technical Barriers to Trade (TBT) agreement takes a close interest in the impacts of standards and the way they are implemented. WTO has an agreement that provides interpretation of the boundaries that standards have to comply with. This agreement, which has been signed by the international standards bodies as well as WTO's member states, makes a clear distinction between technical regulations and standards. The distinction made by the WTO is:

"The difference between a standard and a technical regulation lies in compliance. While conformity with standards is voluntary, technical regulations are by nature mandatory. They have different implications for international trade. If an imported product does not fulfil the requirements of a technical regulation, it will not be allowed to be put on sale. In case of standards, non-complying imported products will be allowed on the market, but then their market share may be affected if consumers prefer products that meet local standards such as quality or colour standards for textiles and clothing."

Source: Technical Information on Technical barriers to trade [34]

In terms of the development of renewable energy standards, an understanding of the basic WTO requirements by the technical committees would be beneficial. By having this understanding, the standards-makers will be aware of the requirements to ensure that universal standards, when used, are a prerequisite for international trading. Cases have already been brought to the WTO on protectionism around renewable energy.[35] While the WTO concern is not about the standards, others, such as Brazilian bioenergy producers, believe that the EC Renewable Energy Directive and the voluntary schemes and standards established to meet the requirements of the directive, may result in barriers to trade.

2.7. Interrelation between standards

Renewable energy standards are not often developed in isolation from other reference documents. Typically other standards, which have either been developed specifically in relation to the subject the standard is concerned with, or existing standards that provide an indispensable requirement of the standard, are used in the development process. These documents are called normative references.

It follows that the normative references may well have other standards that are referenced as normative references. This cascading of requirements has been demonstrated to be difficult to determine during a particular project as not all standardisation organisations provide enough detail of the standards to determine what documents would be required. This has the potential to be costly to the user of the standards, who would need to purchase all the relevant documents in the cascaded chain. Figure 6 below illustrates the cascading effect of standardisation.

While this report has identified a few standards that are cascaded and normative to the renewable energy technology standards, this is just an example of the interrelationship between standards relating to different industries, technologies and processes/services (e.g. steel types, gauge and welding requirements are required when building a boiler; electrical requirements; grid connection; testing methodologies; determining the characteristics of chemicals and mechanical properties).

The understanding of these interrelationships means that, even for a simple standard, there are potentially complex and multi-layered requirements within the standards, that need to be understood.

34 Technical Information on Technical barriers to trade – http://www.wto.org/english/tratop_e/tbt_e/tbt_info_e.htm

35 Dispute DS412 Canada – Certain Measures Affecting the Renewable Energy Generation Sector. See also WTO DS426.s

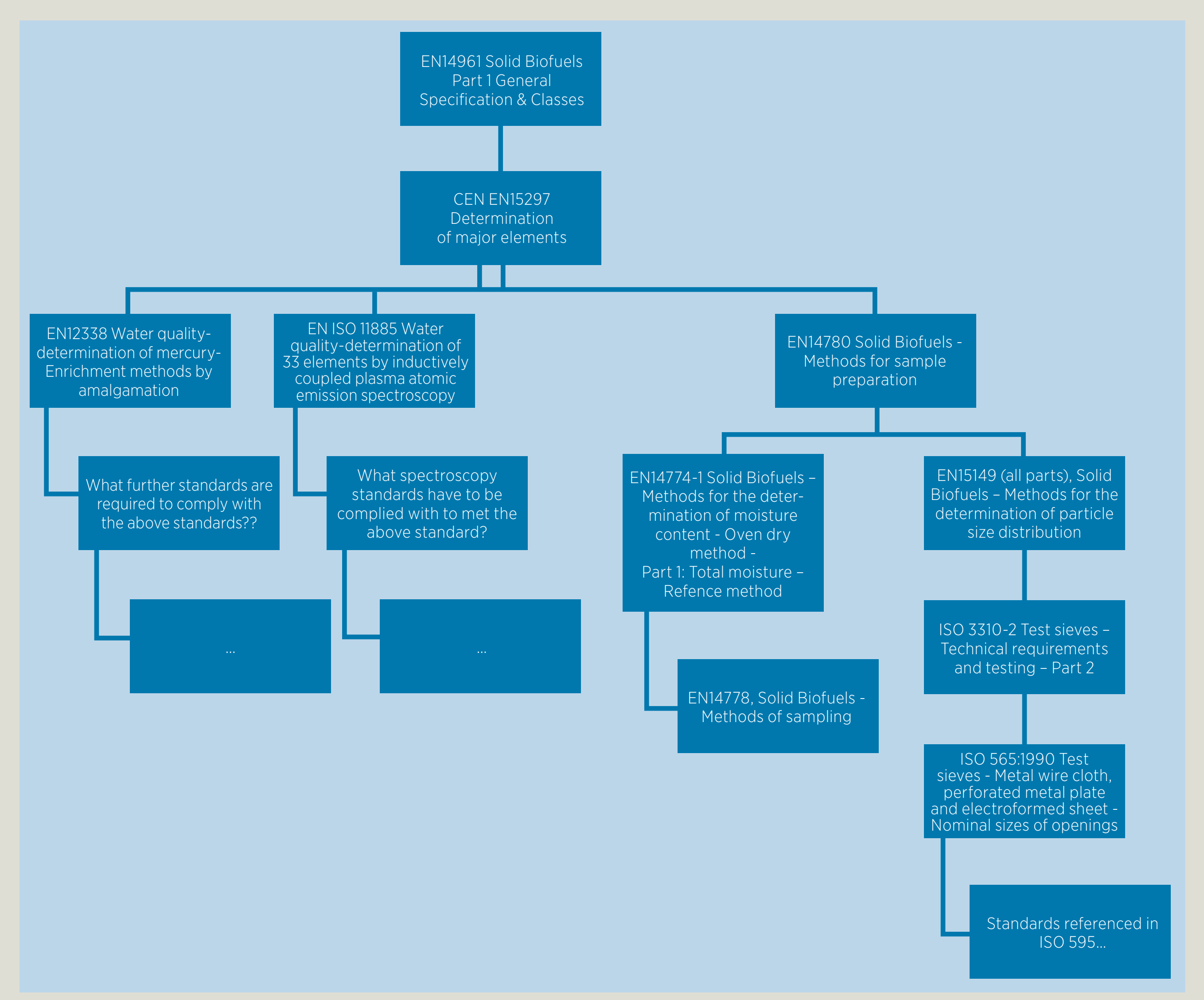


Figure 6: Example of inter-relation between standards

2.8. Cost of standards

One of the highlighted issues with operating under a formal standards regime is that in order to operate within the standards and to demonstrate compliance, the economic operators throughout the supply chain have to a) have access to the standards in the first place – it is difficult in some cases to know what standards are normative within a standard before purchasing them; and b) have access to sufficient funding to own the standards and keep them up to date.

Table 2 below exemplifies the cost implications of requiring one rural electrification standard that a community may wish to follow during the installation of a remote micro-sized renewable energy system. The table illustrates the subsequent normative reference standards that are also required. This is not atypical for standards.

The cost implications for organisations, developing countries and emerging markets can make the difference between engaging with existing internationally developed standards, producing local requirements, or not using anything at all.

While some believe that the costs of standards can be amortised through sales potential, costs of this nature will be seen as a barrier in the first instance to engaging in the use of standards. The scale of such costs also means that community-sized projects will potentially lose the best practice examples brought by standards development.

While standards are sometimes bundled together to reduce costs, the reductions needed to support the use of the rural electrification standard demonstrates that the reduction would probably be outside the scope of what the standards organisations could achieve without the sales being a loss leader, or for charitable reasons.

Table 2: Example of cascading costs from normative standards

"Recommendations for small renewable energy and hybrid systems for rural electrification – Part 9-1: Micropower systems IEC/TS 62257-9-1 & Indispensable Normative Standards"

Standards No.	Standard Name	Cost of Standards (USD) [36]
IEC/TS 62257-9-1	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 9-1: Micropower systems	252.31
IEC 60364 (all parts)	Low-voltage electrical installations Note: All parts would equate to 32 standards documents	4,284.00
IEC 60364-5-53:2001 included in all parts above	Electrical installations of buildings – Part 5-53: Selection and erection of electrical equipment – Isolation, switching and control	Incl.
IEC 60529	Degrees of protection provided by enclosures (IP Code)	262.50
IEC/TS 62257-2:2004	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 2: From requirements to a range of electrification systems	283.22
IEC/TS 62257-4:2005	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 4: System selection and design	188.81
IEC/TS 62257-5:2005	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 5: Protection against electrical hazards	188.81
IEC/TS 62257-6:2005	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 6: Acceptance, operation, maintenance and replacement	94.41
IEC/TS 62257-7-1:2006	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 7-1: Generators – Photovoltaic arrays	293.71
IEC/TS 62257-7-3:2008	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 7-3: Generator set – Selection of generator sets for rural electrification systems	209.79
IEC/TS 62257-9-2:2006	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 9-2: Microgrids	251.75
IEC/TS 62257-9-4:2006	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 9-4: Integrated system – User installation	125.87
Total cost of suite of standards to comply with the indispensable requirements		**6,435.18** [37]

The above issues show that there is both an opportunity and need for the development of a collaborative website that allows either easy access to downloadable standards or an interactive database that can provide a hierarchical tree of the standards for any particular renewable energy technology. If such a website was combined with a social development database, it could be expanded to include all documents and schemes that utilise the standards.

Table 2 illustrates the cost of a single rural electrification standard and its indispensable normative references. The total number of standards is 41 at a total cost of USD 6,435.18. Each of the normative references also has normative references, many of which are duplicates of the other documents already listed. With the next level of normative referenced standards, excluding duplicates, the number of standards listed is over 92.

Standards can be purchased from a number of organisations. The international and regional standards-making bodies, along with the NSBs, typically provide the opportunity to purchase hard copies of the standards or download them from their online sites and there are also commercial licensed resellers of standards.

36 IEC headquarters is in Geneva and standards are priced in Swiss Francs (CHF). The currency has been converted to USD using the conversion rate of 1 CHF=1.05 USD (22 May, 2012).

37 This cost analysis does not include any normative document costs within the referenced normative reference.

However, without some new approaches for allowing standards users to access the standards, especially in developing countries and remote communities, it is not obvious how the increased use of standards will be achieved while complying with copyright law.[38]

In principle, the concept of copyright protects the ownership and identity of the work for its creator.

"Copyright infringement occurs when the intellectual property is reproduced, performed, broadcast, translated or adapted without the express permission of the creator or the group/individual licensed to handle the material in question."[39] Source ISO/IEC.

Therefore, the ability to view and use a standard requires either the purchase of the standard or permission of the creator (e.g. the standards-making bodies) to use part or all of it.

Subject to agreement with the standards-making organisations, three possible solutions to open up the access to the standards might be:

1. To provide free downloadable standards – this would require standardisation bodies to recover costs that would have been covered by the commercial activities around the sales of standards through other means, which may require a change to their business model;

2. To purchase the necessary standards from a licensed reseller. This would only be available for the published standards the reseller holds and would invariably add cost to the whole process by adding in an additional level to the transaction; or

3. To provide free viewable access to all standards without the opportunity to download or print them.

Although the last of these options is far more restrictive, it might be a starting point for opening up access to the standards.

Recommendation 4 – Access to standards and the understanding of the inter-relationship between standards needs to be facilitated

For the standards users, the ability to understand which set of standards is required for specific applications and to easily find and get access to those standards could be rather challenging. There is no obvious, simple and non-time consuming way of understanding which standards outside of the titled standard are normative, (e.g. steel-welding standards or other manufacturing standards) and are therefore also required in conjunction with renewable energy equipment standards. Therefore, it might be useful to investigate ways of to facilitate the search and access to the required standards. This could include working with the standards-making bodies to explore possibilities for a collaborative interactive database that provides a searchable interactive standards portal that includes access to a hierarchical tree of the normative standards for the technologies being searched. Also, it might be worth evaluating the opportunities to provide a library of standards for review through the website.

38 World Intellectual Property Organization (WIPO) – international conventions and acts on copyright. The two key documents are the Berne Convention (1971) and the Paris Act (1971). The WIPO TRIPS Agreement takes these documents and expands on their requirements.

39 ISO and IEC have produced a guide – Copyright, standards and the internet. This guide explains the issues around copyright and standards http://www.iso.org/iso/copyright_information_brochure.pdf

3. INVENTORY OF RENEWABLE ENERGY STANDARDS

3.1. Information availability

The difficultly in collecting data on standards into one place, described in Chapter 2, needs further consideration. There seems to be no harmonised approach or one-stop-shop to listing standards and consequently collection and collation of data is very time-consuming. If this is the case for those already immersed in the development of standards in the field of renewable energy, it must be even more difficult for those without that experience.

Another problem identified in this report's analysis is that the relationship between different standards is not always obvious. These two findings highlight an opportunity to provide a collaborative platform for the collation of available standards, which could be based on the inventory gathered in this report.

However, the inventory evaluation for renewable energy standards, while relatively straightforward at the international level, has proven to be far more difficult as geographical boundaries narrow. This has identified a need for more consistent access to standards, which would provide a better understanding of what is currently in the market for those wishing to use the standards.

FIGURE 7: IEC WEBSTORE INCLUDING THE PREVIEW FACILITY

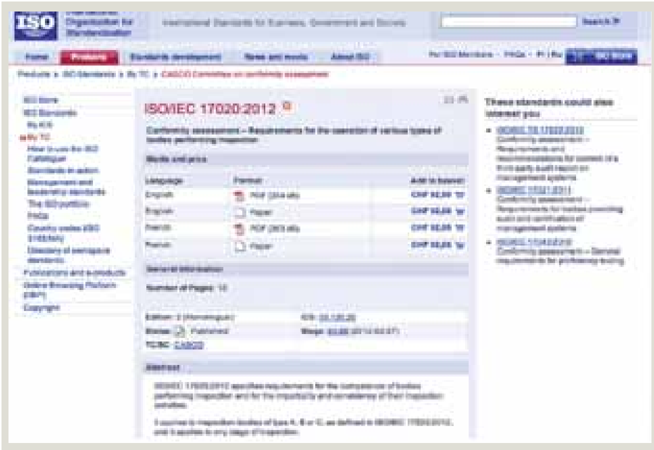


FIGURE 8: ISO WEBSTORE WITH ONLY AN ABSTRACT

This report's inventory analysis of the current international standards for renewable energy has shown which standards are available and generally how the standards environment is developing.

In the renewable energy sector there are a large volume of standards that cover the design, manufacture and testing (laboratory, factory floor and in the field), installation and commissioning of products. These standards cover the various mature technologies. However, there are some aspects of different technologies that are not well covered and the report discusses this issue in more detail, while evaluating the inventory.

Access to standards, even before purchasing them, is a big issue. As discussed below, having a good understanding of what standards may or may not be is an important aspect of the decision-making process, including whether to engage in the standards or not, how much it will cost to use the standards, and how much effort it will take to comply with them. Figures 7 and 8, showing two screen shots of the IEC and ISO webstores, illustrate the different approaches of the two organisations and how, even for the same standards, the sales and pre-information presentation can influence or impinge on their uptake. IEC allows a limited access preview (circled in red) of the standard, while ISO does not have the same facility at present. ISO currently relies on an abstract, which can be limited in information. The IEC's preview

shows normative references, while the ISO abstract often does not. It is understood that BSI in the UK is developing a new searchable database for the identification of standards. However, including all standards will take time and, dependent on BSI's priorities, renewable energy, energy efficiency and associated standards may not be the first to be listed. The ISO Technical Management Board (TMB) is now considering working with SAG-E to provide a one-stop-shop for information on renewable energy and energy efficiency.

Being able to identify the appropriate standards and see how they fit into other external schemes is an important part of the integration of standards, especially when those standards are not identified in regulations. Having a collaborative web-based repository (or access to current standards), that can be accessed and added to by those who utilise the standards in external schemes, could provide a centralised point of access to the standards and encourage the growing community engagement in their use.

In Europe, regional standardisation organisations, such as CEN and CENELEC, are often closely integrated with European Union directives. It is less clear as to how other regions integrate policy and standardisation. Many areas with less well established standardisation capacity appear to follow the European example by adopting international or regional standards. However, this can lead to a poor fit in terms of the local technologies and how they can be recognised in either a market with strong linkages to the standards, or in a globalised market.

If policies and regulations are increasingly established using international standards these issues have the potential to create barriers for local manufacturers and installers in developing countries, particularly where there has been poor engagement from those countries in the standards development process. This may be more pronounced with existing standards than for new work items, as there has been a strong drive in recent years to provide more support for developing countries to attend the various technical committees and working groups that develop standards.

The inventory analysis identified a very limited standardisation process for trainers, training providers, or the evaluation of training courses. Supporting a harmonised approach to skills certification for renewable energy will be important if certification in different countries is to be acceptable across country boundaries.

In 2009 the Institute of Sustainable Power, Inc. (USA) developed the ISPQ standard , which supports its certification of training providers and training courses. All European countries are developing their own certification schemes to meet the requirements of the EU Renewable Energy Directive, which means that there are likely to be a further 27 or more schemes in place, as there is not yet a common standard. Additionally, the development of skills standards for energy efficiency assessors, and the renewable energy and energy efficiency skills sectors, will have disparate sets of competency criteria, which is unlikely to help the global deployment of renewable energies.

Standards for the evaluation of courses and support for global transboundary certification need to be developed at an international level to ensure their acceptability. Their development would support the goals of the Clean Energy Ministerial and the UN's Sustainable Energy for All programme.

3.2. Data collection

The accuracy of standards data collection is often affected by the inconsistent adoption of international and regional standards. This report has tried not to include duplicate standards, where for instance ISO or IEC have produced a standard which has then been adopted by a region, by CEN or CENELEC for example. However, this is not always easy as regional reference numbers do not consistently follow international reference numbers. For example CEN EN14961 Part 1 – the standard for Specification and Classes of Solid Biofuels – will be produced under the title ISO 17225-1 when it is published. Only when a standard has been adopted without changes does it appear to keep the same number. In such cases nomenclature, such as "EN ISO" or "BS EN ISO/IEC", is added to show that the original document was published by ISO and/or IEC and CEN has adopted it as a full standard.

While the report has identified a total of 573 standards to date, it is anticipated that there are many more relating to renewable energy. How many of these would be duplicates is difficult to ascertain.

Table 3 shows a breakdown of the standards by technology group, category and volume.

40 ISPQ International Standard 01022, General Requirements for Trainers and Training Programs Offering Renewable Energy, Energy Efficiency, or Distributed Generation Training.

Table 3: Breakdown of standards by technology group, category and volume

Category	Totals	Performance	Product	Preinstallation	Installation	Testing, sampling and analysis	General	Certification	Cross-cutting	Operation	Manufacturing	Sustainability	Training/ skill / qualification evaluation	Fuel
	573	29	89	36	44	276	9	6	33	6	1	6	2	36
PV	**149**	12	27	8	8	87	5	1	1	0	0	0	0	0
Solid biofuels	**139**	0	8	0	4	88	3	0	5	0	0	0	0	31
Hydro	**61**	4	11	13	10	12	0	0	5	5	1	0	0	0
Solar thermal	**41**	6	8	0	4	19	0	0	4	0	0	0	0	0
Wind	**39**	2	14	7	2	11	0	0	3	0	0	0	0	0
Solid recovered fuels	**30**	0	0	0	0	25	0	0	0	0	0	0	0	5
Rural electrification	**18**	0	4	3	4	0	0	0	7	0	0	0	0	0
General	**16**	0	4	0	4	3	0	0	5	0	0	0	0	0
Electrical	**14**	0	3	0	2	8	0	0	1	0	0	0	0	0
Marine	**12**	4	3	5	0	0	0	0	0	0	0	0	0	0
Heat pumps	**25**	0	5	0	3	14	1	0	1	1	0	0	0	0
micro CHP	**5**	0	2	0	2	1	0	0	0	0	0	0	0	0
Certification	**7**	0	0	0	0	0	0	5	0	0	0	0	2	0
Geothermal power	**6**	1	0	0	1	3	0	0	1	0	0	0	0	0
Bioenergy	**1**	0	0	0	0	0	0	0	0	0	0	1	0	0
Biofuels	**9**	0	0	0	0	4	0	0	0	0	0	5	0	0
Biomass gasification	**1**	0	0	0	0	1	0	0	0	0	0	0	0	0

3.3. Gap analysis

As discussed above, data collection is a difficult task when performing a gap analysis. However, the evaluation of the gaps is, in many respects, even more difficult.

Interpretation of what is included within a standard from its abstract, as stated in the previous section on information availability, is difficult. Therefore, without having access to each and every standard and reading through it, it has been neither possible nor practical to provide a good categorisation of what each standard covers. However, the table above is an attempt to provide a categorisation.

This report has used the titles and sub-titles of standards to categorise them, which has provided broad groups for evaluation. Although some conclusions can be drawn from the data within this chapter, the clarity of the data and the changing emphasis of renewable energy mean that the gaps are not easy to identify. It would therefore be inappropriate to make too many assumptions based on the available data.

It is important to understand that the numbers of standards, their categories and where they are developed, do not necessarily lead to conclusions on whether there are gaps in the standards or not. Gaps are only important if the renewable energy standardisation process does not support stakeholders.

What is noticeable here is a gap concerning sustainability aspects – resource usage and carbon reporting have apparently not as yet been incorporated into the standards. While this is not necessarily surprising, and there are other routes for the likes of life cycle analysis, it may need to be a consistent consideration in the future.

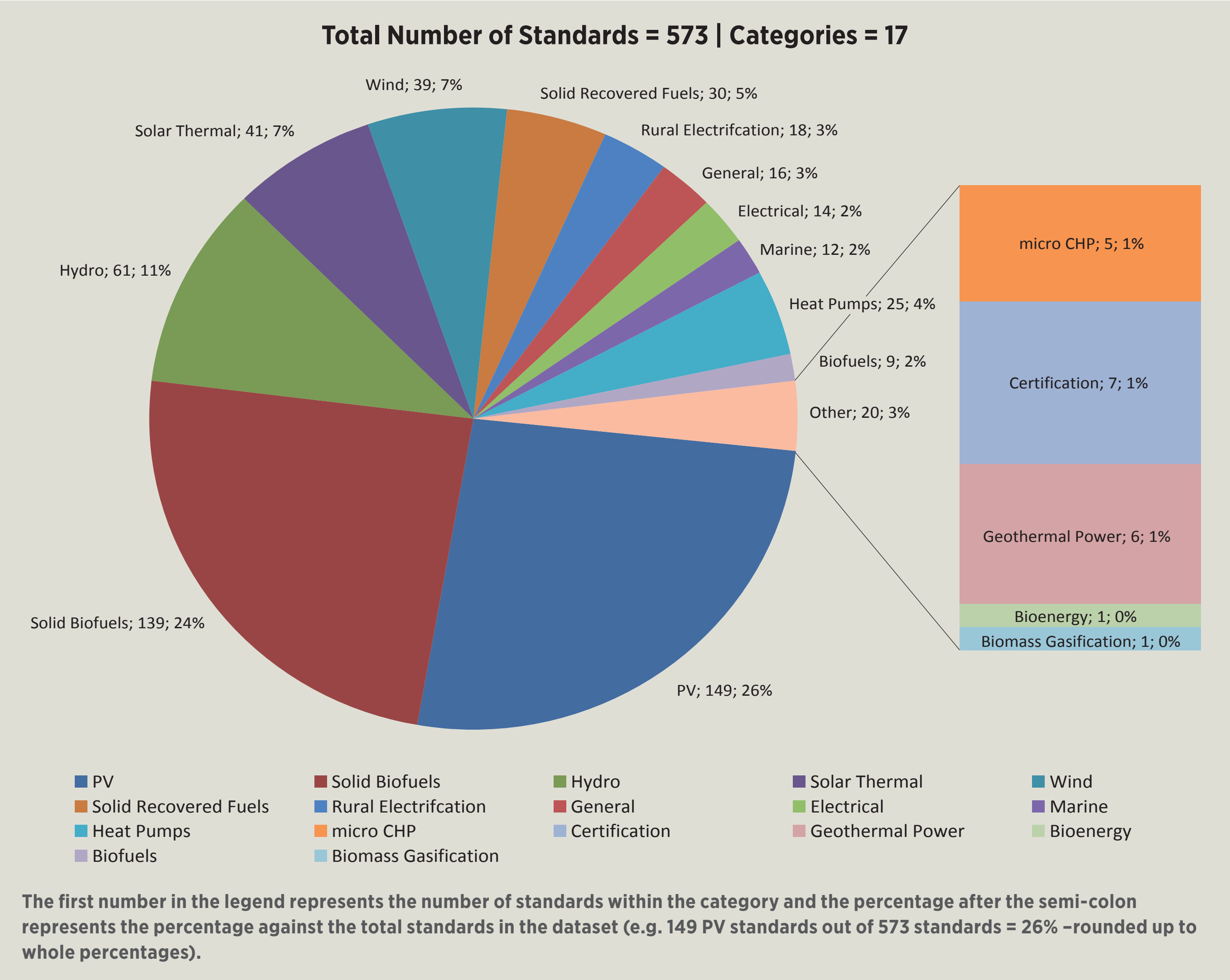


Figure 9: Identified standards by volume and technology

The inventory analysis has identified 573 standards relating to renewable energy. The majority of these are manufacturing and product standards, including test methods and performance evaluation.

The general breakdown in the volume of standards is shown in Figure 9.

The dataset of standards falls into the following geographic coverage for the standards:

Table 4: Breakdown of standards by regional level

Geographic representation of standards	Number	% of Total
International standardisation	313	54.6
Regional standardisation	150	26.2
National standardisation	13	2.3
Organisational standardisations	97	16.9
Total	**573**	**100**

While the number of national standards looks very low, as stated previously the analysis has determined that many National Standards Bodies adopt regional and international standards. Many of the organisational standards are also based on regional and international standards.

Mature renewable energy technologies have existing standards while the current generation of emerging technologies is either in the process of, or is already developing, standards for most of its products.

It has been identified that, as technologies develop, standards have not always kept up with the pace of development and variations in product design. For example, at present standards are being developed for medium-sized wind turbines, which to date have used the same standards as employed for large-scale wind. However, this is either restrictive or not appropriate for the medium-scale wind market. It is also claimed that the available international standards for small wind turbines do not fully reflect the technical and economic demands associated with such turbines and their placement.[41]

To ensure that standards are developed in a timely manner, it is important to ensure that not only those within the standards technical committees understand the industry, but that there are equally informed strategic groups continually looking at the entire sector and understanding where gaps are appearing. This is especially important as many standards committees are focused on specific areas of interest, and either not necessarily looking at the bigger picture of a sector, or operating under the belief that others are already covering those other work areas.

Example – Impacts on other market sectors and their impacts on the renewable energy sector

Agriculture – the sector has to understand and provide mitigation measures for events such as drought and flooding due to climate change. Drought and flooding events, will require more renewable energy solutions to support the increased energy demands of pumped irrigation and flood water clearance. They might also require renewable energy technologies to work in harsher environments, which could rapidly change from in dry abrasive environments to water-logged conditions.

Recommendation 5 – Mechanisms that may facilitate a strategic overview forum for standardisation in renewables need to be explored

Discussions with the stakeholders in different standards has identified an apparent need for a holistic view as to what standards could be required for the various stakeholder groups, and transmitting the received feedback to the appropriate standardisation body. With this aim, the establishment of a strategic overview forum which transmits this feedback to the appropriate standardisation bodies periodically might be considered.

Another important part of understanding the renewable energy sector is to consider the broader scope of energy supply and demand, including the various impacts that energy has on other sectors, and what impacts there will be on renewable energy from those sectors.

The strategic forum suggested in Recommendation 5 could also take a lead on these more holistic issues of assessing the impacts of supply and demand across other sectors, including those not traditionally or directly associated with energy.

41 World Wind Energy Association (2012) Small Wind World Report 2012. Bonn, Germany

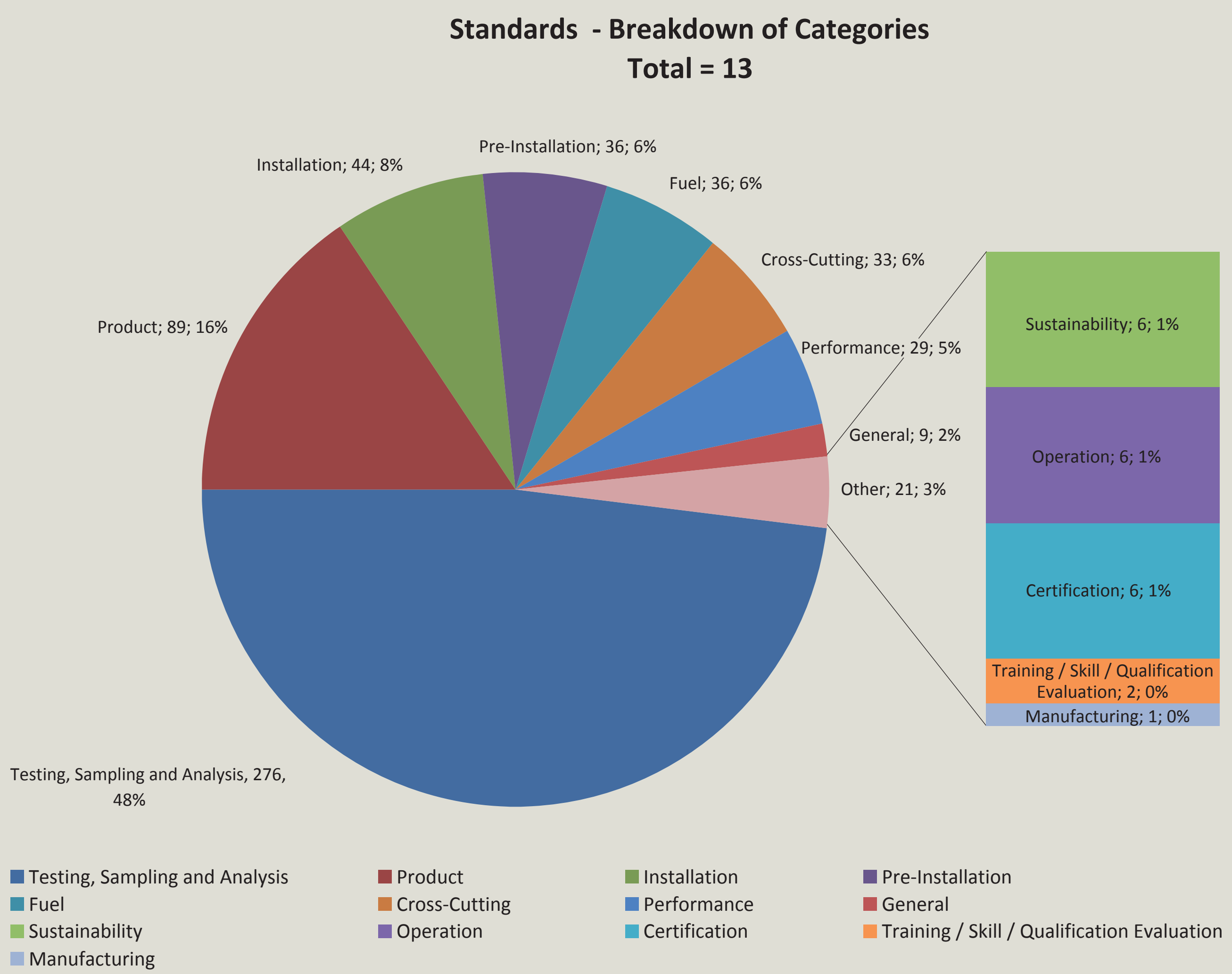
Categorisation of standards is a difficult aspect of the evaluation. Categorisation is not an exact science and requires a lot of interpretation and value judgement, as the majority of standards integrate into a number of categories within one standard, e.g. there will be an element of performance evaluation within testing, or installation standards will have pre-installation requirements.

The evaluation makes no judgement as to the value in the quantity or quality of standards for a specific area. For example, although certification standards are limited in number, globally the ISO/IEC documents are the key documents for conformity assessment.

Some standards are designed to bridge many aspects of renewable energy or product types and are not all necessarily directly related to a specific product, such as the integration of low-energy electrical consumer products and facilities onto a renewable energy grid or transformers.

Taking error factors into consideration, it can still be seen that the majority of the standards in the renewable energy field have been developed for the testing, sampling and analysis of products and systems, and the majority of these have been in the solar PV field.

In terms of the overall standards 48.2% (276 out of 573) were for testing, sampling and analysis purposes and 15.2% (87) of the total testing, sampling and analysis standards were for PV technologies. The proportion of standards for testing, sampling and analysis for biomass-associated activities was 88, equivalent to those for PV. However, this covered 63.3% of the solid biofuels standards (139 total solid biofuels standards).



The first number in the legend represents the number of standards within the category and the percentage after the semi-colon represents the percentage against the total standards in the dataset (i.e. 89 product standards out of 573 standards = 16%).

Figure 10: Standards breakdown by category

The data also appear to be showing that only 20% of the standards are directly related to pre-installation (design, site evaluation, etc.) and installation. This is an area where standards and best practice, when coupled to certification, can significantly improve system performance, safety, durability and cost-effectiveness.

Recommendation 6 – Post-installation aspects of renewable energy system requirements need to be evaluated and documented

The analysis has observed a gap concerning post-installation aspects of renewable energy systems, e.g. operation and maintenance, service and repair. Additional evaluation of standards would be beneficial to ensure that standardisation of post-installation requirements for renewable energies is included in standards. A review should specifically look at those aspects of operation and maintenance, or service and repair, that lead to the reduced optimisation of the systems, or their failure if not properly carried out, and the subsequent effects this has on the wider deployment of renewable energy technologies.

It is clear that there needs to be further analysis within each of the international standards organisations, and collaboratively between them, to identify what the external stakeholders' needs are in terms of standards development and the structure of standardisation, to ensure that standards remain fit for purpose.

As stated previously the ISO Strategic Advisory Group on Energy Efficiency and Renewable Energy (SAG-E) has proposed such a study to the ISO Technical Management Board. SAG-E considers that it will take approximately two years to complete the first phase of a meaningful evaluation.[42] During this period it will be important to identify all the stakeholder groups and engage them in the evaluation.

The inventory also demonstrates that, while some aspects of operational issues, such as running the plant, maintenance and repair, are included in some standards, there is still potential for further development of these aspects. It is unclear from the data how advanced these areas of standardisation are at present. However, further evaluation, workshops and analysis are important if the deployed technologies are to remain effective over their lifetime. Standards would be one route of harmonising the minimum competencies and requirements for the technology service providers. It would also then support regulators and policy-makers when legislating on establishing deployment strategies.

While standardisation work is being carried out in fields such as the calculation of broader performance for communities, cities and regions, it is unclear if this work will specifically cover renewable energy in a meaningful way. This is a further illustration of the need for a holistic approach to the fields of renewable energy and energy efficiency.

One way of supporting the performance and deployment of renewable energies would be the ability to be able to benchmark them against other activities. Without having good base data to benchmark against it is difficult to evaluate the progress being made. Although some studies have equated volume of standards to economic growth,[43] these standards are not always related to renewable energy and the time periods that are covered by the studies could provide many other interpretations, such as the increased use of time and motion, which developed out of the need for more standardised approaches to working practices. However, in spite of this reservation, there are convincing arguments that demonstrate the relationship between standards and economic growth.

In 2010 the ISO Methodology[44] was produced to enable the evaluation of economic benefits of standards on a given organisation. At this time no evaluation of standards on the renewable energy sector appears to have been completed.

However, the conclusion is that there needs to be more evidence and evaluation of standards and their contribution to economic uptake. For an emerging market such as renewable energy, the opportunity to start collecting evidence and carry out long-term evaluation is certainly important, as there is more at stake – climate change mitigation, for example – than just the economic value of standards to the deployment of renewable energy.

42 A presentation to the ISO TMB was made in June, 2012.
43 UK government's DTI, DTI Economics Paper No. 12, The Empirical Economics of Standards, June 2005.
44 ISO Methodology and case studies can be located at the following website http://www.standardsinfo.net/info/benefits/benefits_s1.html

Recommendation 7 – Further assessment and understanding of the impact of the deployment of standards in the field of renewable energy is required

There is a strong case for establishing a programme of research and evaluation to support the benchmarking of deployment and standardisation in the field of renewable energy. Starting this process early and continuing it as renewable energy deployment grows would illustrate and reinforce the importance of standardisation and its benefits at an economic level. This work would support the standardisation process and also provide useful insights into opportunities and barriers to the deployment of renewable energy.

Another aspect of standardisation which is currently lacking is the development of broad technology-based skills requirements and technology-specific installation competency criteria, which could be used as the basis for supporting quality installations, confidence in the market, and policy-makers' fiscal incentives.

Without a benchmarked and harmonised competency criteria establishing equivalence and providing consistency, conformity assessment may continue to be an expensive and time-consuming part of certification.

Recommendation 8 – Promotion of international standards for the evaluation of competencies in the fields of renewable energy is essential

Being able to count on trained professionals with the necessary skills and knowledge to design, install, operate and maintain renewable energy systems is important to the successful deployment of renewables. Therefore, establishing state-of-the-art facilities for the setting and evaluation of competencies, skills and knowledge for renewable energy should be considered. This could result in the creation of support mechanisms that ensure that the international standards development process covers all the requirements of developing countries, as well as those of the established developed skills providers in developed countries.

This aspect of conformity assessment, especially for the installation of renewable energy technologies is very important if there is to be:

- Confidence and trust in the installer base;
- Trans-boundary trading;
- A level playing field for installers; and
- Technological and geographic requirements to increase a quality installer base.

3.3.1. Technology synopsis of gap analysis

3.3.1.1. Solar thermal

ISO's technical committee TC 180 – Solar Energy – currently has 13 standards and two technical reports.

Solar thermal standards or technical reports were first published in 1989 and have been updated with the development of the technology. Issues currently being discussed in the solar thermal field include the integrity of the roof structure for weather tightness, and the fire and durability of the structure. The UK has developed an MCS Scheme Document for both solar thermal and solar PV and ISO and CEN have very active technical committees in this field. However, there has been criticism from a few manufacturers that their products are being restricted in the market by anti-competitive actions. Claims and counterclaims relating to this question have been going on for years, which does not help the credibility of some parts of the standards developing community.

Other issues that have been raised which need consideration by the technical committees include the potential risks of legionella through solar water storage systems and the carbon footprint of the systems. Both are interesting ideas, and merit investigation. However, the evidence to demonstrate that solar thermal systems, especially at the small-scale, pose health risks has yet to provide robust empirical data and the latter concern is a very technical field in its own right. International standards are being developed in the field of carbon footprinting.

Since Concentrated Solar Power is a relatively new technology there appear to be no standards for it at present. However, IEC has recently established the technical committee TC 117 – solar thermal electric plants. As solar thermal power plant is a plant that combines generation of both heat and electricity, there will be close cooperation between the relevant ISO technical committees dealing with heat and IEC TC 117 committees. It is understood that some of this collaboration has already taken place.

3.3.1.2. Solar PV

IEC's technical committee TC 82 – Solar photovoltaic (PV) energy systems – currently has more than 50 international standards, technical specifications and technical reports. Many of these standards are available as bilingual documents.

Solar PV panels have become one of the most commoditised of renewable energy technologies and, with a total of 121 standards identified, one of the most advanced in terms of manufacturing and testing standards. Approximately 90% of these standards relate to the components of PV panels, either in terms of demonstrating their performance, testing and validation of claims and manufacturing validation, or component integration and safety.

As PV systems now cover a range of applications from standard panel modules for electricity generation to building-integrated PV (BIPV), the requirement for more testing methods is likely to grow. New testing methods would enable manufacturers to substantiate their claims and ensure their manufacturing processes are not compromised.

Major fires have occurred with PV installations in Japan, UK, USA and many other countries. Fire services around the world are now looking at ways of tackling what could be life-threatening situations due to the inability of firefighters to isolate the live electrical systems operating in PV installations.

This is a global problem due to the deployment of more on-grid systems and the nature of buildings in the developing and developed world, which range from wooden shacks to skyscrapers. Therefore practical solutions need to be found that suit all types of properties, geographic locations, electrical systems, etc.

Example – Gap in standards for installations and H&S

The lack of design and installation standards and installation safety standards has been identified as a potential problem. As the number of installations rapidly rises – according to the IEA 27 GW of capacity was installed in 2011 with the UK, for example increasing from a few hundred installations to over 315 000 in 2.5 years – the risk of electrical fires is becoming more prevalent. Discussions and common approaches to prevention and how to ensure safety of firefighters are developing. However, the speed of standards development to address this concern may be an issue for the confidence in the technology.

Another priority is to ensure that engagement in the standards development process is appropriate for global situations and that there be a strong communications platform for what is being developed. Communications should ensure that while the standardisation process takes its course, best practice is also disseminated along the way. This illustrates perfectly the points made earlier regarding the interconnectivity and transboundary activities that need to be considered during the development of standards. To ensure that practical advice and systems are developed, it is vitally important that the firefighting and other rescue service communities are also engaged in the development of the standards.

In August 2012 AFSEC (African Electrotechnical Standardisation Commission) held a workshop and technical committee meeting which included a presentation from IEC TC 82 JWG 1. It would appear that AFSEC is now considering expanding its remit to include PV.

3.3.1.3. Geothermal energy

Geothermal energy covers many different types of systems, from power generation from deep aquifers, to heat pumps using shallow earth energy transfer.

ISO's technical committee TC 86 – Refrigeration and air-conditioning – covers heat pumps and has standards either published (16) or in development.

At present neither ISO no IEC appear to be developing standards for geothermal power. However, developmental work on geothermal databases and resource standards is being undertaken by the IEA and EU as well as the governments of Australia and Canada.

IEA has a Geothermal Implementing Agreement (GIA) in place although it ends in 2012. From the IEA geothermal energy website it appears that no activities have yet taken place in standardising the geothermal sector. This could be due to the technology being in early deployment.

The amount of standards for geothermal is relatively low at present, which is surprising as the uptake of this technology, especially at the smaller scale as used in Scandinavia, has been quite high. In northern hemisphere climates, where temperature differentials are good and having coefficients of performance around 2.5 to 4, the opportunities presented by geothermal are certainly perceived as being very good, and its deployment supports some countries' profile of centralised energy production.

An evaluation by IPCC [45] suggests that geothermal power could develop to 122 TWh_e for electricity and 224 TWh_{th} for heat applications by 2015. The UK Committee on Climate Change has produced reports that support the requirements for approx. 1.6 million domestic heat pumps by 2025. The MCS scheme documents for heat pumps have recently had a significant upgrade following field trials to ensure that the systems are more effectively installed. This would suggest, given the nature of geothermal deployment globally, that there is an additional requirement to ensure that the standards being developed by TC 86/SC 6 are robust and will deliver the confidence expected.

The use of geothermal to produce power is also starting to be looked at outside the traditional countries which use it for generating electricity through devices such as steam turbines, using steam heated by geothermal energy from deep in the ground.

JPC 2, the joint ISO/IEC Technical Committee developing standardised terminology for energy efficiency and renewable energy, is having difficulties determining the best common terms for these geothermal technology subgroups as terms are used in many different ways.

3.3.1.4. Wind energy

IEC's technical committee TC 88 – Wind Turbines – has published, or is in the developmental stage of publishing, 21 standards and technical specifications for large- and small-scale wind turbines. These standards cover both on- and off-shore applications.

Wind standards have been seen by many small manufacturers and developers as "too onerous". This is primarily because for a long time there were no requirements in many countries for independent verification of the performance, durability and reliability of wind turbine products. With the introduction of fiscal incentives, there was a new emphasis on ensuring value in terms of energy and carbon savings for the money spent by governments. Not many industries in the world have been able to produce and install equipment while only offering estimates of the equipment's likely performance. However, that situation is changing with the introduction of certified products in the wind turbine industry. [46]

Since the standards were initially designed for large turbines and the relative testing costs are high for medium-sized turbines, until recently there has been a lack of motivation to design specific standards for medium-sized turbines. Certification and a need for more accurate performance data have now led to the development of small- and medium-size wind turbine standards. Much of this demand for standards can be associated with the uptake in deployment through Feed-in Tariffs and the poor experiences that some turbines created in the market.

With the development of offshore wind, a number of standards have been developed to support the market, including tower structure standards and blade design standards. Some of the standards have been developed due to requirements by investors and operators for reassurance that the products will provide cost-effective returns on investment and reduce any down time through maintenance and fault diagnosis. Where such standards have been developed privately and established as being appropriate, they are then taken to the IEC for upgrading to international standards.

3.3.1.5. Hydroelectric

The IEC's technical committee TC 4 – Hydraulic turbines – has published 14 standards and eight technical reports.

The hydroelectric standards have been established for a considerable period of time in some cases and the basic principles of the technology have not changed much. What is now better understood are issues such as the composition of the water that flows through the hydroelectric systems – in some cases it is very aggressive for the machine components due to substances such as sand and minerals in the water, [47] which not only affects the life of the turbine, but also its efficiency. The key challenges that have not been overcome in measuring and monitoring are:

- » A lack of reliable and standard methods and mechanisms; and
- » The lack of proper tools and equipment for precision measurement of weight loss in heavy units.

With support from the Norwegian Development Cooperation (NORAD), Nepal has established a centre of

45 IPCC, Special Report of the Intergovernmental Panel on Climate Change, Renewable Energy Sources and Climate Change Mitigation, 2012.

46 The UK's MCS requires certification to the international standards. The MCS has also been used as a benchmark in other countries, such as in the USA for Small Wind Turbine Certification.

47 Prof. Bhola Thapa, Presentation at AFORE1, Efficiency Measurement of Turbine and Standards to Measure the Erosion Damage of the Turbine Components, November 2011.

excellence for the testing and R&D of turbines and intends to establish a manufacturing base in the country. All the testing is carried out to IEC standards and the TTL (Turbine Testing Laboratory) is a key member of the IEC Technical Committee.

To help better understand the issues around erosion from abrasive minerals in water, IEC has produced IEC 62364 Hydraulic Turbine – Guide for dealing with abrasive erosion in water (due to be published in January 2013). Additional data from the testing experience in Nepal has helped improve the guide. Research and development for the guide has taken place across a number of sites including those in Kathmandu, Nepal.

In the UK MCS has developed "as new" standards for hydro turbines to enable existing turbines (some with 50 to 100-year-old bronze castings) to be brought back into operation after they became dormant. The scheme document has been based on British Standards for Remanufacturing and requires an "as new" warranty to go with the product when it is recommissioned.

This type of innovative thinking could be developed for other renewable energy technologies that still have plenty of life in them but need upgrading. This would support the waste management approach of reuse and would ensure that resources are utilised to the maximum and that second-hand products are appropriate for safe running over their whole life.

3.3.1.6. Bioenergy

ISO's technical committee TC 238 – Solid Biofuels – follows the Vienna Agreement with CEN following CEN's development and publishing of the Solid Biofuel Standards. TC 238 will publish approximately 89 standards in the next few years. Many of the standards for the determination of characteristics of solid biofuels – chemical, mechanical and physical – and their sampling standards can also be utilised for solid recovered fuels.

ISO/TC 208 – Thermal turbines for industrial application (steam turbines, gas expansion turbines) – has produced two turbine standards that, while not specific to biofuels, are used for plants using biomass.

ISO/TC 28/SC 7 – Petroleum products and lubricants – is developing four standards for biofuels for the transport and liquid biofuels for heating applications.

ISO/PC 248 – Sustainability criteria for bioenergy – is developing a standard to support the deployment of bioenergy.

Bioenergy covers solid, liquid and gaseous biomass and can be used for heat, electricity generation and transportation. Standards in all these areas have been developed for product standards. Some standards are more advanced than others, however, all of them are in the public domain.

Combustion standards were once considered for the international market. However, there was no appetite for their development. The same is true for Combined Heat and Power (CHP) standards.

In addition to product standards, work has been done on sustainability standards for bioenergy.[48] In Europe this has led to standards for biofuels and bioliquids as a direct consequence of the threshold values being established by the EU Renewable Energy Directive. Because this was not going to deliver the perceived requirements for many participants, there is a parallel process working on sustainability standards for bioenergy.[49] Unfortunately, due to the methods used for developing the standards, the two standards may not be compatible. As previously stated, the sustainability of bioenergy is a very important aspect for the uptake of biomass as a fuel and the standardisation process, which should have provided reassurance to policy-makers and consumers, may not end up doing so, which will be a very big lost opportunity.

3.3.1.7. Marine energy

IEC's technical committee TC 114 – Marine energy – Wave, tidal and other water current converters is in the process of developing nine standards. Two technical specifications were published in 2012.

Although marine energy is at an embryonic stage at present, standardisation in performance and resource assessment is already being taken seriously.

There are many designs currently undergoing trials in on- and off-shore environments. These, along with dams and estuary tidal systems, will need to consider environmental impacts as well as technical design.

48 CEN TC 383.
49 ISO/PC 248.

However, IPCC recognises that hydroelectric schemes may also support climate change mitigation issues, such as water shortages. Therefore it will be important that the various Technical Committees discuss cross-cutting issues.

In the future the marine energy sector may wish to consider other aspects of standardisation, such as harmonised connectivity to the grid as part of a broader strategy on the electrical grids, smart grids, safety aspects and on-going maintenance.

Recommendation 9 – In-depth analysis of the need for new or updating of standards should be based on experience gained and evaluation of issues raised in the renewable energy sector

After significant effort invested in developing a number of standards for renewables and years of experience utilising them, deeper and periodical assessment of needs for new standards should be performed. The analysis in this report presents some clear examples in this aspect, such as:

- *Provision of best practices concerning safety issues through standards, e.g. fire safety for rooftop PV systems.*
- *To analyse the need for standards targeting the reuse, through e.g. refurbishment or retrofitting, of technologies and therefore prolong the life of products.*
- *Consider a harmonised methodology for the evaluation of particulate emissions from biomass combustion equipment.*
- *For hot water technologies and particularly for solar thermal hot water applications there is a need to consider whether there is empirical evidence that there could be a link between solar hot water systems and health threats such as legionella.*

4. STANDARDS – INNOVATION AND DEPLOYMENT OF RENEWABLE ENERGY

4.1. Innovative products

The inventory analysis identified two further considerations that need to be reviewed. The first is how standardisation can better support innovative products, when legislators and regulators are using it as a demonstration of compliance. The second is how to make globalised standards without creating barriers for developing products and developing countries.

Some new products are truly innovative, while others are improvements or extensions of existing products. Both types have the potential to either significantly support the deployment of renewable energy, or slow the uptake of technology down by bringing the industry into disrepute.

Some might argue that buyers should adopt the *"caveat emptor"* [50] approach to new products. However, non-informed householders in particular can have the most to lose and are often not in a position to determine what is or is not an appropriate product.

This is particularly important at the regional and national level, where policies such as Feed-in Tariffs, can be tied to certification, which can be based on the current standards. Where there are no standards, or where it is difficult to legitimately test against a current standard, trade barriers can be created. There are ways to develop generic principles under standardisation, which may avoid trade barriers. However, at present these generic principles have not been developed.

Without the ability to provide market and consumer confidence in innovative products, there will be a limited opportunity for their large-scale deployment. If, as this report suggests, a harmonised and standardised approach is important for increasing the confidence and deployment of technologies, then this issue must be addressed.

While it is difficult to develop standards for products that are emerging, or when only limited (potentially only one) product(s) are on the market, it is important that innovative market-ready and near market-ready products are given access to the market when they have demonstrated they are safe, perform as anticipated (or within the threshold criteria), and are durable.

This could be achieved by providing a standard to establish what a market-ready or near market-ready product type is, and the threshold boundaries that allow it to be classed as such (for a transition period), before the product is required to become fully standardised.

Under such boundary conditions there could be technical and non-technical issues, such as:

- A demonstration that the product cannot be tested against current standards;
- The manufacturer is ready for full production; and
- Clients understand that they are early adopters, with the consequence that the product may not deliver as anticipated. This clause could also include a section on having formal agreements between the manufacturer, installer and the client on what happens if the product does not meet expectations, or fails to work. It could, for example, ensure that a full support infrastructure is established to support clients.

One problem that needs to be considered is the question of competition and commercial competitive advantage. Standards should be developed in an open and inclusive manner; however, some new technologies may be seen as a threat to other products in the market. Therefore, any measures which might hinder or block new market

50 Caveat Emptor is Latin for "let the buyer beware". In some countries Caveat Emptor is not included in consumer law, but is for business.

entrants through the standardisation process would need to be carefully managed.

4.2. Accelerated/decelerated renewable energy deployment

The deployment of renewable energy depends on many issues external to standards, such as Feed-in Tariffs (FiT), building regulations, planning, environmental factors, and economic standing. However, standards have been used in combination with certification and other policies, regulations and drivers to open up or restrict access to markets.

A key area here is understanding standards, knowing what they are and why they are a benefit to all stakeholders. A number of presentations and reports about the benefits of standards have already been produced. In 2006 UNIDO published an excellent guide to standardisation [51] which explains their benefits and their role in supporting trade.

4.2.1. Power and influence – importance and impacts

The Clean Energy Ministerial (CEM) 2012 made a strong call for more standards to be introduced quickly, not only to aid deployment of renewable energy technologies, but also to ensure that the quality aspects of related products and their intended outcomes were delivered.

The CEM argued that having clear performance data and appropriate standards would allow policy-makers clearer understanding and the ability to manage policies and incentives and would encourage cultural shifts in people's attitudes towards their energy use. It was also suggested that having standards would support the integration of financial incentives into government energy and climate change strategies, aid transboundary trading, stimulate green employment through confidence in the market, and enable improvements in technology efficiencies through competition and regulation.

The CEM also took the view that, by having clear international standards, citizens from countries in the developing world would be protected from the dumping of lower efficiency or less environmentally friendly products, as the minimum standard thresholds would ensure that only appropriate technologies were used.

Judging by the number of times ministers at CEM meetings mentioned standards for efficiency, energy performance, testing and measurement protocols, there seems to be a clear desire to have internationally agreed standards. The IEA has also reinforced this need, specifically for electric vehicles and energy efficiency, a number of times in their report to the CEM.

Although not perhaps directly related to renewable energy, a strong emphasis was placed on resource efficiency, especially for vehicles, including electric vehicles, and on combining minimum energy performance standards and labels, which will include energy-generating systems.

The rising costs and investment in time associated with developing standards is making it increasingly difficult for some actors to participate in the standardisation process. This can leave the door open only to those that can find the time and financial resources, or find it beneficial for their own interests to engage in the standardisation development process, which may not always provide the optimum solution.

Developing standards through the international standardisation process requires consensus from the participant standard-making individuals. Because of the global importance of some of the standards and the fact that trade and commerce is so important, the standards process can, and does, get controlled by influences that are not always in the best interests of the environment or the majority of stakeholders.

More engagement with the external stakeholders using the standards needs to be carried out through reports, case studies and workshops to ensure that the benefits of the standardisation process include a balanced and increased participation in standards. Combining these promotional activities, as an integrated approach with other recommendations in this report, will hopefully stimulate a broader mix of experts that can increase good consensus and develop standards that meet the majority of stakeholders' needs. Along with this there might be a need for additional review and moderation of the standards development technical committees by the standards-making bodies to ensure that balance is achieved wherever possible. In critical cases the standards-making bodies may even need to intervene to bring about this balance.

51 UNIDO under the "Market access and trade facilitation support for South Asian least developed countries, through strengthening institutional and national capacities related to standards, metrology, testing and quality."

In relation to trading, when introduced to economic operators standards are initially perceived as a restriction on access to markets. This is often because there has been no requirement to demonstrate compliance to standards in the past. This leads to a fear, especially for small organisations, that the requirements will be over-complicated and restrictive.

For some operators, having restrictive standards is a competitive advantage and ensuring that competitors are unable or restricted in their trade can be a prime reason for being in the standardisation process.

However, in many cases the standardisation of the products has allowed entry into mass markets by providing common access, connectivity and tradable products. This has happened for example with the standardisation of the electrical plug, standard biofuel specifications, or discussions about the connectivity of electric vehicles to charging stations.

Example: The possible influence of strong stakeholder groups

As biofuels are seen both as a big business opportunity and a potential threat to sustainability, the standards to develop sustainability criteria for bioenergy at the ISO and CEN level has been very much focused on two stances, either of which could provide unexpected consequences.

Some want a very light touch, which provides lots of flexibility and ease of demonstration of compliance, or even self-declaration. This would be achieved through having minimum criteria and indicators that can be presented as sustainable. This kind of light touch may be good for economic operators in the short term. However, if the results of the standards process lack credibility, potential consequences include:

- *The whole sector is mistrusted;*
- *Industrial competitors and other groups use the lack of credibility in the biofuels sector as part of their campaigns and lobbying;*
- *Legislators and regulators are either unwilling to use the standard and add additional levels of requirement or refuse to use the biofuels – The European Commission changed the requirement of 10% transport fuels from biofuels in the RED, to 10% of transport fuels from renewable energy (both electric and biofuels); and*
- *Subsidies are limited due to nervousness about the outcomes.*

The over-prescriptive standard

Over-prescriptive standards may lead to:

- *Fraudulent behavior to meet the standards and the potential for environmental impacts under the auspices of compliance with the standards;*
- *Lack of deployment in the sector due to the high costs of compliance;*
- *Those opposed to the use of biofuels, forest resources, land-use change and potential food crops achieving their objectives; and*
- *Having to find other energy resources (fossil fuels or other) to meet demand.*

Both of the above scenarios (light touch and over-prescriptive) lead to missed opportunities to promote credible alternative fuels, employment, as well as social and economic movement (primarily in developing countries). The scenarios have the potential to hit the smallest economic operators hardest. Additionally they allow the opportunity to attack all standardisation and the organisations that develop standards, reducing the credibility in the whole standardisation process.

To reduce these risks requires that standardisation bodies ensure that an appropriate balance of stakeholders develop the standards and that all stakeholders' views are equally taken into consideration. In some situations this may mean stronger moderation from the standardisation bodies.

4.2.2. Best practice standards

Best practice and international standards provide a clear ability to provide products that are inherently safe and perform to set standards established by the international technical experts. However, what is particularly relevant for remote areas and developing countries is that standardisation based on best practice for testing, performance and manufacture in developed countries could lead to difficulties of compliance in less sophisticated markets. An example of this may be in the design and testing of wind turbines, which some may wish to be manufactured in the local community with local resources. However, if manufactured locally, the turbines may be excluded from trading in a broader market because they have not been tested to international standards.

As previously stated there are already many standards established for the testing of quality and performance for renewable energy technologies. The majority of these have been developed by organisations with technical committees dominated by experts who are more accustomed to dealing with more mature products and/or sophisticated technologies and manufacturing processes.

While standards may be written to allow engagement by anyone who can demonstrate compliance with them, in practice they may have the opposite effect, due to the requirements within the standards. This is potentially a big risk for local producers in developing countries, who effectively start as little more than do-it-yourself entrepreneurs who want to develop into providing products for neighbours, and then get further orders from slightly further afield.

When standards are voluntary, they can be followed as best one can, or not at all. The products can be used at the owners' risk. In many cases the products will remain relatively basic, which means they can be maintained by their owners.

However, if as previously stated in this report, countries are using international standards for regulatory and legislative compliance, or if countries are tied in to fiscal incentives, then this model may well exclude locally-produced products in favour of more sophisticated and expensive technologies brought in from more distant suppliers.

There is a place and argument for both scenarios, to follow or not international standards, in the deployment of renewable energies at the moment. The issue is, if the policy developments do get established from the more stringent standards protocols, how to ensure local organisations and communities are not excluded, or beholden to developed product manufacturers for the provision of equipment, maintenance, training, etc.

It is not suggested that developing countries and rural areas should be excluded from having the best available technologies. The optimum solution would be that all products meet the international standards. However, in practice the barriers to localised entrepreneurial development, job and wealth creation are likely to stifle this solution or mean international standardisation is rejected.

The issues of innovative products and basic localised product manufacture and market engagement are in some respects similar, in as much as they can both present barriers to entry or engagement in support mechanisms and markets unless there is compliance with the rules and standards.

One option which could overcome this problem and needs to be explored would be to develop performance standards that allow companies to demonstrate competencies through "framework standards". A framework standard would require an organisation to demonstrate it had followed basic principles and methodologies in the workplace, without having to be too detailed about specific technology.

Such a standard could include basic minimum requirements for testing, safety and endurance, without having to comply with a specific international standard through high-level procedures and processes. The standard would be designed to provide more basic principles in best practice as well as a framework for demonstrating compliance (e.g. it may ask for information on why a particular technique or material was used and the judgement, risk or assessment that was taken by the organisation in determining why one particular method was better than another).

In more mature markets, where the issue is that current standards (particularly for product testing) are not appropriate for innovative products, there could be a standard protocol that provides a framework for the organisation to develop test procedures that are then open to conversion into full standards for other similar products as they are developed.

With both of the above scenarios, criteria would have to be established that would exclude products from using

this route just to avoid going through the full international standards process. This could be accomplished through strict engagement criteria (e.g. stipulating that the organisation shall demonstrate that there was no standard, or the standards were not appropriate at the time that the product was developed, or that compliance with the international standards would be impossible to achieve in the environment in which the product was produced, or it was not market-ready or near market-ready). If international standardisation were unable to develop such requirements, an alternative would be for the requirements to be part of a conformity assessment scheme's rules.

Having standards frameworks that organisations could follow could allow policy-makers, regulators and legislations and/or certification schemes to provide limited scope, or tailored incentive access, to the marketplace.

Recommendation 10 – It is important to evaluate how standards can support innovation in the renewable energy sector

Standards can be a very useful instrument to promote innovation through sharing best practices and information on state-of-the-art technologies, levelling the playing field for close-to-market products and diffusing knowledge. However, further investigation is needed into how to materialise these benefits for renewable energy technologies. For instance, steps should be taken to:

- *Investigate what criteria would provide confidence in innovative and localised products to be included in policy and fiscal mechanisms.*
- *Provide the support for the development and piloting of innovative and localised product framework standards to bridge the gap between near market-ready and innovative market-ready products that cannot comply with current international standards.*
- *Review how the standardisation process works for standards to be quickly upgraded, modified, or have addendums to accommodate new and innovative products. This review should also consider any barriers that could be created through the standardisation process.*

5. INVOLVEMENT OF DEVELOPING COUNTRIES IN THE STANDARDISATION PROCESS

Part of the role of standards is to facilitate trade. It has also been identified that using renewable energy can support economic growth, social welfare, health provisions, reduction in fossil fuel use, and other benefits in locations such as rural areas. Therefore, the development of standards and the access and ability to provide products against those standards is going to be an important integration process, if standards are going to remain globally relevant.

Standards-makers need to be sensitive when developing workstreams and fully understand the implications and support needed in developing countries when standards are used. Renewable energy considerations in developing countries are very different to those in developed countries. While the technologies may be, and usually are, the same, their implementation and requirements are often driven by different needs and issues.

ISO has a long-established policy committee – DEVCO – specifically to address the needs of developing countries in terms of standardisation. With the emphasis on energy-related issues, and particularly with the growth in renewable energy technologies, there needs to be closer engagement between ISO SAG-E, DEVCO and the renewable energy-related technical committees. Similarly, IEC has established the IEC Affiliate Country Programme that offers developing countries a form of participation in the IEC standards development process without the financial burden of actual membership, by making full use of an electronic environment. This type of mechanism may ensure that developing countries have the capacity to engage more fully in the development of renewable energy technologies.

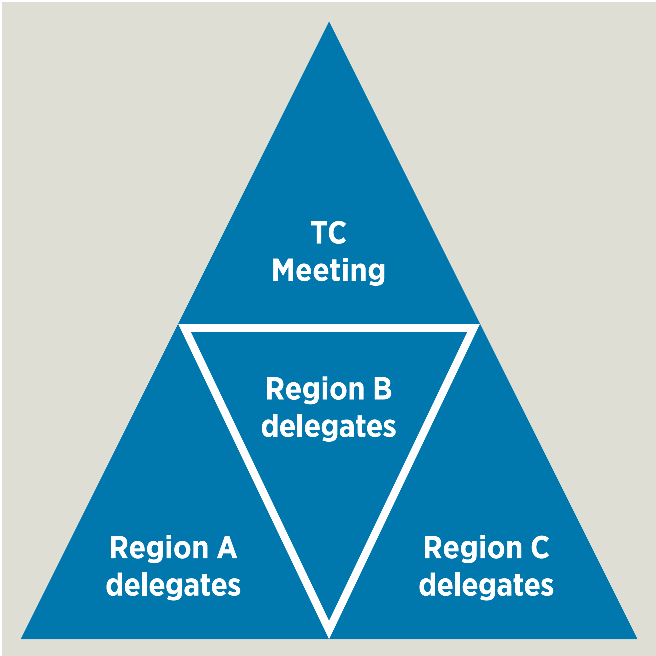


Figure 11: Regional engagement in technical committees

Recommendation 11 – Engagement from developing countries in existing programmes that may support their involvement in the standardisation process for renewables is crucial

Exploration with ISO, IEC and other partners whether more engagement through programmes, such as ISO DEVCO and IEC Affiliate Country Programme for matters relating to renewable energy, would be an effective way of enhancing the involvement of developing countries in the standardisation process.

In addition to these existing mechanisms, two other opportunities might be explored to facilitate increased engagement by representatives from developing countries, or from countries with limited technical expertise, in a particular renewable energy technology.

1. For those wishing to engage, but with limited budgets, potential language barriers, or limited opportunities to travel to meetings, the options are:

» Provide better funding for travel to attend meetings. This is already being carried out to a degree through collaborative programmes for developing country experts such as the international development programme run by the Swedish Standards Institute, where support in areas of sustainability can be provided to help developing countries engage in international standards development.

» In an age where communications are facilitated through the Internet, video, Skype and other telecommunication channels, the possibilities of having better mobile access for remote engagement could be investigated. Providing aggregated meetings, whereby communication centres could be established around the globe with facilities to allow delegates to gather in multiple sites and then be linked together as one group for the meeting, could also be considered.

To carry this out effectively, facilities would have to be reliable and capable of allowing everyone's full engagement (e.g. where video conferencing is carried out, those speaking have the camera and microphone automatically tracking them so that everyone can see and hear what is being said). Additionally, there needs to be training for those engaged in the conferencing, while technical staff need to be on hand to support delegates during the proceedings. Finally, it would be extremely useful to have facilities with translation capabilities, either oral and/or text-based.

Recommendation 12 – Options for using the latest communication technologies for engagement in standardisation development work need to be explored

The ability to utilise better communications would also support the engagement process, facilitating participation from experts in any geographical region. Evaluation of where additional facilities should be sited to add value in providing better communication hubs should be considered as part of this remote engagement.

2. In terms of developing countries or regions with limited or no technical experts to engage in the standardisation process, there is an opportunity to establish a pool of external experts that could act as an intermediary and provide the conduit for the countries or regions trying to engage. It would be important that the experts were capable of understanding the local issues, culture and sensitivities across all stakeholder groups and able to work seamlessly in the standardisation process as if they were representing the country or region.

Developing countries also need to be considered as part of the holistic approach to standards development. If these countries are treated in isolation, there is a danger that they end up being isolated again, as the world moves forward with a more harmonised approach to standardisation and legislation attached to standards. The APEC report and IRENA members have already highlighted that a non-harmonised approach is not helpful to the renewable energy sector if different standards are used in the same region.

That does not mean to say that standardisation issues are not real for these areas. Most, if not all of the issues discussed in the previous chapters relate either directly or indirectly to developing and Pacific island countries. Although they may appear more acute in some parts of the world, the issues will be fundamentally the same – lack of funds to engage in the standardisation process, the need to find new ways to engage in the standardisation process, better access to standards, and other issues.

While the developed world is concentrating on major energy issues, for some developing countries, the issue is how to develop affordable energy in isolated areas, and how to train people with the skills to run and maintain the equipment. SEIAPI, REEEP, UNIDO, FAO, Alliance for Rural Electrification (ARE) and many other organisations are developing programmes that are looking at the deployment of renewable energies, not only for energy generation, but also as opportunities to develop better standards of living, improve health, create economic growth opportunities, extend agriculture growing periods, etc. What does not appear to be widely available or utilised is a quality standard for energy services.

ISO has recently agreed to develop standards in the energy services field. However, it will be important that these standards can cover all scales of operation from sole traders to those offering rural energy opportunities to their neighbours, through to multinational organisations.

As this report indicates, it will be important that there is a good representation from both developed and developing

countries in order to develop localised energy solutions and their supporting organisations. As previously stated, further investigation and support to aid development in this area is needed.

Many organisations, both on the ground and internationally, are supporting the scaling-up of the deployment of renewable energy technologies.

In Africa, standards are starting to be considered for the region through the African Electrotechnical Standardisation Commission (AFSEC). However, concentration on electrical technologies, while important, should not be at the expense of heat technologies.

Quality is being addressed in the Pacific islands for all renewable energy technologies through the development of a certification scheme for installers. The example below highlights the scheme.

Example – Installers competence standards

In Pacific island countries, the Sustainable Energy Industry Association of the Pacific Islands (SEIAPI) has developed a certification programme to ensure that installers of renewable energy systems are competent to do so. The scheme covers businesses offering products, systems and services and will assess against pre-approved courses.*

The scheme includes 13 island countries and is aiming to increase the quality of installations across most of the technology areas in the region.

SEIAPI has recently introduced criteria for those wishing to be provisionally or fully certificated.

* *www.seiapi.org*

Another important aspect of the inter-relationships between communities in developing and emerging countries and big corporate organisations can be illustrated by the example of the telecommunications industry.

When telecommunications are installed in remote areas a lot of consideration is placed on integrating the technology with local communities. This is particularly true for solar PV panels, since community integration helps avoid the need for security to stop the technology being stolen.

This demonstrates that while energy is not directly the issue, the inter-connectivity between concerns such as energy and security are not isolated. There are many sectors that are not typically seen as energy-related, but also have positive and negative impacts on energy supply and demand. With the appropriate additional clauses in existing standards, or with new standards, these other sectors would consider energy aspects to appropriately manage these impacts.

In Africa surplus power is being provided to adjacent communities when power systems based on renewable energy, such as PV systems, are installed for a new telephone mast. This is a positive development, as collaboration helps the companies reduce security costs by decreasing energy theft, and avoid injuries through electrocution. The net result is an improved quality of life for the communities and, more broadly, job creation from mobile phone rentals and access to localised power.

Another issue raised at the third Clean Energy Ministerial (CEM3) in London was the importance of standards not allowing the dumping of poorer quality products or products with more environmental impact on areas that have the least ability to deal with them. Before being published, every standard should be reviewed for environmental impacts, as well as issues such as WTO TBT compliance.

Recommendation 13 – The environmental impact of the standards needs to be assessed before publication

A review of standards by standards-makers for potential environmental impacts, wherever possible, would strengthen the standards.

6. RECOMMENDATIONS

This report presents a number of findings and related recommendations aimed at making the best use of standardisation to promote a growing deployment of renewable energy at a global scale. These recommendations can be broadly categorised as follows:

- » Promotion and knowledge dissemination;
- » Support for broader stakeholder engagement in standardisation;
- » A strategic framework for standardisation in the renewable energy sector; and
- » Specific projects related to standards development.

The table below compiles and provides the overview of this set of recommendations.

Table 5: Consolidation of recommendations from the report

Number	Title	Recommendation Text	Category
1	Further assess and implement activities specifically supporting policy-makers and legislators in their efforts to reduce common globally occurring barriers	There is scope for investigating and promoting the development of standards and/or guidance for globally occurring issues that may require international frameworks. These standards and guidance, when implemented via international or regional standards, would eliminate existing barriers to the trading and deployment of renewable energy technologies. Such barriers might include environmental concerns, such as bird and bat assessment methodologies and visual amenity assessment protocols.	Specific projects related to standards development
2	Mechanisms to support experts' involvement in standardisation are essential	A review should be undertaken of resources available to support the development of standardisation, with a specific focus on technical expert engagement, the barriers and how the governments could better support this process. Mechanisms to support the experts with their related costs should also be explored. Additionally, where technical expertise is limited, or is not available, it is necessary to provide an understanding of what needs to be established to enable technical engagement in standardisation. For example, a bursary scheme for technical expert engagement could perhaps be established, with a particular emphasis on developing countries' experts; a list of experts who could be engaged to support the particular field could also be developed.	Support for broader stakeholder engagement in standardisation
3	Stakeholders' engagement in the ISO SAG-E and support of the strategic mapping exercise is important	Pathways should be established to connect standards users and the ISO SAG-E team working on the strategic mapping exercise. There are valuable opportunities to create a forum for engaging with the ISO SAG-E team, particularly as part of its mapping exercise, and making feedback from stakeholders available to the team.	Strategic framework for standardisation in the renewable energy sector & Support for broader stakeholder engagement in standardisation

Number	Title	Recommendation Text	Category
4	Access to standards and the understanding of the inter-relationship between standards needs to be facilitated	For the standards users, the ability to understand which set of standards is required for specific applications and to easily find and get access to those standards could be rather challenging. There is no obvious, simple and non-time consuming way of understanding which standards outside of the titled standard are normative, (e.g. steel-welding standards or other manufacturing standards) and are therefore also required in conjunction with renewable energy equipment standards. Therefore, it might be useful to investigate ways to facilitate the search and access to the required standards. This could include working with the standards-making bodies to explore possibilities for a collaborative interactive database that provides a searchable interactive standards portal that includes access to a hierarchical tree of the normative standards for the technologies being searched. Also, it might be worth evaluating the opportunities to provide a library of standards for review through the website.	Promotion and knowledge dissemination
5	Mechanisms that may facilitate a strategic overview forum for standardisation in renewables need to be explored	Discussions with the stakeholders in different standards has identified an apparent need for a holistic view as to what standards could be required for the various stakeholder groups, and transmitting the received feedback to the appropriate standardisation body. With this aim, the establishment of a strategic overview forum which transmits this feedback to the appropriate standardisation bodies periodically might be considered.	Strategic framework for standardisation in the renewable energy sector
6	Post-installation aspects of renewable energy system requirements need to be evaluated and documented	The analysis has observed a gap concerning post-installation aspects of renewable energy systems, e.g. operation and maintenance, service and repair. Additional evaluation of standards would be beneficial to ensure that standardisation of post-installation requirements for renewable energies is included in standards. A review should specifically look at those aspects of operation and maintenance, or service and repair, that lead to the reduced optimisation of the systems, or their failure if not properly carried out, and the subsequent effects this has on the wider deployment of renewable energy technologies.	Specific projects related to standards development
7	Further assessment and understanding of the impact of the deployment of standards in the field of renewable energy is required	There is a strong case for establishing a programme of research and evaluation to support the benchmarking of deployment and standardisation in the field of renewable energy. Starting this process early and continuing it as renewable energy deployment grows would illustrate and reinforce the importance of standardisation and its benefits at an economic level. This work would support the standardisation process and also provide useful insights into opportunities and barriers to the deployment of renewable energy.	Promotion and knowledge dissemination
8	Promotion of international standards for the evaluation of competencies in the fields of renewable energy is essential	Being able to count on trained professionals with the necessary skills and knowledge to design, install, operate and maintain renewable energy systems is important to the successful deployment of renewables. Therefore, establishing state-of-the-art facilities for the setting and evaluation of competencies, skills and knowledge for renewable energy should be considered. This could result in the creation of support mechanisms that ensure that the international standards development process covers all the requirements of developing countries, as well as those of the established developed skills providers in developed countries.	Specific projects related to standards development

Number	Title	Recommendation Text	Category
9	In- depth analysis of the need for new or updating of standards should be based on experience gained and evaluation of issues raised in the renewable energy sector	After significant effort invested in developing a number of standards for renewables and years of experience utilising them, deeper and periodical assessment of needs for new standards should be performed. The analysis in this report presents some clear examples in this aspect, such as: Provision of best practices concerning safety issues through standards, e.g. fire safety for for rooftop PV systems; To analyse the need for standards targeting the reuse, through e.g. refurbishment or retrofitting, of technologies and therefore prolong the life of products; Consider a harmonised methodology for the evaluation of particulate emissions from biomass combustion equipment; For hot water technologies and particularly for solar thermal hot water applications there is a need to consider whether there is empirical evidence that there could be a link between solar hot water systems and health threats such as legionella.	Strategic framework for standardisation in the renewable energy sector
10	It is important to evaluate how standards can support innovation in the renewable energy sector	Standards can be a very useful instrument to promote innovation through sharing best practices and information on state-of-the-art technologies, levelling the playing field for close-to-market products and diffusing knowledge. However, further investigation is needed into how to materialise these benefits for renewable energy technologies. For instance, steps should be taken to: Investigate what criteria would provide confidence in innovative and localised products to be included in policy and fiscal mechanisms. Provide the support for the development and piloting of innovative and localised product framework standards to bridge the gap between near market-ready and innovative market-ready products that cannot comply with current international standards. Review how the standardisation process works for standards to be quickly upgraded, modified, or have addendums to accommodate new and innovative products. This review should also consider any barriers that could be created through the standardisation process.	Strategic framework for standardisation in the renewable energy sector
11	Engagement from developing countries in existing programmes that may support their involvement in the standardisation process for renewables is crucial	Exploration with ISO, IEC and other partners whether more engagement through programmes, such as ISO DEVCO and IEC Affiliate Country Programme for matters relating to renewable energy, would be an effective way of enhancing the involvement of developing countries in the standardisation process.	Support for broader stakeholder engagement in standardisation
12	Options for using the latest communication technologies for engagement in standardisation development work need to be explored	The ability to utilise better communications would also support the engagement process, facilitating participation from experts in any geographical region. Evaluation of where additional facilities should be sited to add value in providing better communication hubs should be considered as part of this remote engagement.	Support for broader stakeholder engagement in standardisation
13	The environmental impact of the standards needs to be assessed before publication	A review of standards by standards-makers for potential environmental impacts, wherever possible, would strengthen the standards.	Specific projects related to standards development

7. CONCLUSIONS

The report highlights many of the complex issues faced by standardisation bodies and broader stakeholders in the renewable energy sector. There still appears to be a large requirement to demystify what standards are, and what they can do for stakeholders, external to the standards-making process, particularly at the level that helps individuals or companies to either utilise the appropriate standards or to support their engagement in the development process.

The ability to deliver good outcomes for all stakeholders is a balancing act that needs all the appropriate individuals and organisations around the table at the same time. This is especially true when it comes to balancing the needs of developing and developed countries. The ability to develop well-balanced consensus standards is more important than ever, as the use of standards is becoming more of a regulators' tool. Therefore, the requirement to engage more people in the standards-making process needs to be reviewed and the process needs to become more engaging and less costly for those who develop the standards, but do not directly gain through recompense in other business activities.

To support this balancing act, this report provides some recommendations on how greater engagement can be achieved, e.g. by providing a pool of experts who can support geographic areas that lack the expertise available to ensure that standards are developed that cover issues in their particular area. There are also recommendations on how financial and other mechanisms, such as improved use of 21st-century telecommunications, could support and help the engagement of those currently unable to attend standards meetings. Furthermore, IRENA is in a very good position to play an important role as a facilitator for inclusive engagement in this process by linking countries, standards-developers and standards-users.

There is also an important opportunity for policy-makers to further utilise international standards for the benefit of national regulations for renewable energy by providing detailed technical basis for laws and regulations in the energy sector, supporting tendering processes, and avoiding technical barriers to trade. IRENA can support policy-makers by improving their understanding on how to utilise standardisation and quality assurance schemes by documenting relevant case studies on their impact on renewable energy technologies. This would also facilitate the dissemination of best practices.

The issue around the cost of standards is not just about engagement in standards-making, but also about the purchasing of appropriate standards. There appears to be a mismatch of the cost perception between standards developers and users. This was illustrated when the standards for rural electrification were priced (Chapter 2, Table 3). For developing countries these standards will be invaluable. However, the costs of the standards are high if a community wants to establish its own electrification system. The ability to come up with new solutions for accessing standards would be a big leap forward.

The inventory gathering and resultant gap analysis in this report is particularly challenging for the renewable energy sector. While the data gathered was not exhaustive, it was enough to identify some key issues, although it still has not provided a comprehensive database of renewable energy standards. This is a recommendation for the next stages, which should provide opportunities for an innovative approach to establishing and maintaining a renewable energy standards database.

The report tries to categorise the standards into logical groups. However, this process relies on assumptions on what each standard is developed to achieve, as this is not always evident prior to purchasing. This means that the inventory categorisation may have been allocated differently, dependent on the understanding of the subject area. Furthermore, this process also showed that having a list of the standards is not sufficient in itself. It is also important to understand which standards are the same, or just slightly modified, and which standards interconnect with other standards through normative references. IRENA could contribute to bridging this information gap through the development of a web information platform in consultation with relevant stakeholders. This would provide easy access to information on international standards for renewable energy, including existing standards and those under development, as well as providing information on the ben-

efits of standardisation and the development process, use and application of standards.

For the analysis, it appears that the more complex the production and manufacturing process, the more detailed the standards must be. It has also been observed that where the technology fits into a commoditised mass-market manufacturing process, the standards appear to be more detailed. This is probably why solar PV systems have the most detailed standards, which appear to cover all aspects of manufacturing, testing and performance.

The report also identified issues such as developing projects to evaluate what is needed after the installation of equipment, and the need to develop innovative and localised product standards. Both of these aspects of renewable energy need supporting if the associated products are to remain effective, especially in remote places where access to parts and skilled labour may be limited. Minimising risk through sound quality assurance schemes may enhance the experience, confidence and trust in systems, further aiding deployment of the technologies. In this area, IRENA is committed to analyse how to overcome the barriers to the wider use of quality assurance schemes, including testing and certification of equipment focused on small-scale and off-grid renewable energy systems.

Other areas of renewable energy deployment are already developed but may require a continued assessment of needs for new development, such as design, installation, operation and maintenance, and competency criteria. If issues across the whole life cycle of the system are not covered, renewable energy could have issues with deployment. Strong comprehensive standards need to be continually reviewed and updated and, as new technologies or gaps in the knowledge appear, they should be considered for standardisation.

A cohesive, structured and strategic approach to all the recommendations would provide a progressive change in the field of renewable energy standardisation and demystify standards and their ability to support climate change mitigation via an accelerated deployment of renewable energy technologies.

BIBLIOGRAPHY

AFSEC Information Bulletin, April 2011

Andrew Maiyo, ARSO Secretary General, Presentation Korea – Africa Standardisation Forum, 2010

APEC 21st Century Renewable Energy Development Initiative (Collaborative VI): Adoption of Renewable Energy Standards Phase II, 2006

ARSO Website

ASEAN, ASEAN Good Regulatory Practice (GRP) Guide, February 2009

Benjamin Kimani Kiuru, Presentation – The Green Belt Movement Experience, Green Economy in the Context of Sustainable Development and Poverty Eradication

CEN Website

CEN/CENELEC website, 2012 – List of Standards Development Committees and the standards developed or under development - http://www.cenelec.eu/dyn/www/f?p=104:6:6047764828960681

COPANT Website

DNV (Det Norske Veritas), DNV-OS-J101 Design of Offshore Wind Turbine Structures, Sept 2011

DNV, Tore Hølfødt, Website Press Release, Offshore turbine blades require increased reliability focus, 13 January, 2012

Economics of Standards – Australia Report

Energy Saving Trust, Installing small wind-powered electricity generating systems (CE72), 28 April, 2011

Gerundino D. and Hilb M., The ISO Methodology – Assessing the economic benefits of standards, ISO Focus, June 2010

IAF Website

IEC Report to WTO TBT Committee, November 2009

IEC Website

ISO Website

MCS (Microgeneration Certification Scheme), Microgeneration Installation Standard MIS3003 Requirements for contractors undertaking the supply, design, installation, set to work commissioning and handover of micro and small wind turbine systems, Issue 3.1a

Ottinger, R.L., Experience with Promotion of Renewable Energy: Successes and Lessons Learned – Parliamentarian Forum on Energy

Rolland Simon et al, Alliance for Rural Electricification, Rural Electricification with Renewable Energy – Technologies, quality standards and business models, June 2011

UNIDO, Role of standards – A guide for small and medium-sized enterprises, Working Paper, 2006

United Nations Foundation, Energy Access Practitioners Network – Towards Achieving Universal Energy Access by 2030, 2012

World Wind Energy Association – Small Wind World Report 2012. 2012, Bonn, Germany

ANNEXES

1. Standards and their publishing status
2. Key ISO/IEC certification, verification and auditing standards
3. Information on regional standardisation and overview of the activities
4. Voluntary schemes, third-party independently verified
5. Case studies

Annex 1 – Standards and their publishing status

CEN / CENELEC[52]		Publishing of standards	Review frequency
European Norm (EN)	EN is the ideal deliverable to support European legislative needs, or where the standardisation need is focused on protecting health and safety, or as support to certification.	The European Standard is announced at national level, published or endorsed as an identical national standard, and every conflicting national standard is withdrawn. The content of a European Standard does not conflict with any other CEN Standard.	Within five years.
Technical Specification	A Technical Specification is a normative document made available by CEN in at least one of the organisation's three official languages. This serves as a normative document in areas where the actual state of the art is not yet sufficiently stable for a European Standard.	The Technical Specification is announced and made available at national level, but conflicting national standards may continue to exist. Technical Specifications are also often used as a pre-cursor to the development of a full standard, as they provide a period of time whereby the standards can be tested and trialled when products and services are emerging.	
Technical Report	Technical Report (CEN/TR) for information and transfer of knowledge.	A Technical Report may be established as an informative document in cases when it is considered urgent or advisable to provide information to the CEN national members, the European Commission, the EFTA Secretariat or other governmental agencies or outside bodies, on the basis of collected data of a different kind from that which is normally published as an EN. A Technical Report may include, for example, data obtained from a survey carried out among the CEN national members, data on work in other organisations, or data on the "state-of-the-art" in relation to national standards on a particular subject.	No lifetime, but reviewed regularly.
Workshop Agreement	CEN Workshop Agreement (CWA), which aims at bringing about consensual agreements based on deliberations of open workshops with unrestricted direct representation of interested parties.	A CEN Workshop Agreement is a technical agreement developed in an open structure, the CEN Workshop (WS), and not in a Technical Committee.	

52 CEN BOSS description of deliverables - http://www.cen.eu/boss/supporting/Guidance%20documents/GD059%20-%20CEN%20deliverables/Pages/GD%20-%20CEN%20deliverables.aspx

ISO / IEC			
Committee draft (CD)	The consensus document created by the working groups.	Circulated around the Technical Committee/Project Committee for commenting (iterative process until consensus reached).	
Draft International Standard (DIS) / Committee Draft for Vote (CDV)	The DIS is the first formal draft of the international standard developed by the Technical Committee or Project Committee. The draft is registered by the ISO Central Secretariat or the IEC Central Office and made available to all ISO or IEC members.	If two-thirds majority of the P-Members vote in favour, and not more than one quarter of the total votes cast are negative, the standard can move forward to FDIS.	Three-month voting period.
Final Draft International Standard (FDIS)	The final vote on the Standard before publication. Circulated to all ISO or IEC members by ISO Central Secretariat or IEC Central Office.	Comments not considered at this stage but would be considered at future revisions. The vote is a Yes/No vote; percentages as for DIS/CDV.	Two-month voting period.
ISO / IEC Standard	Published by ISO or IEC and accepted by ISO or IEC members.	Voluntary Standard that may be adopted by any NSB for publishing. These standards are developed in accordance with Parts 1 and 2 of the ISO/IEC Directives.	Three-year interval in ISO; as relevant in the IEC.
ISO/IEC TS Technical Specification	Developed when typically the state of the art has not been reached or the maturity of the product, service or process is likely to change, or if full consensus cannot (yet) be reached, but a normative document is thought to be a positive support to the industry.	Developed in a similar staged process to full standards. Typically committed to as a TS at the start of the development process. However, may be changed within the TC if there is a consideration that a full standard cannot be achieved. Can be published without conflicting standards being removed from the field. After three years the TS is reviewed to establish whether it should be upgraded to an ISO or IEC International Standard, withdrawn, or left as a TS. This will depend on the state of the art in the field the standard is being discussed.	Three-year life.
ISO or IEC PAS (Publicly Available Specification)	The PAS is developed in a shorter timescale than a technical specification as it requires only consensus of the developing committee, or is accepted from outside.	Can be published without conflicting standards being removed from the field. After three years the TS is reviewed to establish whether it should be upgraded to a TS or ISO or IEC standard.	Three-year life

National Standards			
National Standard	National standards are published and made available through the NSB. National standards often adopt regional or international standards and will typically have within the nomenclature of the body that developed them, e.g. BS ISO 12345 – BS (British Standards Institution, plus ISO.	NSBs typically work within agreed international frameworks for standards development. Where international standards have been first adopted by CEN/CENELEC these shall be adopted by NSB in the same way as CEN/CENELEC documents are. Harmonisation of national and regional standards (CEN/CENELEC) is required to be carried out within six months of publishing by the regional body.	

Annex 2 – Key ISO/IEC certification, verification and auditing standards

Standard No. and Title	Description	Key Attributes
ISO/IEC 17000:2004 Conformity assessment – Vocabulary and general principles	Conformity assessment terminology in fields such as testing, inspection and various forms of certification.	Provides a common language and understanding to the following standards in the field of conformity.
ISO/IEC 17020:2012 Conformity assessment – Requirements for the operation of various types of bodies performing inspection	Specifies requirements for the competence of bodies performing inspection and for the impartiality and consistency of their inspection activities. Applies to inspection bodies of type A, B or C, as defined in ISO/IEC 17020:2012 (a measure of the inspection bodies' demonstration of independence), and applies to any stage of inspection. Assessments on behalf of private clients, their parent organisations, or authorities, with the objective of providing information about the conformity of inspected items with regulations, standards, specifications, inspection schemes or contracts. Inspection parameters include matters of quantity, quality, safety, fitness for purpose, and continued safety compliance of installations or systems in operation.	Covers the activities of inspection bodies whose work can include the examination of materials, products, installations, plants, processes, work procedures or services, and the determination of their conformity with requirements and the subsequent reporting of results of these activities. The standard distinguishes between inspection, testing and certification, which overlap in many cases, by the recognition of professional judgement. i.e. Inspection normally requires the exercise of professional judgement in performing inspection, in particular when assessing conformity with general requirements.
ISO/IEC 17021:2011 (Also BS EN ISO/IEC 17021:2011) Conformity assessment – Requirements for bodies providing audit and certification of management systems	Certification of a management system, such as a quality or environmental management system of an organisation, is one means of providing assurance that the organisation has implemented a system for the management of the relevant aspects of its activities, in line with its policy.	This International Standard specifies requirements for certification bodies. Observance of these requirements is intended to ensure that certification bodies operate management system certification in a competent, consistent and impartial manner.
ISO/IEC 17022:2012 Conformity assessment – Requirements and recommendations for content of a third-party audit report on management systems	Contains requirements and recommendations to be addressed in a third-party management system certification audit report based on the relevant requirements in ISO/IEC 17021.	This standard has been developed to provide a more consistent approach to interpreting the requirements of the standards deliverable.
ISO/IEC 17024:2012 Conformity assessment – General requirements for bodies operating certification of persons	This has been created with the objective of achieving and promoting a globally accepted benchmark for organisations operating certification of persons. One of the characteristic functions of the personnel certification body is to conduct an examination, which uses objective criteria for competence and scoring.	While it is recognised that such an examination, if well planned and structured by the certification body, can substantially serve to ensure impartiality of operations and reduce the risk of a conflict of interest, alternative requirements have been included in this International Standard. In either case, this International Standard should be the basis for the recognition of the certification bodies and their certification schemes, in order to facilitate their acceptance at the national and international levels. Only the harmonisation of the system for developing and maintaining certification schemes for persons can establish the environment for mutual recognition and the global exchange of personnel.

Standard No. and Title	Description	Key Attributes
ISO/IEC 17025:2005 Conformity assessment – General requirements for the competence of testing and calibration laboratories.	Specifies the general requirements for the competence to carry out tests and/or calibrations, including sampling. It covers testing and calibration performed using standard methods, non-standard methods, and laboratory-developed methods.	ISO/IEC 17025:2005 is applicable to first-, second- and third-party laboratories, for all scales of organisations and their scope of testing and/or calibration. The standard is used by laboratories in developing their management system for quality, administrative and technical operations, and for accrediting or assessing laboratories. Laboratory customers, regulatory authorities and accreditation bodies may also use it for confirming or recognising the competence of laboratories.
ISO/IEC Guide 65: 1996 / EN45011 /ISO 17065 General Requirements for Bodies operating Product Certification Systems	Sets out the criteria for bodies operating certification of products. The term "product" is defined in ISO 9000:2000 and is still used as the basis for the four generic product categories – these are: services (e.g. installation of RE); software (e.g. control software, calculation tools); hardware (e.g. PV panels, solid biomass boilers); and processed materials (e.g. lubricant). Many products can be comprised of elements of the various categories within generic product categories. The determination of what the product is categorised as will depend on which category is dominant.	Guide 65 provides the framework for the accreditation or assessment of those providing Product Certification. The document provides the minimum aspects that need to be addressed to provide confidence in the certification. The documents require the certification body to demonstrate how it complies and what it is doing to provide confidence that the system is robust. Guide 65 will shortly be superseded by ISO/IEC 17065.
Guide 67 (ISO/IEC 17067) Conformity assessment – Fundamentals of product certification.	Guide 67 describes some of the activities of product certification, identifies basic elements and types of product certification, and shows some of the ways of combining these elements to design a product certification system.	Guide 67 only covers third-party** conformity assessment and the broader sense of product is used (see Guide 65 information). The product certification incorporates, as a minimum, the following three functional stages: selection (sampling); determination and review; and attestation (decision). There are a number of different elements and types of product certification, which determine the requirements of the scheme certification. These are discussed in Guide 67, Section 6.2. *** Third-party gives written assurance that a product (including process and service) fulfils specified requirements.*

Annex 3 – Information on regional standardisation and overview of the activities

African Continent

The African Organisation for Standardisation (ARSO) is an intergovernmental body supporting the development of harmonised standards for the African continent. "With over 27 members, within the framework of the African Union and African Union Commission Trade and Industry standards established by the United Nations Economic Commission for Africa, with the purpose of promoting trade and industrialization, and more recently, protecting the health of consumers and ensuring fair practices in trade. ARSO also promotes coordination of all standards work undertaken by African governmental and non-governmental organisations and aligns the regulatory framework (standards, guidelines, codes of practice and other recommendations) to AU systems for the benefit of African economies and benchmark for global best practices." [53]

In May/June 2011 a meeting of the Africa-Korea Standards Cooperation Forum was held. This led to a Memorandum of Understanding (MoU) being signed between ARSO and KATS (the Korea Standardisation Body) in December 2011. The Areas of Co-operation between ARSO and KATS were identified as: Capacity Building in Inspection, Testing, Product Certification, System Certification (Environmental) and Metrology. There will also be support for Technology Harmonisation Committees (THCs) and for common conformity assessment procedures in Africa.

It would appear that much of the initial concentration of the standardisation process has been on quality and environmental systems, including sustainability of agricultural systems.

ARSO has an Electro-Technology Harmonisation Committee. However, at this time the scope of its involvement in the development of standards is unclear.

As with all standardisation, the costs of engaging in international standardisation is relatively high and it is therefore important to consider this within the context of the Inventory and Gap Analysis study.

The other prominent regional body concerned with standardisation on the African continent is the Southern African Development Community Cooperation in Standardisation (SADCSTAN), which forms part of the SADC and currently has 15 members.

Under Article 9 of the MoU on SQAM (Standardisation, Quality Assurance and Metrology), SADC states its objectives as: "The SADC Co-operation in Standardisation shall promote the co-ordination of standardisation activities and services in the Region, with the purpose of achieving harmonisation of standards and technical regulations, with the exception of Legal Metrology regulations, in support of the objectives of the SADC Protocol on Trade."

Both ARSO and SADCSTAN are aligned in their aims and objectives and have specific aims of cooperation between the two organisations.

At present it has not been possible able to establish the role of the two bodies in standardisation in the field of renewable energy technologies. We have been informed that South Africa adopts the international standards.

In the field of electricity, electronics and related technologies the African Electrotechnical Standardisation Commission (AFSEC) was established in 2008, following declarations of the Conference of African Ministers of Energy in March 2006 and February 2008. In 2011 AFSEC had 12 statutory members which are AFSEC National Electrotechnical Committees (one per country) and six Affiliate Members: African Union Energy Commission (AFREC), Union of Producers, Transporters and Distributors of Electric Power in Africa (UPDEA), East African Power Pool (EAPP), Southern African Power Pool (SAPP), Power Institute for East and Southern Africa (PIESA) and SADCSTAN (SADC Standardisation Expert Group).

AFSEC is responsible for the identification and harmonisation of existing standards and prioritisation of standardisation needs. AFSEC has signed cooperation agreements with the IEC (2009) and CENELEC (2010). AFSEC has established five mirror technical committees of the IEC, each with strategic business plans to guide their activities.

Asia Pacific

Asia Pacific has two regional bodies for standardisation – the Pacific Area Standards Congress (PASC) and ASEAN Consultative Committee for Standards and Quality.

It would appear that while a number of National Standardisation Bodies are active in their own right, it is less clear how the region as a whole is working.

53 Extract from the foreword from the ARSO Strategic Framework 2009-2014 – Membership currently shows 29 countries.

Desires have been expressed for a regional Korea – China – Japan standardisation network, which would strengthen the region's participation in standards development, and support a growing new and renewable energy marketplace.

Euroasian Interstate Council for Standardisation, Metrology and Certification.

The membership of this organisation covers 12 countries including the Russian Federation, the Republic of Moldova, the Republic of Azerbaijan, Turkmenistan, the Republic of Kazakhstan and Georgia. There is little indication at present of how the organisation is working on its standards for renewable energy. However, there is a programme of cooperation with ISO, IEC, CEN and CENELEC aimed at harmonising existing standards.

Americas

COPANT – Pan American Standards Commission

"The Pan American Standards Commission, COPANT, is a civil non-profit association. It has complete operational autonomy and is of unlimited duration.

It comprises of the National Standards Bodies (NSB) of the Americas, which currently totals 25 active members and 9 adherent members.

COPANT is the reference for technical standardisation and conformity assessment for the countries of the Americas for its members and international peers, and promotes the development of its members."[54]

COPANT has a Technical Committee – CT152 Energy Efficiency and Renewable Energy. It is believed that this group has been supporting the development of ISO 50001 Energy Management Standards through its National Standardisation Bodies (NSBs). There are 14 "P" members of the group and seven "O" members (not all of which are NSBs from the Americas. AENOR – Spain's NSB – is a member, for example.)

ANSI in the USA is the leading standards developing organisation with a large catalogue of standards, including renewable energy and energy efficiency. ANSI is active on the global standardisation development stage. Further work will be carried out on ANSI's standardisation activities in due course.

AMN – (Asociación Mercosur De Normalización) is a nongovernmental, non-profit, civil association recognised by the Group Common Market (GMC). It is the only organisation responsible for the management of voluntary normalisation in the scope of the Mercosur.

AMN consists of four associations – IRAM (Instituto Argentino de Normalización y Certificación, ABNT (Brazialian NSB), INTN (Instituto Nacional de Technologia, Normalización y Metrologia) and UNIT (Instituto Uruguayo de Normas Tecnicas).

At this stage it is unclear what renewable energy standardisation work is being carried out by AMN. There are committees for Electricity, Electronics and Environmental Management.

The Council for Harmonisation of Electrotechnical Standardisation of the Nations of Americas (CANENA) is a volunteer-based organisation focused on electrotechnical standards harmonisation activities within the Americas, and thus helping to facilitate trade. CANENA was originally founded in 1992 by the electroindustry manufacturers' associations of North America, who seized the opportunity resulting from a negotiated trade agreement to form the organisation with the aim of fostering the harmonisation of electrotechnical product standards, conformity assessment test requirements and electrical codes between all the democracies of the Western Hemisphere.

CROSQ (CARICOM Regional Organisation for Standards and Quality) welcomes visitors to its website with the statement: "CROSQ is the regional centre for promoting efficiency and competitive production in goods and services, through the process of standardisation and the verification of quality. It is mandated to represent the interest of the region in international hemispheric standards work, to promote the harmonisation of metrology systems and standards, and to increase the pace of development of regional standards for the sustainable production of goods and services in the CARICOM Single Market and Economy (CSME), and the enhancement of social and economic development." The organisation is made up of 15 NSB members from island nations in the Americas.

54 http://www.copant.org/en/web/guest

At present it is unclear whether this organisation has been involved with renewable energy and energy efficiency standardisation.

Middle East

The state of standardisation organisations in the Middle East has not been reviewed at present. While we understand there is the International Arabic Union and the Arab Industrial Development and Mining Organisation – and of course the region is becoming increasing involved with renewable energy and energy efficiency – it is not clear if the Regional Center for Renewable Energy and Energy Efficiency (RCREEE) is involved in standardisation at the regional level.

Annex 4 – Voluntary schemes, third-party independently verified

ISCC (International Sustainability and Carbon Certification)

ISCC is a global initiative involving a large number of companies from the entire product supply chain in a multi-stakeholder approach. Research organisations, NGOs like WWF, and industry associations from different countries are also involved. ISCC is governed by an association which currently has 55 members. ISCC covers all types of biomass and biofuels and has a global scope. The scheme has received recognition for all criteria of the EU Renewable Energy Directive. The scheme's development has been supported by the German Federal Ministry of Food, Agriculture and Consumer Protection through the Agency for Renewable Resources (FNR).

Bonsucro EU

Bonsucro EU is a special version of the Bonsucro scheme, specifically designed to meet the mandatory requirements of the EU Renewable Energy Directive. Bonsucro is a roundtable initiative, in which a large number of companies from the different parts of the supply chain are involved. WWF is also a member. Bonsucro EU is a standard for ethanol based on sugar-cane with a strong focus on Brazilian sugar-cane production. The scheme has received recognition for all criteria of the EU Renewable Energy Directive, except for the provision on highly biodiverse grasslands.

RTRS EU RED (Roundtable for Responsible Soy)

RTRS EU RED is a special version of the RTRS scheme, specifically designed to meet the requirements of the EU Renewable Energy Directive. RTRS is a roundtable initiative, in which a large number of companies from the different parts of the supply chain are involved. A number of representatives from civil society, including environmental NGOs are also members. Among these are: Conservation International, the Nature Conservancy and WWF. RTRS EU RED is a standard for soy-based diesel with a strong focus on Argentinean and Brazilian soy production. The scheme has received recognition for all criteria of the EU Renewable Energy Directive.

RSB EU RED (Roundtable on Sustainable Biofuels)

RSB EU RED is a special version of the Roundtable for Sustainable Biofuels scheme, specifically designed to meet the mandatory requirements of the EU Renewable Energy Directive. RSB is a roundtable initiative, in which a large number of companies from the different parts of the supply chain are involved. RSB has members from civil society including environmental NGOs. Among its members are: Conservation International, the International Union for Conservation of Nature (IUCN), the United Nations Foundation, Wetlands International and WWF. RSB EU RED covers all types of biofuels and has a global scope. The scheme has received recognition for all criteria of the EU Renewable Energy Directive.

2BSvs (Biomass Biofuels Sustainability voluntary scheme)

2BSvs is a French initiative, developed by a consortium of different companies led by Bureau Veritas. 2BSvs covers all types of biofuels and has a global scope. The scheme has received recognition for all criteria of the EU Renewable Energy Directive, except for the provision on highly biodiverse grasslands.

RBSA (Abengoa RED Bioenergy Sustainability Assurance)

RBSA is an industry initiative, developed by Abengoa, covering ethanol. It has a global scope and is characterised by a mandatory requirement to calculate actual greenhouse gas values, with a view to drive better greenhouse gas performance in the supply chain. The scheme has received recognition for all criteria of the EU Renewable Energy Directive.

Greenergy Brazilian Bioethanol verification programme

This standard is an industry initiative, developed by Greenergy. It is applied to sugar-cane-based ethanol produced in Brazil. The scheme has received recognition for all criteria of the EU Renewable Energy Directive, except for the provision on highly biodiverse grasslands.

Source: Europa Press Release, Certification Schemes for Biofuels, 19 July, 2011

Annex 5 – Case studies

During the research for this report virtually no case studies were found that demonstrate a direct causal link between standards and the deployment or barriers to deployment of renewable energy technologies. In most cases the case studies are established to promote a project or technology or to try and draw out lessons learnt. The recognition of standards is usually made in only the briefest of comments, if any at all.

This annex has used case studies – either developed for the report from the lead authors' experiences and knowledge from their involvement in standardisation, or from other published articles which can be used to illustrate aspects of the report's findings and the connectivity between standardisation and renewable energy.

Case study 1 – Solid biofuels and the introduction of quality standards for wood pellet fuel

Illustrative Points *– The development of common European standards for wood pellet fuel has enabled a more consistent approach to the fuel quality and how the quality is communicated. It has also enabled a certification scheme to be developed across the region. With the use of the Vienna Agreement and the move to convert the standards into ISO standards, a compatible certification scheme has also been introduced in the USA and Canada. If these certification schemes are recognised globally, they will support the facilitation of trade through a harmonised approach to fuel quality.*

With the publication of the European standards for solid biofuels, initially as technical specifications and then as full European standards, there has been a shift away from other individual countries' own economic operators specifying against differing standards. In Europe there were three main standards for fuel to be specified against – Austrian, German and Swedish. However, there was no harmonised approach to testing the fuel's characteristics. This caused widespread variations in fuel quality. As a consequence there were many issues with the combustion and storage of the fuel, which slowed the uptake of the biomass technology by creating uncertainty about how well biomass systems operated. In 2011 ENPlus – a certification scheme based on the European standards – was launched in Europe and provided additional confidence in the fuels,[55] especially in the emerging markets and their manufacturing capabilities. This growing confidence in the products and biomass heating systems has in turn stimulated the supply chain upstream to manufacture through the certificated route since customers are now aware of the quality control and promotion of quality pellets. The pellet fuel industry in the US has also developed a similar certification scheme based on the ENPlus model and European standards, which are now being upgraded to international standards.

Case study 2 – Voluntary non-harmonised standards reducing confidence in the deliverable

Illustrative Points *– Care and consideration of the consequences of standards development need to be reviewed at an early stage in the development process. This case study demonstrates the unintended consequences of having national annexes in a standard.*

The case study also draws out the opportunities for addressing the issues through facilitation of dialogue and agreement of policy-makers and legislators with standards-makers and testing facilities to establish acceptable correction factors where regulation and legislation is based on existing methodologies, thus allowing new harmonised methodologies to be introduced seamlessly. This would ensure that renewable energy products (in this case biomass boilers and stoves) can be traded with confidence and that the results do not impede the continuity of existing country regulations.

Development of standards, while seeming to create a harmonised market, can actually have unintended consequences. A good illustration of this is the European Standard for combustion appliances EN303-5,[56] which has regional annexes to allow for variations of test methods for

55 While much of the evidence in the early stages of the scheme is anecdotal, indications from less mature geographic areas of the pellet market suggest that an increase has been seen in the acceptability of the fuel as well as indications of the reduction in the failure rate of technology using the fuel.

56 EN303-5 Heating boilers – Part 5: Heating boilers for solid fuels, hand and automatically fired, nominal heat output of up to 300 kW – Terminology, requirements, testing and marking.

particulates in different European countries. While this appears to be a pragmatic approach to standardisation, and while harmonisation can be achieved, it has actually caused issues for the acceptance of data, as the methodologies provide wide variants in the results. Although there have been many attempts to harmonise to a single standardised methodology, unfortunately due to legislative measures in different countries (referencing the standards) and the fact that there is no consensus on which is the most appropriate methodology within the Technical Committee, this issue is still outstanding and creates uncertainty in countries such as the UK, where air quality from biomass combustion is perceived to be a serious issue.

To address this issue there needs to be political will to ensure that a harmonised approach to the measurement methodology is incorporated into all the legislation using the standard. Before this can happen there needs to be confidence in the final approved methodology for reliability and repeatability of results, so ensuring that regulators have confidence in the methodology and can establish new threshold values that equate to their existing values.

Case Study 3 – Benefits of national engagement in international standardisation

Illustrative Points – *The South Korean government has recognised that enabling and developing targets for manufacturers to lead in standards development at a national and international level will benefit the economy through the country's manufacturers being recognised as leading providers of products and services. The government also appears to understand that by leading or being a major contributor to standards development, the country's manufacturers can also influence the direction of standards to better support their requirements. South Korea's historic low participation in influencing standards has illustrated that deployment of its technologies for new and renewable energies has not been as strong as in other countries.*

A positive understanding of how standards support policy is demonstrated at a national level in South Korea where there has been recognition by policy-makers that the country's engagement with developing standards for new and renewable energy and energy efficiency will benefit and strengthen the country's position in the manufacturing and deployment of these sectors.

Korea has recently established policies to establish increased engagement with standardisation and the expansion of testing facilities. The decision has not been made because KATS (the Korean NSB) is concerned that Koreans could add value to standards per se. The strategy is for Korean companies to engage in the standardisation process to ensure that the country's technologies, particularly solar PV, wind and hydrogen, remain capable of being deployed globally. By engaging in the development of the products, their standards and testing protocols, Korea aims to be a leading partner for the delivery of new and renewable energy technologies.

Korea has set itself targets for the number of standards it would like to promote (50 in Korea, five internationally) and lead internationally (three) up to 2013.[57]

This is a very positive step as Korea has traditionally had a low participation from industry in standardisation. The internal infrastructure is now being developed to ensure that a greater engagement of Korean companies takes place in international standardisation. This includes:

» To develop and propose five international standards in the fields of solar PV, wind turbine, hydrogen fuel cell and ocean energy:
  - Solar PV: solar PV access equipment (in process), next solar cell (silicon thin-film, 4th fuel cell).
  - Wind turbine: security requirements for design of offshore wind turbine, blade deflection test, earthquake-resistant design.
  - Hydrogen fuel cell: micro fuel cell compatibility of electricity and data (in progress).
  - Ocean energy: ocean thermal energy conversion system performance test (in progress).

» Take the leader's position in the international project through cultivating and supporting experts in standardisation.

» Strengthening the cooperation for being leading country in the renewable energy international standard field up to 2013 by:
  - Promoting standard and technology through north-east Asia cooperation within Korea – China – Japan (signing a private standardisation MOU); and
  - Holding an international standardisation conference and conducting joint R&D projects.

57 BOO, Kyung-Jin, Review of the Current Status of Korea Standardization in the field of New and Renewable Energy, 2012 for this IRENA project based on Prof. Boo's presentation at the Korea Energy Economics Institute.

To support the above targets Korea has developed a strategy which supports the implementation process and includes:

- Developing Pan-Asia cooperation corresponding to that in the US and Europe;
- Promoting the training of experts through development programmes, constructing standard databases, designating a permanent agency for the promotion and implementation of standards;
- Revising related laws for the promotion of standardisation plans – organisation, budget and human resources; and
- Revising a number of laws and articles to ensure that new and renewable energy standardisation is embedded in the political framework[58].

Case study 4 – Mozambique wind developments

Illustrative Points – *This case study highlights three aspects of standardisation.*

The first is the minimal association between standards and the ability to support or hinder the deployment of renewable energies.

The second point is about how standardisation needs to be, and should be, more inclusive – especially in developing countries and areas with localised development of products.

The third point is that renewable energy technologies have an important role to play across all areas of society. By ensuring full engagement in the standards development process (in this case the Rural Electrification standards), the entrepreneur will have better knowledge and capabilities to develop safe and effective energy solutions.

In Mozambique only 5% of the population currently has access to electricity – mainly in urban areas. 50% of the country's public health infrastructure is without power. Homes and public buildings that do have power suffer regular electricity blackouts; this is the reality in Mozambique.

Rural areas where agriculture is a particularly large aspect of economic life are being affected by droughts and flooding, while fishing on the 2 800 km coastline is also affected by the harsh environment of the Indian Ocean.

Mozambique, being on the eastern coast of Africa (latitude of 40° north to 40° south), has good winds and solar radiation due to its geographic location. However, the cost of imported technologies remains a barrier to the uptake of renewable energy.

This is being overcome by an entrepreneurial social enterprise company – the Clean Energy Company (TCEC) situated in Pemba on the northern coast – which is developing locally produced wind turbines, manufactured to be simple and sufficiently robust to withstand the harsh conditions in Mozambique.

TCEC is using permanent magnet generator (PMG) picoturbines[59] designed specifically for this environment. The turbines will be manufactured locally, installed by local installers, with local resources and craftsmen. They will be installed in rural areas and can be maintained and operated by rural communities.

The company employs Fundi (woodwork professionals) who work with local hand-carved seasoned African hardwood, which is durable in the harsh Mozambique environment. It also uses locally made generators and support structures to build the turbines which then provide electricity in remote areas in order to support local enterprise and needs of the local community, such as pumping water for irrigation, or running cold storage freezers to prolong the life of produce and the growing season.

TCEC, which is supported by the charity Renewable World,[60] has already built and installed a turbine in a 22-strong farming association site near to Pemba.

While there is no direct reference to standards in the company's case studies, there are links to the Alliance for Rural Electrification (ARE) on the Renewable World website,

58 BOO, Kyung-Jin, Review of the Current Status of Korea Standardization in the field of New and Renewable Energy, 2012 for this IRENA project based on Prof. Boo's presentation at the Korea Energy Economics Institute – Conclusions and Recommendations.

59 The Clean Energy Company wind turbine is based on the Hugh Piggott design www.scorraigwind.org

60 Renewable World aims to tackle poverty through renewable energy and has programmes across East Africa, South Asia and Central America. www.renewable-world.org

who advocate the use of the IEC and other standards for the design and installation of rural electrification systems.

As discussed before, if the standards were to require compliance to international standards for the manufacture, testing, installation and commissioning, then these turbines may well not meet the requirements. That does not mean that they are an inappropriate technology, it is more about how standards facilitate trade. As part of the recommendations in this report further investigation, possibly at national, regional, and international levels, is required into how organisations such as TCEC can be included in the larger harmonisation of standards and their implementation. For example TCEC, if it is not already engaged in standardisation, could potentially be part of the Mozambique IEC NEC (National Electrotechnical Committee).

Case study 5 – Power Collective

Illustrative Points – *This case study could be anywhere in the world and is an important aspect of standardisation as legislation and regulation are more closely aligned with standards.*

It illustrates that the standardisation process can create barriers to trading of new and innovative products, if they do not conform, or cannot be recognised, within existing standards.

National, regional and international standards are not developed for individual companies or individual products. The case study demonstrates that individual technologies developed for a market, especially those that could be market-transforming (potentially against the current technologies in the marketplace), have to be handled sensitively. The standardisation process is slow and the introduction of new technologies is often very fast in emerging markets. There are definitely important reasons for having standards, i.e. for safety, demonstrating performance, etc. However, full harmonised product standards may be more difficult to establish.

Ways of bridging these gaps need to be established to ensure that market deployment is effective and stimulates innovation.

Power Collective is a UK-based company that is developing the ridgeblade – an innovative roof ridge wind generator [61]. The product is nearly market-ready, has potential orders and the company has already won awards for its design in the Netherlands. However, due to UK legislation regarding to Feed-in Tariffs (FiT), Power Collective would not be able to sell the product. Customers would be unable to claim the FiT at present, as the company believes it cannot test its product against the current wind turbine standards or the MCS scheme documents which are based on the international standards. This prevents Power Collective from getting the product certified for MCS and hence obtaining access to FiT for their customers.

MCS is looking to pilot an innovative product standard, similar to that which has been recommended previously in this document. However, this will take time.

The pace of developing standards for innovative products causes concern for new entrants to the market and will do so with more frequency unless the standardisation process can find new ways of allowing companies to demonstrate that their products are appropriate while standards are being developed.

Case study 6 – Standards for the measurement of the Calorific Value of Coal

Illustrative Points – *This case study demonstrates the importance of standardisation for the communication, understanding and acceptance of products in transboundary trading. It also highlights the need to consider global relevance when developing standards and ensuring that, wherever possible, they are developed and accepted as widely as possible.*

During the early to mid-20th Century coal was shipped across the world, particularly from the USA. However, the calorific value of shipments was always changed when it reached the UK. As the coal had not changed its physical properties, there was only one explanation for this. The calculation methodologies were different on each side of the Atlantic. As the coal was purchased using the US calorific value, this distorted the traded value of the fuel. The introduction of a standardised method for testing and calculating the calorific value of the fuel was agreed by all parties (the standard) and provided an equitable and harmonised determination of the fuel's calorific value.

61 www.ridgeblade.com

The same principles are being used within the CEN and ISO Solid Biofuels standards to ensure there is equity across the globe. This is important, especially for developing countries that are developing large supply chains with major utility companies across the globe for Pine Kernel (PK), Olive Cake and other solid biofuel pellets, chip and clean agri-waste biomass.

Case study 7 – Sustainability of bioenergy and the Global Bioenergy Partnership (GBEP)

Illustrative Points – *This case study highlights the need for more holistic consideration of stakeholder needs and requirements earlier in the development cycle. The synergies between what each stakeholder group is aiming to achieve and how a cooperative approach could have supported this appears to have been lost. The lack of these holistic and harmonised approaches have probably reduced the overall effectiveness of the system, potentially added complexity and bureaucracy to the reporting structures, and also potentially added to costs. It may also have slowed the ability to understand the impacts of sustainability and hence reduced the deployment of bioenergy.*

GBEP was introduced following the G8 Gleneagles Summit in the UK and is now supported by more than 34 Partners with 31 Observer Members. GBEP states that: "Current GBEP Partners and Observers account for the majority of bioenergy produced in the world."

GBEP has developed sustainability criteria and indicators for governments to use for reporting externally and internally. However, ISO does not even have an observer at these proceedings.

This represents a missed opportunity, since ISO is developing standards for the sustainability of bioenergy, which effectively could have provided an underlying support mechanism for harmonised evaluation and reporting. The development of standards is not integrated into the GBEP process, nor is GBEP's work integrated into the ISO PC's work programme. If a strategic view had been taken at an early stage, GBEP could have been supported and measures could have been taken to ensure that the whole information supply chain was cohesive and optimised.

Also, at the same time as GBEP was developing its criteria and indicators, CEN was beginning to develop sustainably produced bioenergy standards, which ended up as being specifically for compliance with the RED for biofuels. The ISO standards were specifically started because some standards-makers in the field of bioenergy did not like the way the CEN standards were developing.

Unfortunately, some participants in the standards development process strongly felt that powerful lobbies and influencing groups had managed to affect both the CEN and ISO standards development processes and the opportunity to deliver standards that could be used to support policy-makers and economic operators might have been lost.

Trust in the sustainability of biofuels is a critical element for their uptake and therefore anything that affects, or is perceived to affect, that trust can have a major impact on its viability.

Additional competition for sustainably produced bio-based products and materials is also coming from the bio-plastics and biochemical sectors. Without harmonisation of the sectors' standards where practical, economic operators may need to either be certified through multiple schemes or restrict their trade through one route to market.

These potential barriers to trade by standards development could lead to unintended consequences, whereby the easiest route to compliance for sustainability is the most likely to be chosen, even if it is not the most useful to society.

This would have a great effect on developing countries that have good resources and opportunities to develop markets for sustainably produced biomass at the small scale before expanding to trade in wider markets.

Case study 8 – Alliance for Rural Electrification

Illustrative Points – *This case study demonstrates how clear publications on energy-related aspects and their linkage to standards can greatly improve the understanding and quality of installed systems.*

It also illustrates how cross-boundary issues, such as energy management, energy efficiency and integration of other technologies (in this case LED lighting) should not be standardised in isolation of each other.

While researching this case study it also reinforced the cost aspects of standards (see Chapter 3: Costs of standards)

and the importance of maintaining their currency (i.e. they need to be reviewed and updated regularly), which also can have ongoing cost implications.

The Alliance for Rural Electrification (ARE) is promoting the use of renewable energy in rural off-grid and mini-grid locations. ARE demonstrates how the renewable energy and the energy demand sides can be integrated to ensure the benefits of renewable energy are optimised, e.g. through the appropriate installation of low-energy lighting and energy-efficient appliances.

As part of its supporting literature, the ARE has produced a document that directly covers the issues of renewable energy and what standards support the best integration of the technologies, including how to manage the projects. [62] This useful document provides not only the standards that directly relate to renewable energy technologies, but also the peripheral component standards, such as for batteries, inverters and lighting. As a relatively recent publication and a valuable reference source this document should be promoted widely for developing countries, Pacific island countries and those looking to engage in rural electrification. However, it is important that the underlying standards and the document are maintained and updated regularly to ensure they remain current.

It is understood that the PAS [63] Rural Electrification Standards were established and funded through the IEC by a group led by EDF in France. JWG 1 of IEC TC 82 is now developing the IEC 62257 series on rural electrification. The group is led by convenors from Malaysia and South Africa.

As the standards are now over five years old and the renewable energy industry has a lot more experience in deploying its technology in rural locations, those who have been recently engaged in the process are actively encouraged to share their knowledge when updating the standards. Encouragement should be given for the PAS standards to be upgraded to full IEC standards, and a formal consensus-based approach should be taken to their development.

62 ARE, Rural Electrification with Renewable Energy – Technologies, quality standards and business models.

63 PAS - Publicly Available Specification.

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