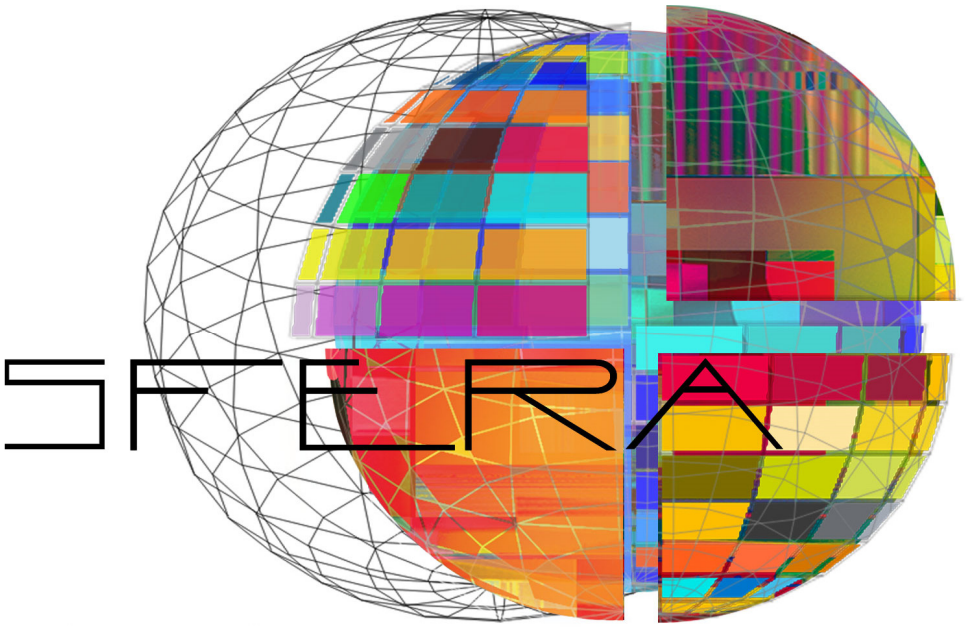

Solar Facilities for the European Research Area

N4.1

The Approach of SFERA on Standardization: State-of-the-Art, Strategy and Expected Impact

The SFERA Project is co-funded by the European Commission under the 7th Framework Programme Capacities
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SEVENTH FRAMEWORK PROGRAMME

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	PU	Public	PU
	PP	Restricted to other programme participants (including the Commission Services)	
	RE	Restricted to a group specified by the Consortium (including the Commission Services)	

Table 1. Document history/change log.

Version	Date	Amended by
01		

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Introduction

This deliverable summarizes the activities of the project *SFERA Solar Facilities for the European Research Area* concerning standardization; it explains how standardization is organized on the International, European and national levels, with focus on solar applications in general and on concentrated solar power, to set the backdrop for activities of the project concerning standardization.

These are explained in greater detail, including the impact of the evaluation by the evaluator of European Commission.

Recommendations on further handling standardization to exploit the benefits of standardization activities in a research project in view of a second phase of the project are given as well.

1 The correlation of standardization and research

1.1 General aspects

Standardization is acting in a well-defined framework. Next to internal rules for organizing work, this framework is influenced by requirements and drivers of standardization: standards are voluntary by nature to be implemented or not; proposals may come from any individual, group, association or any stakeholder, while standardization in Europe is considered to be industry-driven, thus addressing industry´s needs, not without consulting and including all interested stakeholders in the development process of a standard; others dimension are added by standards being referenced in legislation and being a backbone of the overall quality infrastructure in Europe. The framework is constantly adapted to the needs of industry, needs of users, needs of politics.

When new technologies or new research results and knowledge are available, they are integrated into standardization within the existing framework, which is characterized by a consecutive process that has two parallel strands (refer to Figure 5).

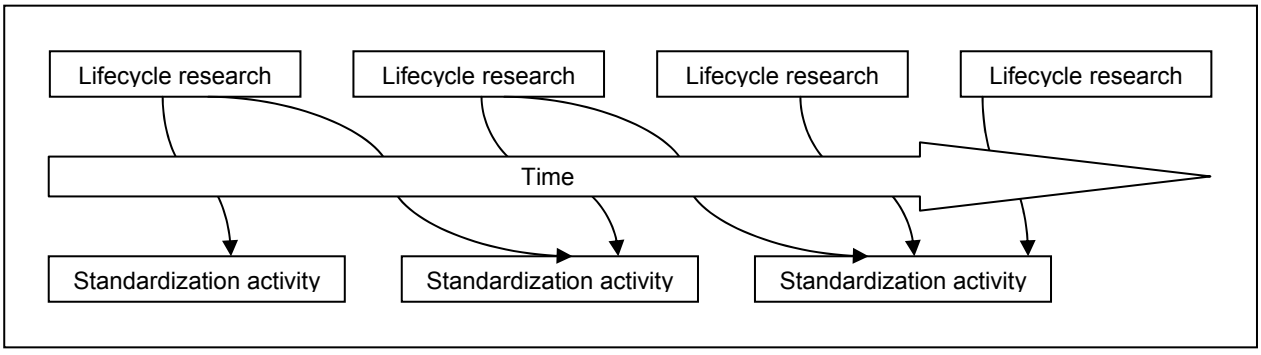

Figure 1: Lifecycles of Research and Standardization Activities

Research in this type of process is thus lagging "behind" standardization, meaning to say that its results are being transferred mostly after a research project has been finished, rarely during its lifetime; if specific research has been linked to specific standardization, which is often called pre-normative research; this implies even the consecutiveness in the process of transfer.

1.2 The role of standardization in research projects

The function of standardization in the research process has been studied and documented. The approach of Blind and Jungmittag breaks down "research" into the life cycle of research and relates the different types of standards to the phases of research that it can significantly support, refer to Figure 6.

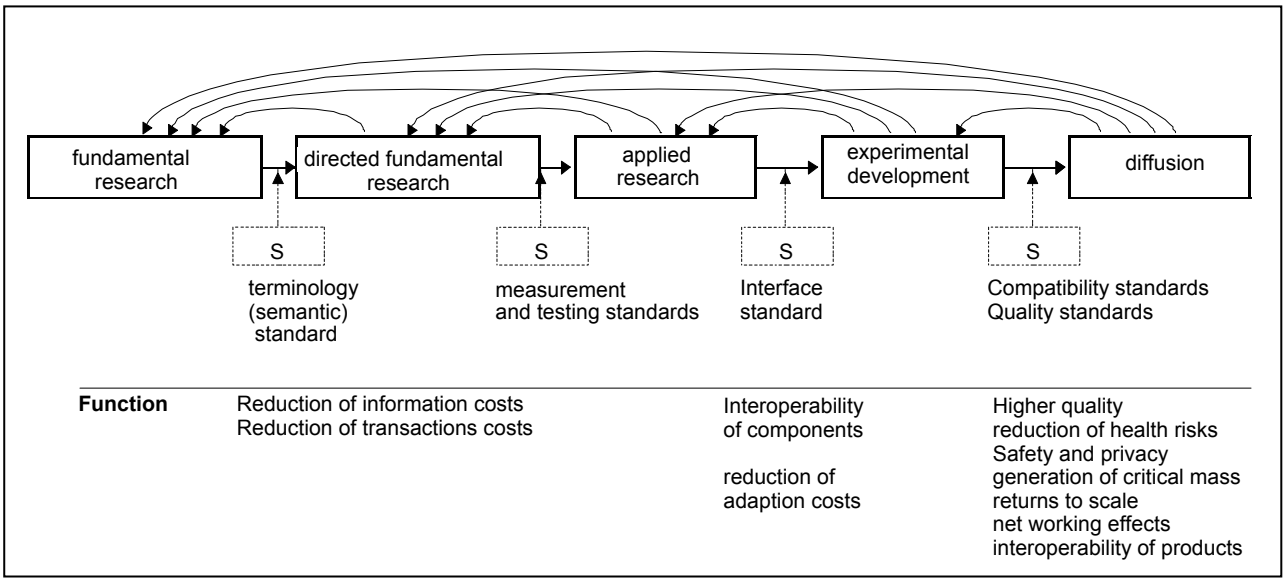

Figure 2: Standards in the research and innovation process[1]

Standards can impact research in such, as they can provide knowledge already verified by a group of relevant stakeholders, i. e. experts in the field. Standards can codify, define and describe recognized methodologies, processes, terminology, etc. assuring that these present the state-of-the-art. This can prevent research from reinventing the wheel.

One example is the SolarPACES *Guideline Measurement of solar weighted reflectance of mirror materials for concentrating solar power technology with commercially available instrumentation*. Here, several existing standards are listed as normative references, meaning that their application is required in the context of the guideline.[2]

Thus, the identification and use of existing standards can contribute to a research project.

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1 K. Blind, A Jungmittag, The impact of patents and standards on the macroeconomic growth: a panel approach covering four countries and 12 sectors; J. Prod. Anal. 29 (1) (2008) 51-60.

2 http://www.solarpaces.org/Tasks/Task3/Interim_Reflectance_Guideline.pdf

On the other hand, standardization can enable fast and easier market exploitation of research results, as standards available in the area usually reassure users. Project outcomes can be "tested" with a wide community of stakeholders, raise their awareness of the project results and expand the original network.

On the technical side, standards enhance i. e. interoperability, comparability and compatibility with what exists, thus supporting market entrance and market penetration. Project results taken up in a standard remain available beyond the project's life-time, are regularly revised and present a format for long-term exploitation of the project results.

Last, but not least, standards contribute to increasing the intensity of competition and export potentials and powers.

Discovery and exploitation of standardization potentials therefore should be another focus of linking research and standardization. If the interrelationship of standards, markets and innovation are neglected, leadership in markets could be lost, as happened in the case nanotechnology.[3]

Concerning the economic impact of standards on the economy, it has been found that the impact can be expressed as contribution of standardization to economic growth. For Germany, this figure could be identified to be around 22%.

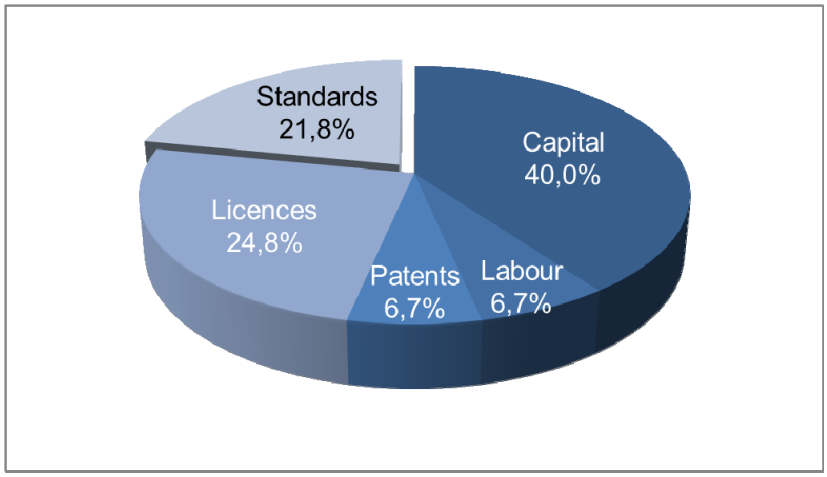

Figure 3: Economic impact of standards in Germany[4]

[3] Documented inter alia in: Blind, K., Gauch, S. (2009). Research and standardisation in nanotechnology: evidence from Germany. Journal of Technology Transfer (2009) 34:320–342.

[4] Data as per DIN study "Economic Benefits of Standardization- An Update of the 2000 Report ", 2011; further information available at http://www.din.de/sixcms_upload/media/2896/GNN_2011_engl_FINAL.pdf

1.3 The contribution of research projects to standardization and their benefits

A recent study commissioned by CEN and CENELEC[5] provides a basis of evidence for understanding how European research projects can contribute to standardization activities, and how such links can help to facilitate the dissemination of innovation.

The study[6] analyzed how different research projects have included links with standardization and the benefits this brings, focusing on research projects supported by the European Union's 6th and 7th Framework Programs (FP6 and FP7).

According to the results of the study, around one third of European research projects (supported by FP6 and FP7) have either made use of standards or addressed standardization in some other way.

The study identifies a wide range of benefits for projects that contributed to standardization. For example, more than 80% of projects having proposed or developed new standards declared that standards improved dissemination of their research results. Nearly three-quarters (73%) of project coordinators who had included standards in their previous projects said that they would be willing to address standardization again in their future projects.

2 State-of-the-art in standardization for solar thermal energy

2.1 Introduction to standardization

According to DIN EN 45020:2006 *Standardization and related activities – general vocabulary (ISO/IEC Guide 2:2004), Trilingual version EN 45020:2206*, standardization is the "activity of establishing, with regard to actual or potential problems, provisions for common and repeated use, aimed at the achievement of the optimum degree of order in a given context". A standard then is a "document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines and characteristics for activities or their results, aimed at the achievement of the optimum degree or order in a given context."

Standardization can thus be done and standards be developed on many levels and by many organizations.

International standardization is standardization in which involvement is open to relevant bodies from all countries, while e.g. national standardization takes place at the level of one country.

There are organizations that are recognized as standards developing organizations or as organizations representing national standpoints and interests.

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5 The European Committee for Standardization and the European Committee for Electro-Technical Standardization

6 The final report of the 'Study on the contribution of standardization to innovation in European-funded research projects' is available at: www.cencenelec.eu/research/SuccessStories. The summary can be found at http://www.cencenelec.eu/research/news/publications/Publications/https___nitrocloud-prod.s3.amazonaws.com_(111821598)%20Connect14.pdf

Figure 4 illustrates some types of standards and some of their characteristics. Standards developed for the solar field are originating from all levels, while various regulations at national and international levels exist[7] and must be respected whenever components' manufacturing and plant's construction are concerned.[8]

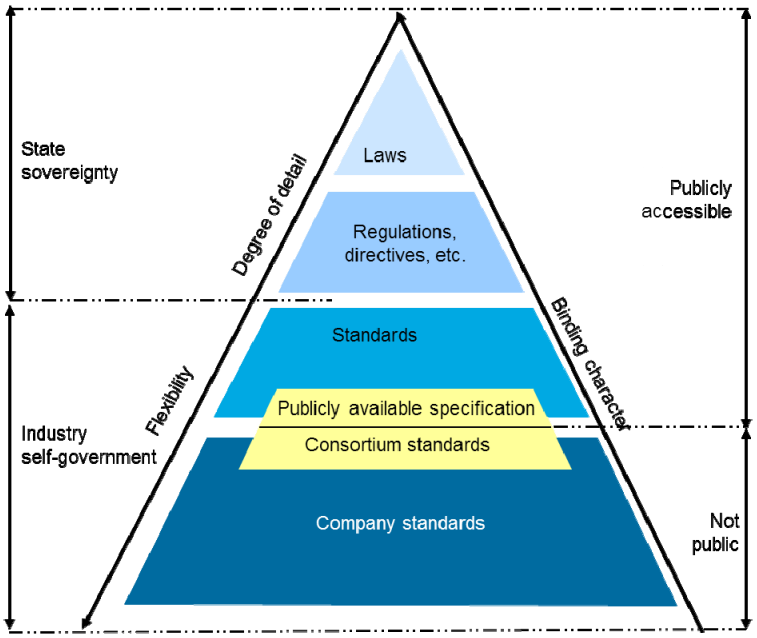

Figure 4: Standards and their specifications regarding development, accessibility and binding character

Figure 5 shows how standardization, from the perspective of German standardization, is organized in Europe and in the international context, when looking at so-called formal standardization.[9] The latter follows specific requirements concerning transparency, openness, accessibility, stakeholder involvement, consensus, among others.

7 Source: http://www.iec.ch/cgi-bin/getfile.pl/sbp_117.pdf?dir=sbp&format=pdf&type=&file=117.pdf

8 There may be such covering select aspects of solar application, e. g. regarding the essential requirements for products covered by European directives and to be placed on the European Single Market. An overview of legislation promoting CSP implementation can be found at http://www.solarpaces.org/Library/Legislation/legislation.htm

9 Formal standardization follows the WTO Standards Code of Good Practice; http://www.wto.org/english/tratop_e/tbt_e/tbt_e.htm and http://www.wto.org/english/docs_e/legal_e/17-tbt_e.htm

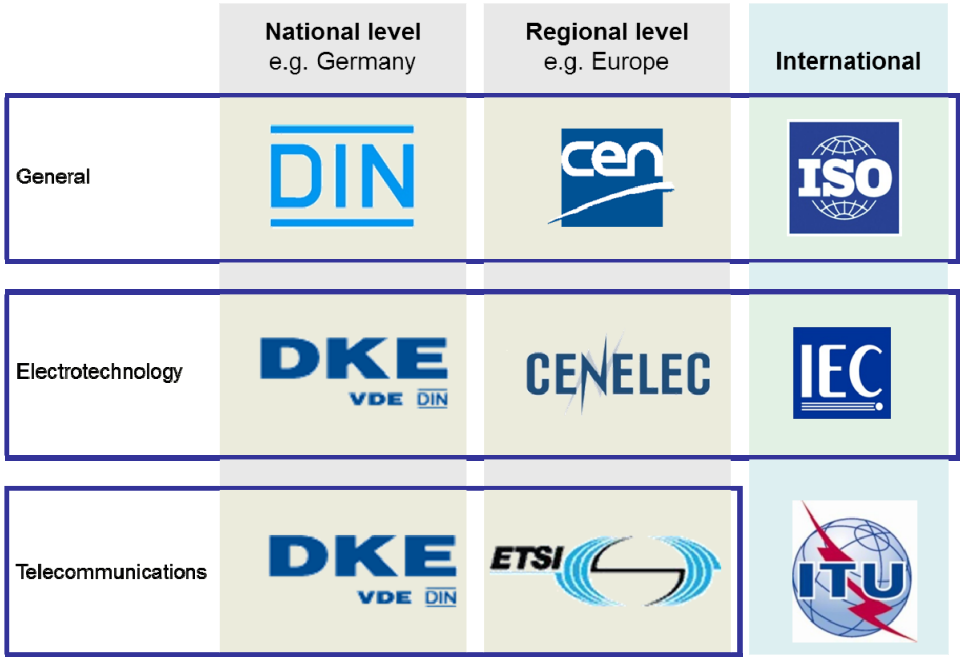

Figure 5: Formal standardization and its organizations

Another significant issue concerning standardization is the principle of participation in standardization. On the national level, this is open to any qualified stakeholder; this person is usually sent by a company, an association, or some other body with full power to present not personal interests, but those of the sending organization. This principle holds true for participation on the European and International levels as well; delegates present the views of their sending national standards committee, while experts give technical input on the working level.

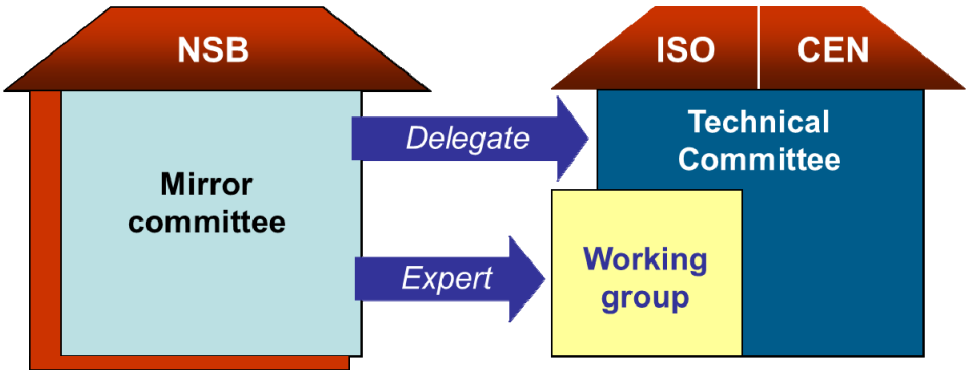

Figure 6: Principles of participation in European and International standardization[10]

[10] NSB National Standards Body;
ISO International Organization for Standardization; the same holds true for IEC, the International Electrotechnical Commission
CEN European Committee for Standardization; the same holds true for CENELEC, the European Committee for Electrotechnical Standardization

Cooperation among the different levels exists, and can be managed through different channels and by different tools. Cooperation between European standardization and International standardization can e. g. be governed by the Vienna (CEN/ISO) or Dresden (CENELEC/IEC) Agreements.[11]

2.2 Overview of ongoing activities on the International and on European the level related to CSP

2.2.1 International standardization

International standardization is handled by two organizations, ISO, the International organization for Standardization, and IEC, the International Electrotechnical Commission. Figure 5 briefly reflects the scope of both.

Both organizations have committees for the solar field.

2.2.1.1 IEC

IEC/TC 117 *Solar thermal electric plants* is responsible for the preparation of international standards for systems of Solar Thermal Electric (STE) plants for the conversion of solar thermal energy into electrical energy and for all the elements (including all sub-systems and components) in the entire STE energy system.

In 2012, IEC/TC 117 established a Business Plan,[12] which addresses such topics like business environment, market demand and trends, trends in technology, strategies and action plan.

The main objectives of IEC/TC 117 will be to set the reference terms for the different systems, subsystems and components along with the most proper way to measure their respective performance.

The standards are to cover all of the current different types of systems in the STE field, as follows:

- Parabolic trough
- Solar tower
- Linear Fresnel
- Dish
- Thermal storage

[11] Further information can be found at http://www.cen.eu/cen/AboutUs/CENnetwork/EurIntOrg/Pages/default.aspx for the Vienna Agreement and at http://www.iec.ch/about/globalreach/partners/regional/iec_cenelec_agreement.htm for the Dresden Agreement.

[12] http://www.iec.ch/cgi-bin/getfile.pl/sbp_117.pdf?dir=sbp&format=pdf&type=&file=117.pdf

The standards would define terminology, design and installation requirements, performance measurement techniques and test methods, safety requirements, "power quality" issues for each of the above systems.

The standards would also address issues of connectivity and interoperability with the power grid related to connections, bi-directional communicates and centralized control (Smart Grid) and environmental aspects.[13]

Currently, 11 countries participate actively in IEC/TC 117, while another 11 have an observer status.[14]

The chair is with Israel, the secretariat with Spain.

Table 1: Membership of IEC/TC 117[15]

Country	**Type of membership**	
Australia		O-Member
Austria		O-Member
Brazil		O-Member
Canada		O-Member
China	P-Member	
Czech Republic		O-Member
Denmark		O-Member
France	P-Member	
Germany	P-Member	
Israel	P-Member	
Italy	P-Member	
Japan	P-Member	
Korea, Republic of		O-Member
Mexico		O-Member
Poland		O-Member

[13] Source: http://www.iec.ch/dyn/www/f?p=103:7:0::::FSP_ORG_ID:7851

[14] For information on the responsibilities and rights of participating and observing members, go to http://www.iec.ch/about/locations/iec-aprc/iec_aprc_get_involved.htm

[15] Information retrieved from http://www.iec.ch/dyn/www/f?p=103:29:0::::FSP_ORG_ID,FSP_LANG_ID:7851,25?q=dresden agreement

Country	Type of membership	
Portugal		O-Member
South Africa	P-Member	
Spain	P-Member	
Sweden	P-Member	
Switzerland	P-Member	
United Kingdom		O-Member
United States of America	P-Member	

Liaisons were proposed for

- IEC TC 5 Steam Turbines
- IEC TC 82 Solar photovoltaic energy systems
- ISO TC 180 Solar Energy
- ISO TC 192 Gas turbines

So far,[16] a liaison has been established with ISO/TC 180.

The action plan for IEC/TC 117 includes the establishment of working groups or project teams, covering the different types of STE systems. As of 2013-10, three ad-hoc groups have been set up.

2.2.1.1.1 AHG 1 General subjects

The scope of AHG 1 covers the development of IEC deliverables regarding common aspects for the different STE technologies such as Terminology, Safety requirements, Typical Meteorological Year (TMY) definition, as well as their relevant schedule.

The chair is with the US national committee; participating are Germany, Spain, Japan and the US.

2.2.1.1.2 AHG 2 Systems and components

The scope of AHG 2 covers the development of the necessary IEC deliverables to standardize the requirements to qualify the components of the different technologies as well as the parameters for the operational monitoring of the plants and the relevant acceptance tests.

The chair is with Spain; Germany, Israel, Japan. Spain, Sweden, and the US are participating.

[16] 2013-12-03

2.2.1.1.3 AHG 3 Energy storage

AHG 3 is developing the necessary IEC deliverables for characterizing the thermal energy storage focusing on the whole system and on the specific components.

Germany has the chair, while Germany, Israel, Japan, Spain, Switzerland and the US are members.

2.2.1.1.4 Documents published or under development

IEC/TC 117 so far has not published any standard or draft standard.

2.2.1.2 ISO

ISO/TC 180 *Solar Energy* was founded in 1983 and is responsible for standardization in the field of solar energy utilization in space and water heating, cooling, industrial process heating and air conditioning.[17] It prepares International Standards for the development, testing, installation and servicing of equipment and systems related to solar energy. The committee's major activity is in relation to thermal applications for water heating.

The committee is also involved with standards on the instrumentation and procedures used for measuring solar energy. The committee acts in liaison with IEC/TC 82, *Solar photovoltaic energy systems* and the World Meteorological Organization.

The business plan of ISO/TC 180[18] includes a list of current areas of priority interest:

- *Communication of information* — standards for uniformity of terminology and climatic data, including instrumentation standards and measurement procedures, with particular reference to resource evaluation, monitoring of test conditions and traceability of calibration.
- *Uniformity of test methods* — standard test methods to promote data exchange between different test sites, and to facilitate trade.
- *Provision of test methods* and, where appropriate, specifications for materials for solar energy applications, as an aid to designers, consumers and government agencies providing support for market development.

25 countries participate in ISO/TC 180, while there are 39 observing countries.

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[17] Source: http://www.iso.org/iso/home/standards_development/list_of_iso_technical_committees/iso_technical_committee.htm?commid=54018

[18] Source: http://isotc.iso.org/livelink/livelink/fetch/2000/2122/687806/customview.html?func=ll&objId=687806&objAction=browse&sort=name

Table 2: Membership in ISO/TC 180

Country	Type of membership	
Algeria (IANOR)	P-Member	
Argentina (IRAM)		O-Member
Australia (SA)	P-Member	
Austria (ASI)	P-Member	
Barbados (BNSI)	P-Member	
Belgium (NBN)		O-Member
Botswana (BOBS)	P-Member	
Bulgaria (BDS)		O-Member
Canada (SCC)	P-Member	
China (SAC)	P-Member	
Cuba (NC)		O-Member
Cyprus (CYS)		O-Member
Czech Republic (UNMZ)		O-Member
Denmark (DS)	P-Member	
Ecuador (INEN)		O-Member
Ethiopia (ESA)		O-Member
Finland (SFS)		O-Member
France (AFNOR)	P-Member	
Germany (DIN)	P-Member	
Greece (ELOT))	P-Member	
Hong Kong, China (ITCHKSAR)		O-Member
Hungary (MSZT)		O-Member
India (BIS	P-Member	
Indonesia (BSN)		O-Member
Ireland (NSAI)		O-Member
Islamic Republic of Iran (ISIRI)	P-Member	
Israel (SII)		O-Member
Italy (UNI)		O-Member
Jamaica (BSJ)	P-Member	

Country	Type of membership	
Japan (JISC)		O-Member
Kenya (KEBS)		O-Member
Libyan Arab Jamahiriya (LNCSM)	P-Member	
Malta (MCCAA)		O-Member
Mauritius (MSB)		O-Member
Mexico (DGN)		O-Member
Mongolia (MASM)		O-Member
Netherlands (NEN)		O-Member
New Zealand (SNZ)		O-Member
Norway (SN)		O-Member
Oman (DGSM)		O-Member
Pakistan (PSQCA)		O-Member
Philippines (BPS)		O-Member
Poland (PKN)		O-Member
Portugal (IPQ)		O-Member
Republic of Korea (KATS)		O-Member
Romania (ASRO)	P-Member	
Russian Federation (GOST R)	P-Member	
Saudi Arabia (SASO)	P-Member	
Serbia (ISS)		O-Member
Slovakia (SUTN)		O-Member
Slovenia (SIST)		O-Member
South Africa (SABS)	P-Member	
Spain (AENOR)	P-Member	
Sri Lanka (SLSI)		O-Member
Sweden (SIS)	P-Member	
Switzerland (SNV)	P-Member	
Syrian Arab Republic (SASMO)		O-Member
Thailand (TISI)		O-Member
Trinidad and Tobago (TTBS)		O-Member

Country	Type of membership	
Tunisia (INNORPI)	P-Member	
Ukraine (DSSU)		O-Member
United Kingdom (BSI)	P-Member	
United States of America (ANSI)	P-Member	
Uruguay (UNIT)		O-Member

2.2.1.2.1 Liaisons of ISO/TC 180

ISO/TC 180 has a network of other technical committees it collaborates with.

It has established liaisons with the following committees, allowing mutual access to documents:

- ISO/IEC JPC 2 *Joint Project Committee – Energy efficiency and renewable energy sources - Common terminology*
- ISO/TC 59 *Buildings and civil engineering works*
- ISO/TC 61 *Plastics*
- IEC/TC 52 *Solar photovoltaic energy systems*
- IEC/TC 117

Additionally, it liaises to

- EC
- IEA
  Concerning collaboration with the IEA Solar Heating and Cooling Program, further engagement is sought with especially TASK 43: *Solar Rating and Certification Procedures - Advanced Solar Thermal Testing and Characterization for Certification of Collectors and Systems*.
- UNECE
- UNESCO

ISO/TC180 is holding meetings in conjunction with CEN/TC 312, whenever possible, in order to better align ISO standards and CEN test methods.

2.2.1.2.2 Subcommittees/Working Groups

ISO/TC 180 has two sub-committees and two working groups.

Table 3: SC and WG of ISO/TC 180

SC or WG	Title	Secretariat
TC 180/SC 1	Climate – Measurement and data	Australia (SA)
TC 180/SC 4	Systems – Thermal performance, reliability and durability	USA (ANSI)
TC 180/WG 1	Nomenclature	Australia (SA)
TC 180/WG 3	Collector Components and Materials	China (SAC)

2.2.1.2.3 Documents published by ISO/TC 180

ISO/TC 180 has published 13 standards and 2 technical reports (refer to Table 2). There are one new work item, two committee drafts and one final draft (refer to Table 3).

Table 4: Standards under the responsibility of ISO/TC 180

Standard and/or project
ISO 9059:1990 Solar energy -- Calibration of field pyrheliometers by comparison to a reference pyrheliometer
ISO 9060:1990 Solar energy -- Specification and classification of instruments for measuring hemispherical solar and direct solar radiation
ISO 9459-1:1993 Solar heating -- Domestic water heating systems -- Part 1: Performance rating procedure using indoor test methods
ISO 9459-2:1995 Solar heating -- Domestic water heating systems -- Part 2: Outdoor test methods for system performance characterization and yearly performance prediction of solar-only systems
ISO 9459-4:2013 Solar heating -- Domestic water heating systems -- Part 4: System performance characterization by means of component tests and computer simulation
ISO 9459-5:2007 Solar heating -- Domestic water heating systems -- Part 5: System performance characterization by means of whole-system tests and computer simulation
ISO 9488:1999 Solar energy -- Vocabulary
ISO 9553:1997 Solar energy -- Methods of testing preformed rubber seals and sealing compounds used in collectors
ISO 9806:2013 Solar energy -- Solar thermal collectors -- Test methods
ISO 9808:1990 Solar water heaters -- Elastomeric materials for absorbers, connecting pipes and fittings -- Method of assessment

ISO 9845-1:1992 Solar energy -- Reference solar spectral irradiance at the ground at different receiving conditions -- Part 1: Direct normal and hemispherical solar irradiance for air mass 1,5
ISO 9846:1993 Solar energy -- Calibration of a pyranometer using a pyrheliometer
ISO 9847:1992 Solar energy -- Calibration of field pyranometers by comparison to a reference pyranometer
ISO/TR 9901:1990 Solar energy -- Field pyranometers -- Recommended practice for use
ISO/TR 10217:1989 Solar energy -- Water heating systems -- Guide to material selection with regard to internal corrosion

Table 5: Projects under the responsibility of ISO/TC 180

Project
ISO/NP 9488 Solar energy -- Vocabulary
ISO/CD 22975-1 Solar energy -- Collector components and materials -- Part 1: Evacuated tubes -- Durability and performance
ISO/CD 22975-2 Solar energy -- Collector components and materials -- Part 2: Heat-pipe for evacuated tubes -- Durability and performance
ISO/FDIS 22975-3 Solar energy -- Collector components and materials -- Part 3: Absorber surface durability

2.2.2 European standardization

Standardization in Europe is handled by two organizations, CEN, the European Committee for Standardization, and CENELEC, the European Committee for Electrotechnical Standardization. Figure 5 briefly reflects the scope of both.

Both organizations have committees for the solar field.

2.2.2.1 CENELEC

CENELEC does not have a technical committee for solar applications; even though most of the European standardization work is undertaken within CENELEC Technical Committees or Subcommittees, this area has been allocated to a Reporting Secretariat (SR).

CLC/SR 117 *Solar thermal electric plants* provides information to the CENELEC Technical Board on any work of IEC/TC 117 which could be of interest for CENELEC. As IEC is very active, national participation – which in this case is reporting on IEC activities to CENELEC – in

CLC/SR 117 is limited to Austria, Malta and Slovakia. Except for Austria, who is an observing member, the other two are not members of IEC/TC 117. The SR is not developing standards.

A Dresden Agreement was established between IEC and CENELEC to collaborate within the scope of IEC/TC 117 and CENELEC.

2.2.2.2 CEN

CEN has a Technical Committee active in solar applications.

CEN/TC 312 *Thermal solar systems and components* is developing standards covering terminology, general requirements, characteristics, test methods, conformity evaluation, certification and labelling of thermal solar systems and components.

Currently, CEN/TC 312 is focusing on solar thermal energy applications relevant for covering energy demand of buildings, such as solar heating for hot water production and space heating as well as cooling.

The European Standards developed by CEN/TC 312 support the development of solar thermal energy by helping to provide economies of scale, ensuring quality and helping to reduce testing costs.

Table 6: Structure of CEN/TC 312

SC/WG	**Title**
CEN/TC 312/WG 1	Solar collectors
CEN/TC 312/WG 2	Factory made systems
CEN/TC 312/WG 3	Thermal solar systems and components; Custom built systems
CEN/TC 312/WG 4	Labelling and Marking

The secretariat of CEN/TC 312 is held by the Greek standards body ELOT.

Table 7: Standards published by CEN/TC 312

Standard reference	**Title**
EN 12975-1:2006+A1:2010	Thermal solar systems and components - Solar collectors - Part 1: General requirements
EN 12975-2:2006	Thermal solar systems and components - Solar collectors - Part 2: Test methods
EN 12976-1:2006	Thermal solar systems and components - Factory made systems - Part 1: General requirements
EN 12976-2:2006	Thermal solar systems and components - Factory made systems - Part 2: Test methods
EN 12977-1:2012	Thermal solar systems and components - Custom built systems - Part 1: General requirements for solar water heaters and combisystems
EN 12977-2:2012	Thermal solar systems and components - Custom built systems - Part 2: Test methods for solar water heaters and combisystems

EN 12977-3:2012	Thermal solar systems and components - Custom built systems - Part 3: Performance test methods for solar water heater stores
EN 12977-4:2012	Thermal solar systems and components - Custom built systems - Part 4: Performance test methods for solar combistores
EN 12977-5:2012	Thermal solar systems and components - Custom built systems - Part 5: Performance test methods for control equipment
EN ISO 9488:1999	Solar energy - Vocabulary (ISO 9488:1999)

Table 8: Standards under development in CEN/TC 312

Project reference	**Title**	**Current status**	**DAV[19]**
prEN ISO 9488 rev	Solar energy - Vocabulary	Under Drafting	2011-11
prEN 12976-1	Thermal solar systems and components - Factory made systems - Part 1: General requirements	Under Approval	2013-11
prEN 12976-2	Thermal solar systems and components - Factory made systems - Part 2: Test methods	Under Approval	2013-11
prEN 12975-1	Thermal solar systems and components - Solar collectors - Part 1: General requirements	Under Approval	2013-10
prEN ISO 9806	Solar energy - Solar thermal collectors - Test methods (ISO/DIS 9806:2012)	Under Approval	2014-02
prEN 12975-3-1	Thermal solar systems and components - Solar collectors - Part 3-1: Qualification of solar absorber surface durability	Under Approval	2013-05

2.2.2.3 The Solar Keymark

Though not part of standardization activities, the Solar Keymark is mentioned in this chapter. This is to illustrate the relevance of standards when looking at the framework of standardization.

The Solar Keymark is a voluntary certification scheme, it is a commercial activity and part of self-government of industry. It was developed by the European Solar Thermal Industry Federation (ESTIF) and CEN (European Committee for Standardisation) in close co-operation with European test labs and with the support of the European Commission.[20] The aim is to

[19] Planned date of availability

[20] Source: http://www.estif.org/solarkeymarknew/press-room/european-standards

reduce trade barriers and promote the use of high quality solar thermal products in the European market and beyond.[21]

The Solar Keymark is mostly used in Europe and claimed to be increasingly recognized worldwide. It is solely dedicated to:

- Solar thermal collectors (based on European standard series EN 12975)
- Factory made solar thermal systems (based on European standard series EN12976; refer also to Table 7 and Table 8).[22]

Due to CE-marking based on the Construction Products Regulation (EU) No 305/2011 (CPR) which repeals the Construction Products Directive (EU) No 89/106/EEC (CPD), CE-marking of solar collectors related to the Construction Product Directive (CPD) is under preparation and is expected to be in force by 2014-15.

The CE-marking is expected to cover the following characteristics for solar thermal collectors in buildings:

- Mechanical resistance to climatic loads (wind, snow, ...)
- Fire safety (e.g. initiation, reaction to fire, risk to adjacent elements, ..., as relevant)
- Weather tightness (when relevant, i.e. for roof integrated or façade integrated collectors)

The Solar Keymark initiative considers CE-marking being the manufacturer declared (lower level) quality assurance scheme, with "keymarking" being the 3rd party certified (higher level) quality assurance scheme and recommends CE-marking to go hand in hand with keymarking.[23]

2.2.3 Consortia standardization

Research organizations/ bodies, such as NREL, SolarTAC and SANDIA (USA), CIEMAT, CENER and CTAER (Spain), DLR (Germany), Ben Gurion University National Solar Energy Center and The Weizmann institute Solar facilities (Israel), independently or under the umbrella of the SolarPACES Implementing the Agreement of the International Energy Agency have started developing measurements and evaluation techniques to respond to the needs of the different agents of the sector.[24] These may be considered de-facto standards or specifications.

As examples, SolarPACES works e.g. on guidelines, such as measurement of solar weighted reflectance of mirror materials, while ASME has developed PTC 52, Performance Test Code on Concentrated Solar Plants, providing procedures for conducting tests and analyses to

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[21] Source: http://www.estif.org/solarkeymarknew/press-room/solar-keymark-certification

[22] Source: http://www.estif.org/solarkeymarknew/press-room/solar-keymark-certification

[23] Source: http://www.estif.org/solarkeymarknew/press-room/solar-keymark-certification

[24] Source: http://www.iec.ch/cgi-bin/getfile.pl/sbp_117.pdf?dir=sbp&format=pdf&type=&file=117.pdf

determine the performance of Concentrating Solar Power (CSP) plants such as in parabolic trough, continuous linear Fresnel reflector, power tower, and dish Stirling technologies.[25]

2.2.4 National activities

Activities related to STE on national levels mirror activities on the European or international levels; therefore, the members in any of the above TC should at least have mirror committees to be able to work on the other levels. Following are a few examples.

In Spain, a specific STE mirror committee to IEC/TC 117 has been established within AENOR to promote standardization procedures in this field composed of industry experts, academic and R&D experts (AEN/CTN 206/SC1).

Three working groups are active on topics of the whole plant, the components and the storage sub-system. The work involves staff from Spanish research and industry. First drafts of standards are under preparation and will be submitted to AENOR within a year's time. The work includes vocabulary and aims at larger coverage of issues subject to standardization.

In Israel, within the framework of the Israeli Standardization institution (SII), an "Energy" mirror committee was established in 2009 to follow International activities of various international committees (in IEC and ISO) in the entire energy field. SII plans to interest specific experts from the Israeli STE industry and academy to join this mirror committee.[26]

In Germany, DKE, the German Commission for Electrical, Electronic & Information Technologies of DIN and VDE has established committee DKE/K 374 Solar Thermal Electric Plants mirroring CLC/SR 117 and IEC/TC 117. The mirror committee was established in 2011.

DIN is running a mirror committee to ISO/TC 180.

3 Standardization in SFERA

3.1 SFERA activities planned and related to standardization

The description of Work of SFERA refers to standards and standardization in several contexts. Its networking activities e. g. "aim at the creation of a stable Framework for co-operation in which … common standards developed, duplication of research effort is avoided…" Its joint research activities target the "development of common standards and procedures for better consortium performance and development of advanced instrumentation and new RI thus improving the services offered to the user community, as there is a lack of commonly accepted

[25] http://cstools.asme.org/csconnect/CommitteePages.cfm?Committee=100045590

[26] Source: http://www.iec.ch/cgi-bin/getfile.pl/sbp_117.pdf?dir=sbp&format=pdf&type=&file=117.pdf

protocols, and there are as yet no officially accepted standards for industrial components, endangering the booming, dynamic market now getting underway."[27]

In its plan for the use and dissemination of foreground, contribution to standards is seen as one vehicle:

"As CSP is quickly moving from 'prototype' stage to commercial stage, the need of internationally recognized standards is becoming urgent for the industry and trading communities. Within the Networking Activities of SFERA (WP 4) it's foreseen to establish 'working groups' for solar experts and 'round tables' for potential users and emerging companies to facilitate the:

- Development of standards for qualification of CSP components and plants
- Development and publication of specifications and/or standards in a standardization approach driven by demand
- Initiation of process for development of an European CSP Standard
- Dissemination of standardization activities and new CSP standard.

This approach will exploit knowledge gained in the project to relevant and interested stakeholders and integrate them into standardization activities, assuring that relevant requirements are considered in standardization while at the same time familiarizing stakeholders with the knowledge and generating user potential for the new standards.

A CEN workshop agreement is to be signed in order to reach these goals."[28]

Several work packages include activities related to some form of standardization.

WP 12 "Improve Quality of Testing Services at R&D Infrastructures for CSP" was to deliver "Guidelines for testing of CSP components", which were intended to serve as input to the standardization and dissemination activities that is part of the networking activities.

WP14 "Infrastructure improvements to perform durability predictions of CSP components by accelerated aging" was expected to transfer of knowledge to Standard Organizations and preparation of guidelines for optimal characterization testing and validation of both accelerated aging and lifetime prediction experimental methods applied to selected CSP materials.

Last, but not least WP 4 "Expert working groups and round tables" incorporates activities dedicated to standardization.

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[27] Description of Work; SFERA Solar Facilities for the European Research Area, Grant agreement no.: 228296

[28] Description of Work; SFERA Solar Facilities for the European Research Area, Grant agreement no.: 228296

3.2 Activities of WP 4

The aim of this WP was to establish working groups for experts and round tables for potential users and emerging companies to facilitate the

- Development of CSP standards for qualification of CSP components and plants.
- Development and publication of specifications and/or standards in a standardization approach driven by demand.
- Initiation of process for development of a European CSP Standard.
- Dissemination of standardization activities and new CSP standard.

Major expected impact of these activities was to widely spread the knowledge about SFERA.

This approach was to exploit knowledge gained in the project to relevant and interested stakeholders and to integrate them into standardization activities, assuring that relevant requirements are considered in standardization while at the same time familiarizing stakeholders with the knowledge, and generating user potential for new standards.

Two types of actions were foreseen.

- Expert Working Groups consisting of project participants (internal), focusing on the following tasks concerning the analysis of state-of-the-art methods and procedures for qualification:
  - Analysis of existing standards and procedures in CSP research institutes and industry
  - Comparison of existing and new procedures developed in the technical areas of SFERA taking into account technical, economical and warranty point of view
  - Development of a standardization concept.
- Round Tables consisting of other external stakeholders (industry, users, decision makers….), sharing the implementation of the standardization concept – that is the actual development of standardization documents – among project experts and other relevant stakeholders concerning the development of standards:
  - Development of a standardization strategy for national and European standards,
  - Open Round Table for all interested parties,
  - Review of concept after feedback from Industry, institutes, politics and others (at Round Tables),
  - Workshop and definition of a Roadmap towards new CSP standards,
  - Development of a normative document or documents,
  - Preparation and publication of standards.

Transfer of project knowledge documented in a standard (or standards) was considered essential for sustainable project results, including coordinated with other networking activities.

Milestones of WP 4 are listed in Table 9.

Table 9: List of milestones of WP 4

No.	Milestone
4.1	First round table
4.2	First meeting of the expert working groups
4.3	Second round table
4.4	Availability of a draft for a CEN Workshop Agreement (CWA)[29] and Kick-off Workshop
4.5	Third round table
4.6	Availability of final draft for the CWA
4.7	Fourth round table
4.8	Proposal for a European standard on CSP

Deliverables of WP 4 are listed in Table 9.

Table 10: List of deliverables of WP 4

No.	Deliverable title
N4.1	The Approach of SFERA on Standardization: State-of-the-Art, Strategy and Expected Impact
N4.2	Proposal for a CEN Workshop Agreement: Procedure, Business Plan, Contents, Implementation
N4.3	Report on Progress of the CEN Workshop Agreement (CWA): Technical Development, Stakeholder Interest, Impact
N4.4, N4.5, N4.6, N4.7	Minutes of the Round tables

3.3 Round Tables

Two roundtables were implemented.

3.3.1 Workshop realized 2010-01-17 in Sevilla, Spain

This was the initial Round Table meeting on Standardization Activities for CPS components; in the discussion is was stated that standards help to clarify technical questions and are urgently needed in the CSP market. An important point to consider in standardization development is

[29] A CEN Workshop is a specific form to develop a standard, in particular for innovative technologies, applications and services.

also the performance of the whole system. Quality control based on standardized measurement procedures of the different components was requested, but also system integration as having a decisive impact on final plant performance (e. g. single collector elements/alignment to complete loops).[30]

3.3.2 Workshop realized 2011-03-11 in Syracuse, Italy

This round table meeting aimed to provide an overview of the current state of technical standard preparations and ongoing national and international efforts to create formal standards and support the creation of European Standards for CSP components. The discussion touched issues such as common acceptance of standards supported by consensus, transparent elaboration processes, possibility for all stakeholders to participate, and the public enquiry as verification of the contents and endorsement of a standard.

It was stated by discussants that it is essential to make use of existing standards from related technologies (solar thermal, photovoltaic, energy, building …) in order to advance in the field of CSP based on the existing specific know-how. It was proposed to start in areas where sufficient knowledge for finalizing first drafts is already available (such as mirror optical properties).

At the time of the round table, Spain had made proposals to IEC for draft standards for solar thermal electric power plants, as Spanish industry had an urgent need for standards. European standardization paths with it large number of member countries and following the principle of consensus, might be too slow for the development speed of CSP. A strategy like a CEN Workshop Agreement (CWA) was considered to be fast enough (6-8 months) and also viable with limited resources.

Two main strategy lines were identified:

- Support the Spanish momentum and transfer this later to European level.
- Identify needs for standards and gaps at international level and identify appropriate groups.

The participants mainly agreed on supporting the Spanish activities with the objective of creating a set of rules that can later be proposed for adoption at the international level.

It was also brought into the discussion that more international stakeholders should be involved early enough to achieve sufficient consensus for the internationalization process, as input to the Spanish mirror committee to IEC/TC 117 only poses hurdles, e. g. access and confidentiality of AENOR working groups and Spanish as working language in the Spanish committee.

[30] Source: http://sfera.sollab.eu/downloads/Minutes_of_Round_Table_1.pdf

The question arose why IEC and not ISO were leading the work at international level, although the majority of the topics related to STE plants are not electro-technical related. An assessment of this was recommended be made considering needs and scopes.[31]

3.4 Other activities in WP 4

The other activities of WP were not implemented due to the recommendation of the evaluator of the European Commission.

4 Evaluation of WP 4 by the Commission

The evaluator suggested to reconsider WP 4, as the objective of the WP was addressed by many other initiatives, mentioning the committee in Spain, and the then up-coming creation of IEC/TC 117.

Next to these formal standardization activities, he mentioned standardization initiatives within ASME, and supporting activities within the International Energy Agency's SolarPACES Implementing Agreement.

He recommended to either cancel WP 4 or to the redefine the goal of this WP, also in view of using resources effectively and efficiently.

4.1 Impact of the evaluation

Due to the evaluation, the WP 4 leader did not implement the remaining activities of the WP; this in turn leading to a halt of activities related to standardization.

4.2 Comments on the evaluation

The following comments assess the statements concerning standardization in the project.

4.2.1 Objective of WP 4

It is true that CSTP standards are addressed by many initiatives. This shows that the functions of standards and standardization as well as their impact have been recognized and are being used in the course of research and in placing products on the market.

As listed by the reviewer, they have been developed, are under development or under preparation mentioning IEC and ASME as developing organizations. It can be added that standards relevant for the area are also being developed or have been developed by ISO, CEN, CENELEC and national standards bodies, e. g. in Europe or Asia.

However, the relationship and correlation of the committees are neither mentioned nor addressed; neither is the significance of the type of participation in the bodies listed mentioned, which all have significant impact on standardization.

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[31] Source: http://sfera.sollab.eu/downloads/Minutes_of_Round_Table_2.pdf

The installation of national committees has always to be seen in a broader context, as was done by AENOR after creating its national committee and then proposing to establish a committee on the international level, "clear evidence that a global approach to standardization in this domain is necessary and desired."[32]

International standardization is undertaken by recognized standards bodies in the framework of ISO and IEC; the technical committees of both organizations rely on expertise to be delivered by the national members; consequently, strong national standards committees mirroring the international activities are essential to have powerful results on the international level.

Therefore, neither the existence of the one national committee (AENOR) at the time of the review and meanwhile other national committees established since then, nor that of a TC at IEC do assure that standardization needs, gaps or potentials specifically identified by SFERA are channeled into standardization work. Rather, it must be SFERA as a significant research project in the field and in a proactive approach that should have used the unique chance of influencing standardization and contributing to the direction in future standards development. SFERA had the opportunity to contribute to streamlining standardization activities instead of just adding more standards, being in the unique situation of having activities in standardization funded by the European Commission.

All partner countries of SFERA are active in IEC/TC 117 *Solar Thermal Electric Plants* as participating countries except for Portugal, having an observer status. Participation of the respective country does by itself not assure that knowledge from SFERA is transferred into standardization, unless all partners in the project know how mechanisms and the respective contact point at their national standards bodies. Individual input contributes to selected input, chosen by own reasoning by the respective partner; an integrated approach, of e. g. all partners contributing with the same issue and attitude to their national technical committees or working groups has quite a different effect.

4.2.2 Ongoing consortia standardization

ASME is a professional organization developing standards and it administers several bodies, which develop the United States position on ISO activities. Such bodies are designated by the American National Standards Institute (ANSI) as U.S. Technical Advisory Groups (TAG) for specific ISO (and also IEC)[33] activities.[34] There is currently, however, no such TAG to either ISO or IEC in the field of CSTP indicated on the website of ASME, meaning that work invested into ASME activities at the moment does not contribute to international standardization, while international standards are needed per declaration of IEC: *"… As STE is moving from a*

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32 http://www.iec.ch/etech/2011/etech_0511/tc-2.htm query 2012-06-25

33 added by author

34 http://www.asme.org/kb/standards/boards-and-committees/iso-secretariats-and-us-technical-advisory-groups- query 2012-06-26

research phase to an industrial scale, International Standards are essential for the global introduction of this technology."[35]

While certainly all individual activities of members of the project related to ASME standardization are up to the discretion of those members, this does not have any effect on the impact of SFERA on formal standardization. Rather, it should be questioned why knowledge gained in SFERA, a European research project and funded by the European Commission, should contribute to standardization of a professional organization that at this point does not interact with IEC or ISO and not with CEN or CENELEC.

4.2.3 Cancellation of WP4

A cancellation of the work package would result in a chance lost to enhance existing standardization. The standardization activities were planned as a pro-active approach of the project to take an active role e. g. in the identification of needs and thus new work items for existing initiatives. They also contribute to dissemination of results and can facilitate market entrance.

The Business Plan of IEC/TC 177 states that while technological development is mainly led by the industry, which is highly motivated by cost reduction, and while after more than 20 years of successful operations, STE is now entering a commercial ramp-up phase with several large scale projects, there are huge scientific challenges to be undertaken by research bodies and by the industry to contribute to this real need of reducing costs, increasing efficiency and enhancing reliability of solar concentrating technologies and to the real need for standards in this field, but neither standards, nor univocal definitions with respect to performance and testing methods exist.[36]

ISO/TC 180 in turn appreciates the activities on the European level, with CEN having been extremely active in developing standards applicable to Europe. Concerning solar water heater products and components, these must meet requirements for reliable and durable performance to fulfill the needs of Government sponsored support programs such as the European Directives on Energy Efficiency and Renewables, regulations in a number of countries including Israel, Spain, Germany and Australia; and subsidies in many countries.[37]

Even with SFERA focusing on CSP, there is evidence that standards developed by ISO/TC 180 are relevant here as well (refer to chapter 1.2, chapter 3.3.2, and chapter 2.2.1.2.1).

When looking at the aspect of dissemination and exploitation of project results, and using standardization as a vehicle, the Technopolis Study recommends that the European

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35 http://www.iec.ch/etech/2011/etech_0511/tc-2.htm 2012-06-25

36 http://www.iec.ch/cgi-bin/getfile.pl/sbp_117.pdf?dir=sbp&format=pdf&type=&file=117.pdf

37 Source: http://isotc.iso.org/livelink/livelink/fetch/2000/2122/687806/customview.html?func=ll&objId=687806&objAction=browse&sort=name

Commission should continue to highlight the relationship between research, innovation and standardization, and encourage projects to address standardization wherever relevant.[38]

The resources of SFERA would have allowed expert partners from the project to take results from the project forward to support industry in its need for CSP standards (refer to the business plan of IEC/TC 117) in general, and in an interim and consolidating form of joining forces with external experts in a CEN-CENELEC Workshop; the exploration of the immediate needs, part of the assessment of standardization potentials would have allowed to prioritize topics identified and to look for the best channels to attach to standardization.

The selection of a CEN Workshop Agreement would have catered to the need of a having a specification available within a timeframe much shorter than in ISO, IEC or CEN-CENELEC.

4.2.4 Use of resources

The activities of SFERA in standardization should be seen under the light of the comments on 1, 2 and 3. The establishment of a CEN-CENELEC Workshop to develop a specification is a project with predefined lifetime to develop a document that is to have impact on standardization in the field. After that the workshop is by rule disbanded and shall not develop any other activity not covered by its business plan. Additionally, any CWA can be used as consolidated input into formal standardization.

A significant issue here, recommended in the Technopolis report, is also projects could be a way ways to provide additional support to researchers that would enable them to spend time contributing to standardization activities, for example by participating in Technical Committees and Working Groups.[39]

4.3 Recommendations concerning standardization activities in the field based on research

As standardization activities could not be implemented to the extent planned during the implementation of SFERA, nonetheless some recommendations concerning the linkage of standardization and future research can be made.

Figure 7 shows where a standardization strategy is bound into the framework of standards; when the strategy is developed backed by a research project, aspects such as benefits for research should be considered as well. The economic framework will be shaped by questions such as IPR, market access and uptake and innovation potential. Stakeholders might yet be quite limited and recruited from the research community, rather than from a wide range of interests. Actors in the development process, i. e. participants in the standards development process, will as well be limited to coming from research and industry needing research.

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38 http://www.cencenelec.eu/research/news/publications/Publications/https___nitrocloud-prod.s3.amazonaws.com_(111821598)%20Connect14.pdf

39 http://www.cencenelec.eu/research/news/publications/Publications/https___nitrocloud-prod.s3.amazonaws.com_(111821598)%20Connect14.pdf

This will shape the development process and might lead to choosing documents that can be developed fast, accepting that not all stakeholders would participate and consensus processes be limited.

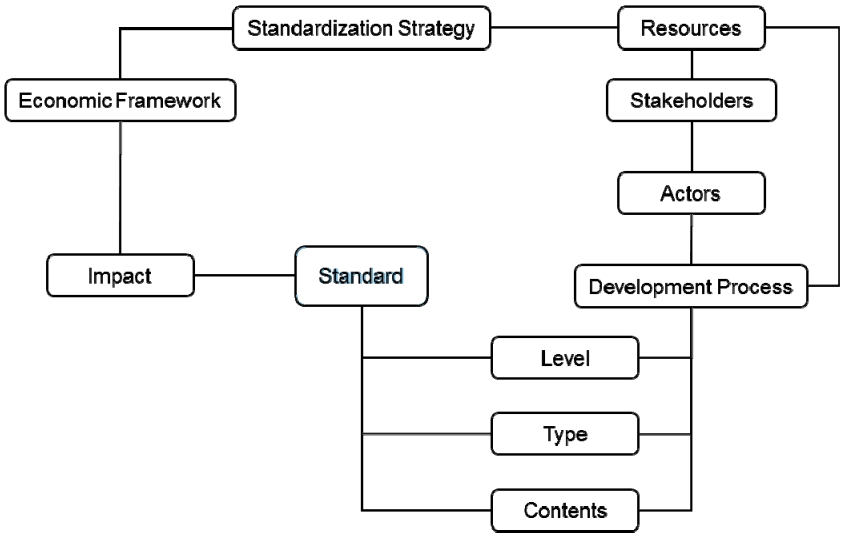

Figure 7: Framework impacting the development of standards

When then looking in detail at dimensions impacting standards development, the key factors illustrated in figure 8 should be considered.

Even though there often is a need for simultaneously answering questions concerning all dimensions, the analysis of existing standards and standardization should be the very first step. Existing standards provide knowledge, while also telling where a topic has already been studied and verified by interested parties. This can also provide access to standards bodies.

Analyzing on-going activities provides an initial key to where to look for collaboration and liaisons.

The assessment of potentials should always be done in collaboration with the research partners and relevant stakeholders from outside to assure acceptance of the topic and scope as early as possible.

Last but not least, having a standards body as partner provides significant support to connecting to standardization.

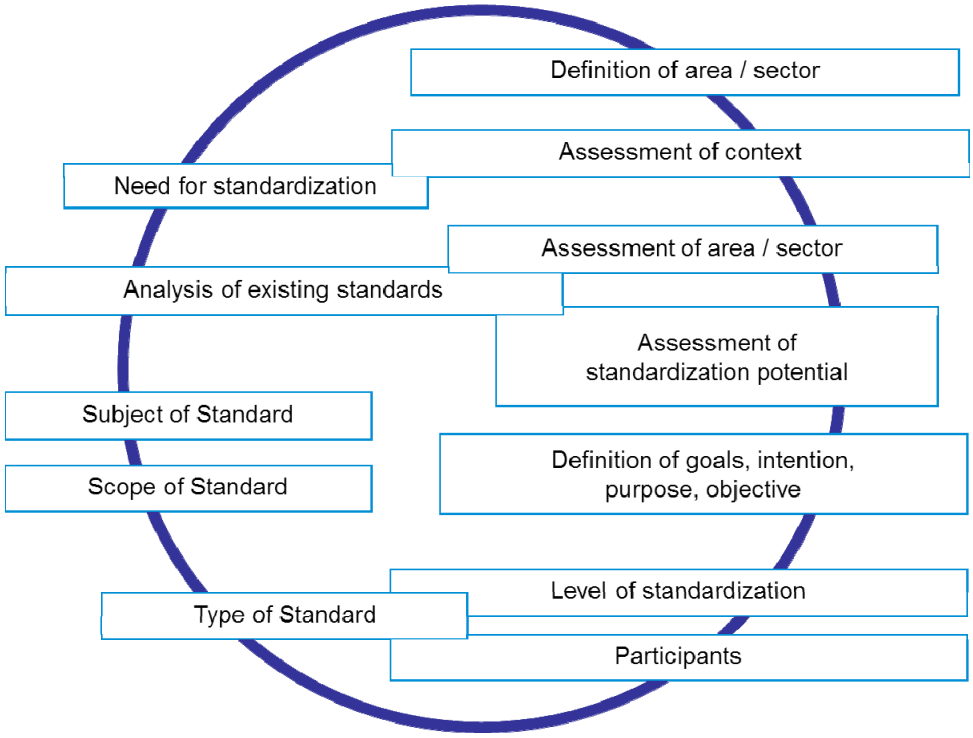

Figure 8: Exploration of dimensions having impact on the development of a standard