Project SOPHIA

PhotoVoltaic European Research Infrastructure

Funding Scheme: Combination of CP & CSA

GA N° 262533

Date of latest version of Annex 1: 25/10/2013

Data Beneficiary

Lead Beneficiary	CEA-INES
Contact person	Philippe Malbranche
Contributors	All partners
Author contact details	50 av du Lac Leman, 73375 Le Bourget du Lac, France
	+33 479792199
	philippe.malbranche@cea.fr
Period covered	M1 - M48
Dissemination level	Confidential
Project Website	www.sophia-ri.eu

Action 6: Management

D6.5 - Final report

Reporting period: From 01/02/2011 to 31/01/2015

Document Information

Document Name	**SOPHIA_D6.5_Final Report_48M_230715_VF**
Revision	Final | ~~Draft~~
Due date Annex I	M48
Author	Philippe Malbranche
Dissemination Level	Public | ~~Restricted~~ | ~~Confidential~~

Document approval

Name	Position in the project	Beneficiary	Date	Visa
Philippe Malbranche	Coordinator	CEA-INES	23/07/2015	PM

Document history

Revision	Date	Modification	Author
V1	06/01/2015	Creation	Maud Bossard, ALMA
V2	10/02/2015	content	Fabien Bergeron, CEA-INES
V3	16/03/2015	Format and minor corrections	Maud Bossard, ALMA
V4	14/04/2015	Revisions	Fabien Bergeron, CEA-INES
VF	22/07/2015	Finalisation	Maud Bossard, ALMA

Table of contents

1 Final publishable summary report

1.1 Executive summary

This project was aiming to join forces within European PV research to offer better services for researchers from academia and industry. It was set up to promote on a large-scale an increased coordination in order to:

1. avoid unintended duplication;
2. avoid unnecessary investment;
3. get more value out of the same budgets. « Working together to progress faster or to learn more », on activities such as:
    - Benchmarking of characterisation methods,
    - Validation of simulation models with a larger number of data to increase the confidence level.

In the three types of activities, the main outcomes can be summarized as follows:

1. Joint research activities

These activities improved and upgraded the services provided by the European research infrastructures through four topics, thanks to a better understanding of the various mechanisms and processes:

1. Greater accuracy of rated power and energy output prediction of PV modules & systems;
2. Quicker lifetime prediction of PV modules though accelerated ageing tests and improved failure analysis procedures;
3. Improved Material characterisation procedures dedicated to:
    - silicon material,
    - thin films and TCOs,
    - and organic solar cells.
4. Improvement and validation of software infrastructure for material, cell, module and system modelling.

2. Networking activities

These activities provided exchange of know-how and best practices, better coordination and joint development of the Research Infrastructures, along eight selected topics.

- **training performed:**
    - 18 networking seminars and workshops
        - 200 participants from 27 countries
    - 30 webinars
        - 830 participants in total (+ 100 in live streaming)
        - Majority of non-SOPHIA members (around 65%)
    - 30 exchanges of personnel

- **11 common databases developed :**
    - Listing of test- and analysis capabilities: 6 databases
        - TNA infrastructures,

- TCO test facilities,
- PV systems and smartgrid test facilities,
- PV module test equipment,
- accelerated ageing test procedures,
- silicon imaging techniques.

- Sets of measurement data and test results: 3 databases
  - irradiance,
  - PV performance,
  - silicon material.
- Overviews of modelling tools: 2 databases
  - Database of module power- and energy prediction models,
  - Database of modelling tools.

- **Contribution to Test procedures and standards:**
  - Common procedures for testing and characterising PV materials, modules and systems have been studied: 5 Round Robins (in silicon material, OPV, thin films and CPV) and a large test plan have been carried out.
  - Contributions to IEC TC82 WG2 & WG7.

- **Definition of common objectives per topic**

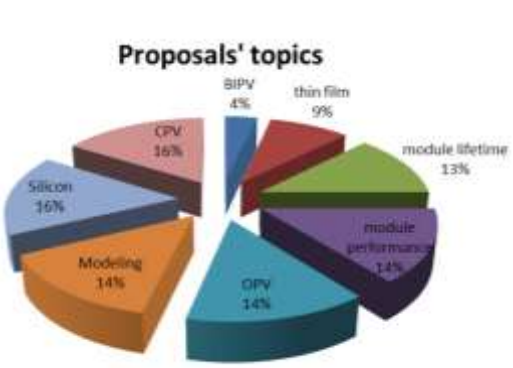
A Strategic Research Infrastructure Agenda has been written ("strategic vision on photovoltaic research infrastructure" brochure).

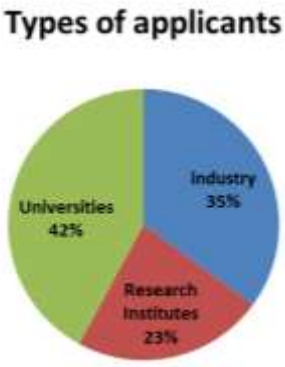
3. Transnational access activities

Transnational access activities provided free of charge and open access to 48 research infrastructures offering the researchers various services, through a single entry point:

- Prototyping,
- Better characterisation of materials and innovative technologies,
- Performance characterisation and lifetime prediction of PV modules,
- Modelling of cell, module and systems.

- **8 calls** for research proposals were organised
- **68 proposals** submitted in total, out of which **42 research activities** did actually take place.





1.2 Context and project objectives

Many different Photovoltaic (PV) research facilities exist all over Europe. Some of them are considered unique (i.e. BESSY3 in HZB, Berlin or the Super Computer in FZ Jülich), while others can be found in different places across the continent.
The SOPHIA RI project was the first European initiative to promote large-scale coordination in order to:

1. avoid unintended duplication and unnecessary investment;
2. get more value out of the same budgets. “Working together to progress faster or to learn more”, within activities such as :
    - Benchmarking of characterisation methods,
    - Validation of simulation software with a larger number of data to increase the confidence level.

Main Goals

- Strengthen and optimise PV research capabilities, mainly by coordinating efforts on important but precompetitive topics.
- Address the issues of fragmentation and costly duplication of research at the European scale. Large research infrastructures working together will avoid the useless replication of a large number of small efforts.
- Bring together the main European Photovoltaic Research Infrastructures in order to provide the scientific community with common referential to conduct efficient and coordinated research work in the field of PV technologies.

Selected topics

The project focused on **8 topics** covering most of the PV value chain:

- Silicon material
- Thin films and TCOs
- Organic PV
- Modelling
- Concentrated PV (CPV)
- Building-Integrated PV (BIPV)
- PV Module lifetime
- PV module and system performance

Most of the networking activities (training, workshops, staff exchange, standardisation activities) were organised along these eight topics.

1.3 Main S&T results/foregrounds

1.3.1 NA 01 (WP1) : Joint management of access provision and pooling of distributed resources (WP leader : Philippe Malbranche, CEA- INES)

Trans-national Access Activities (TNA) achievements:

The objective of the Trans-national Access Activities (TNA) within SOPHIA is to offer to the industry, research centers, and universities a free of charge access to the existing research infrastructures (RI) of the SOPHIA partners.

Access to research infrastructures

A large panel of testing platforms were proposed, covering most aspects of solar photovoltaics.

In total, 48 research infrastructures (test platforms) from 17 European SOPHIA partners were proposed, covering 8 PV topics: BIPV, thin films, module lifetime, system performance, OPV, Modelling, Silicon and CPV.

These European PV platforms offered various types of services, typically:

- Prototyping
- Better characterisation of materials and innovative technologies,
- Performance characterisation and lifetime prediction of PV modules
- Modelling

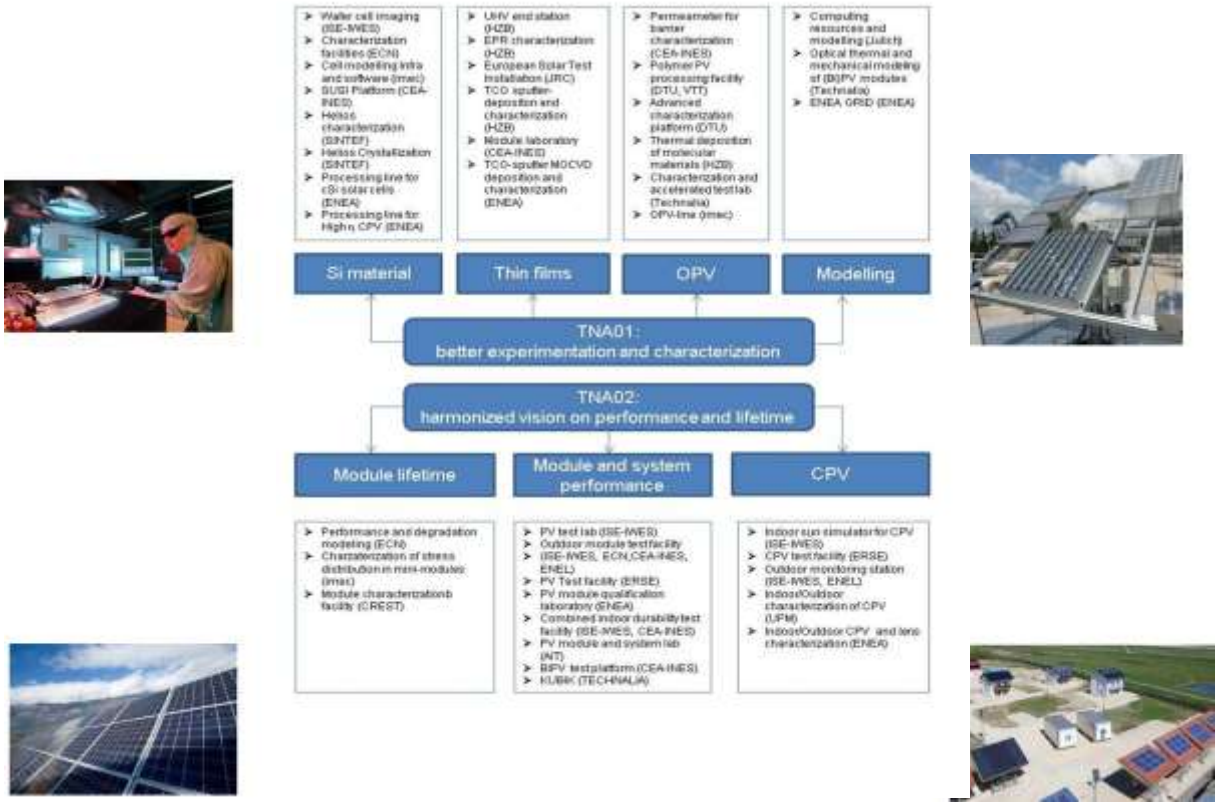


Figure 1: List of research infrastructures offered by SOPHIA partners

Proposals

From January 2012 to December 2014, **8 calls** for research proposals were organized and **68 research proposals were** submitted in total.

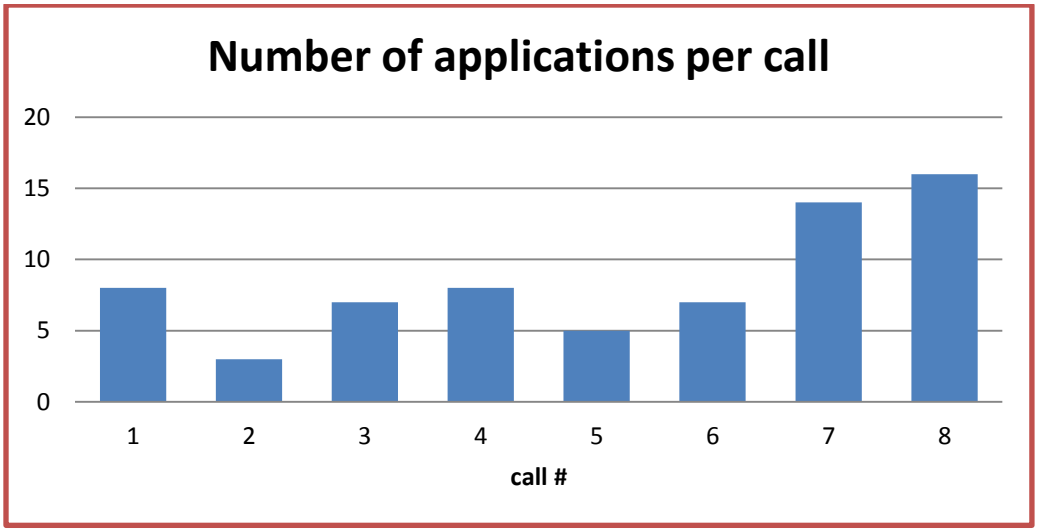


Figure 2: Number of application per TNA call

Applicants

The respondents of these calls for proposals can be categorized into 3 types of users, which are quite well balanced in terms of request proportion (majority of universities):

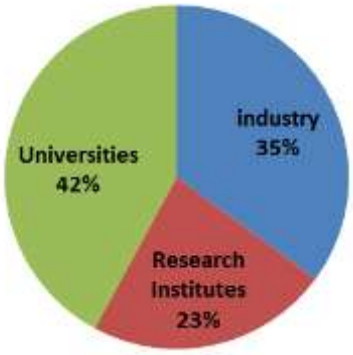


Figure 3: Repartition of the type of applicants

Topics addressed

The 8 proposed topics are covered by the proposals, but not uniformly, as visible on the following diagram:

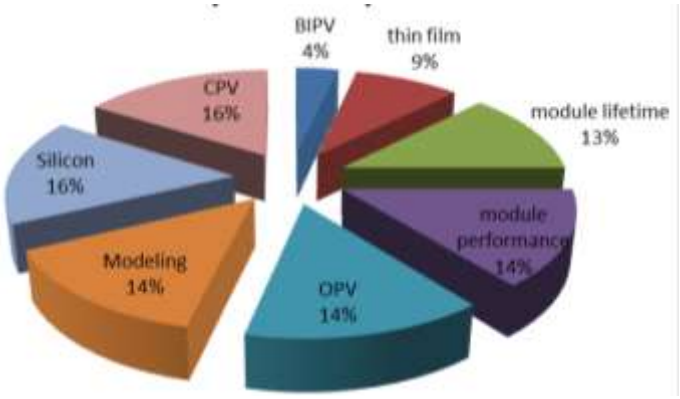


Figure 4: Repartition of the topics of the TNA proposals

The most popular topics addressed were Silicon and CPV, followed by Modelling, OPV and module performance.

RI hosts:

Through a selection process to assess the degree of innovation (evaluation by independent topic experts), 52 TNA access were eventually granted and 42 actually took place (10 proposals were dropped from applicants for various reasons).

Research infrastructures of 15 partners were used:

Host infrastructure	# projects hosted
Fraunhofer-ISE	7
CEA-INES	7
HZB	5
IES-UPM	4
CREST	4
Jülich	3
DTU	3
Tecnalia	3
ENEA	2
SINTEF	2
IMEC	1
AIT	1
ECN	1
RSE	1
EC JRC	1
Enel	0
VTT	0

Figure 5: Number of hosted TNA proposal per RI

List of deliverables submitted during the project lifetime:

D1.1: Infrastructure database

D1.2: Transnational user access procedures

D1.3: Report on the call preparation and proposal selection

D1.4: Recommendations for NA02 "strategic vision"

1.3.2 NA 02 (WP2) : Expert groups for a PV Infrastructure Strategic Vision (WP Leader: Jan Kroon, ECN)

The “Strategic Vision on PV Research Infrastructure” is an important finale to the SOPHIA project, integrating the lessons learned from the project and proposing a new PV research infrastructure strategy for the coming years. It will serve as a proposal to ESFRI, the European Strategy Forum for Research Infrastructures, which is a platform of experts with a mandate to look into Europe’s research infrastructure (RI) needs.

Within the SOPHIA project and, we expect, the wider PV community, there is increasing consensus on the need to overcome fragmentation and to cooperate on the development and use of research infrastructures because:

- Funds for investing in RI are limited;
- Continuous investment is needed to keep the RI at the highest level;

- Sharing helps resources to be used optimally;
- It can assure faster and efficient achievement of critical mass, i.e. sufficient research activity on a topic for new ideas to be generated readily and the topic to attract interest and talent.

These key points represent the practical translation of the objectives of EERA-PV, namely to ensure the implementation of the strategic research agenda beyond the SOPHIA project. There is also an increasing need to address the various means of supporting technology transfer to, and innovation within the industry. Although not initially part of the SOPHIA project, throughout the project, **pilot lines** were found to be one of the key components in supporting these required developments. The importance of different kinds of RI to different parts of the value chain is given in Figure B.

The Strategic Vision represents the consensual view of the 20 partners of SOPHIA (European research centres, EPIA and EUREC) on RI for photovoltaic energy. The proposal is detailed in the following chapters:

Chapter 1 describes in short the context and the scope of the document,

Chapter 2 discusses current trends in the access and use of photovoltaic RI from the entire PV field: silicon materials, organic PV, thin films, concentrator PV, module lifetime, module and system performance, modelling and building integrated PV,

Chapter 3 identifies the future needs by setting up a whole range of multi-purpose RI addressing all the PV value chain from lab to fab and the market,

Chapter 4 provides concluding remarks and recommendations.

The evidence base for the SRIA is written input from the members of the SOPHIA consortium with expertise in certain specific fields of PV technologies, who have been consulted in a structured manner. Drafts of the SRIA were presented to the whole consortium at project General Assemblies taking place in April 2013, November 2013 and March 2014. Suggestions for improvements were taken up, especially during the Part 1 of the final event, in September 2014. The document can therefore be taken to represent the view of the consortium.

List of deliverables submitted during the project lifetime:

D2.1: Yearly progress report for each task 2.1 to 2.8

D2.2: Consolidated public yearly progress report on PV Infrastructure Networking Activities

D2.3: Contribution of SOPHIA to EERA Work Programme

D2.4: Strategic vision document on PV Research Infrastructure

1.3.3 NA 03 (WP3) - Interoperability benchmarking, Definition of test procedures, Common database (WP leader: Michael Koehl, ISE-IWES)

The final objectives of this workpackage were mainly to:

- Organize networking seminars and workshops
- Provide harmonised databases within common criteria on several topics,
- Develop common test procedures and organize feedback and exchange information with standardisation committees

Networking seminars and workshops

The many SOPHIA courses offered opportunities to experienced researchers and senior scientists to deep in research and technical themes different from their own to improve collaboration and take profit from the cross fertilisation of different field of science and technology as subsidiary instrument to do better and more efficiently their own work.

Training courses focused on the exchange experiences and best practices, aiming to harmonise approaches and assuring that participants could physically participate in the work, for example in making measurements independently interpreting data of selected results.
The following courses were offered during the four years of the project:

- Sophia Workshop on PV-Module Reliability "Interactive training course on EL & DLIT characterization of PV modules" held by ECN in June 2013;
- four Sophia international Workshops on PV-Module Reliability organized by FHG-ISE (April 2011), FHG-IWES (May 2012), JRC (June 2013) and CEA-INES (June 2014);
- four Spectroradiometer and Broadband Intercomparison held from 2011 to 2014;
- two workshop on PV Modelling infrastructure: The modelling chain (2011) and PV performance modelling 82013) organized respectively by FZ- Jülich and CEA-INES;
- two BIPV Workshops – the requirements and peculiarities of PV in buildings organized by CEA-INEs in 2013 and 2014;
- "Best practices for power measurement of PV modules" held by JRC in July 2014;

In the tight collaboration with NA04 (W4) the following training workshop/courses were also offered:

- two workshop on analytical tools for PV organized by HZB (November 2012 and June 2014);
- three summer schools ISU Energy on Solar energy, wind energy, economics of renewable energy held in Falera, Switzerland (august 2012, 2013 and 2014);
- A huge amount of guest lectures by researchers addressing a topic of relevance to PV research infrastructure offered in different Universities and organisations (during the whole project);
- Short on-line courses and webinar offered by SOPHIA e-learning platform (see following paragraph for details) (during the whole project).

Extra information on courses can be directly found on SOPHIA web site News&Events >past events> at http://www.sophia-ri.eu/news-events/past-events/

Development of common databases

The good use of the infrastructure shared within the SOPHIA project is achieved through the development of common databases on users, infrastructures and procedures. The eleven following databases have been created and maintained (the location can be asked from the coordinator):

- Measurement of irradiance and spectral data;
- Monitoring data for a mono-crystalline module;
- BIPV database;
- Inventory of available module level qualification test and analysis equipment;
- TNA infrastructure database;
- Silicon material and imaging databases;
- Database for the collection and management of various photovoltaic measurement data ;
- Module power- and energy prediction models ;
- Accelerated testing procedures and degradation phenomena;
- Database on TCO testing facilities;
- Database of DER and Smart Grid Research Infrastructure.

Development of common testing procedures

SI Material

A good agreement was reached and the confirmation of the published mobility model was obtained. The bifacial round robin was successfully finished. The results will be directly transferred to the

standardization working group. A good agreement in the course of the lifetime round robin was achieved for most important parameter range, if carrier lifetime measurements are realized in the comparable and well defined way as established in the project.

OPV

A number of round robin activities were carried out within the topic of OPV technologies related to accurate characterization of initial performance both in indoor and outdoor conditions, as well as stability testing of OPVs under various conditions and barrier property testing of barrier materials for OPV encapsulation. Two particular outcomes can be highlighted:

1. Accurate characterization of initial performance of various OPV devices and modules were conducted among 16 laboratories with the purpose to harmonize the test procedures among the partners and test the suitability of the sample architecture for reproducible testing. Based on the results a set of guidelines were developed for device production and accurate testing, published at http://dx.doi.org/10.1016/j.renene.2013.09.034
2. Comparative stability studies of OPV modules were carried out among a number of partners in order to establish a general methodology for lifetime intercomparison of OPV samples. This has also set off the process of developing a lifetime prediction tool based on gradual buildup of data via the aforementioned diagram (the project is ongoing). The results of the stability studies and o-diagram description are published here: http://dx.doi.org/10.1016/j.polymdegradstab.2014.07.013 and http://dx.doi.org/10.1016/j.solmat.2014.06.031

Thin Film

Two main activities were carried out and directed towards the development of common testing procedures for thin film devices, namely:

- Improving the energy rating of multi-junction thin film devices

Here, the development and improvement of energy rating procedures for thin film tandem devices were the main task. In order to obtain data for this development, a thin film measurement round robin was conducted. The results have been described in deliverable D11.7 (Validation of characterization procedure for fast tandem call IV measurement). However, the round robin will be repeated with thin film tandem cells with housing and connectors and the results of both rounds will be used to refine the characterisation procedures.

- Evaluation of a pre-treatment procedure for thin film devices

The second module round robin (JRA 2, Sub-Task 3) was designed to integrate thin film modules and check their need for specific pre-treatment procedures. The results of that round robin are described in the JRA 02 section of this document.

CPV

The main goal of the CPV activities within SOPHIA is the support of the standardization activities within the IEC technical committee 82 working group 7 (IEC TC82 WG7). Here the focus is on the power rating procedures for CPV modules and systems as this is seen as one of the most urgent needs of the CPV community. In this context the first international CPV module round robin has been planned (NA2) and successfully executed (JRA2). The initial results and findings of the round robin activity helped to further improve the draft standard IEC 62670-3 “Concentrator Photovoltaic (CPV) - Performance testing - Part 3 - Performance Measurements and Power Rating”. The intermediate results of the round robin have been presented at both semester meeting of IEC TC82 WG 7 in Albuquerque (April 2014) as well as in Ispra (September 2014) and successfully submitted for the CPV

power rating draft standard IEC 60670-3 as NWIP (new work item proposal) to the IEC in November 2014. This can be seen as a big success also for the CPV subgroup of the SOPHIA project.

Module Lifetime

The test-plan for climate chamber testing of three different types of PV modules was completed as part of the work in JRA01. The results allowed a comparison of the approach to testing and characterization between the institutes involved in the test-plan to be made.

In addition, a quality assurance test sequence was proposed, based on the results of the test plan and on the desire to develop a test sequence that would allow prediction of life time expectancy for modules. The test sequence consists of a series of accelerated stress tests performed at two or more temperatures. The tests are chosen to represent a stress that would be seen in the field. The test sequence was evaluated in JRA01 with UV, damp-heat and dynamic mechanical loading as the accelerated tests. The aim is to propose a uniform test standard for quality assurance.

Module & System Performance

This sub-task is linked to the work of the expert groups NA02.7- module and system performance, and NA02.8- BIPV, as well as JRA02 "Greater accuracy of PV modules rated power and energy output prediction of PV modules".

Alongside the STC measurements, low irradiance conditions and temperature coefficients measurements were performed. The largest measurement deviation from the median at STC was for HIT modules from -3.6% to +2.7% in PMAX. Larger deviations from the median from -5% to +3% in PMAX at low irradiance conditions and -6.6% to +18.3% for the PMAX temperature coefficient were observed. The results of the round robin on thin film modules were available for 7 laboratories at the end of the project. The preliminary results highlighted difficulties with pre-conditioning for some technologies.

All these findings have implications for future updates of the IEC standards concerning power calibration and temperature coefficient determination, but they are also relevant to the proposed new standards work item on module energy rating in the IEC 61853 series.

Concerning BIPV, SOPHIA modelling results are relevant to efforts to standardise the thermal and electrical performance characteristics, which are being addressed in a proposed CENELEC standard prEN 50583-1:2014 Photovoltaics in buildings - Part 1: Modules.

List of deliverables submitted during the project lifetime:

D3.1: Organisation of networking events on at least three selected topics
D3.2: Report on "Task 3.2: General criteria for laboratory work and equipment management"
D3.3: Common reference database are established
D3.4: Development of inter-comparision protocols and harmonised test procedures
D3.5: Yearly report on contribution to sandardization committees

1.3.4 NA 04 (WP4): Exchange of personnel, spreading of good practices, and training courses to new users, summer school (WP leader: Francesco Roca, ENEA)

The SOPHIA project offered various opportunities for staff working in one organisation member of the consortium as well as non-SOPHIA partners to receive training related to the use of equipment and test procedures in PV research infrastructure:

- The individual actions (internal/external courses, personnel exchange, etc.) were currently planned through the Human-Mobility and learning work Plans (HM&LP), which were updated and implemented during the execution of each annual programme:
- Exchanges happened over a timescale ranging from 1 day to 6 weeks with a targeted population ranging from technicians, junior researchers to senior researchers.
- It was based on senior researcher/expert coming to a host organization offering them opportunities to deepen technical-scientific themes on deposition techniques, characterization of materials and devices, performance and life time testing, accuracy of measurements and characterization, validation of models and computational procedures, etc. (duration 2-3 days)
- Specific training targeted initiatives were also offered for short stay in a hosting organization having relevant scientific reputation in the field to both students /researcher at the beginning of their carrier and experienced researchers would deepen research activities in field different from their own.
- SOPHIA Internal and external courses focussed on the exchange experiences and best practices, aiming to harmonize approaches and assuring that participants, particularly who are at the initial stage of their career physically participate in the work, for example in making measurements, or doing by themselves data interpretation on selected results so forth, assisted by an expert.
- Participants were also requested to contribute to the interactive discussion, by giving a presentation, and when applicable courses were also open to any interested non-SOPHIA organizations.

Summary of Exchange actions:

Cross-border collaborations among organizations and individuals in knowledge sharing have been promoted and sustained by following actions:

- *Short stay of permanent staff* aimed for technical discussions, transferring technology and technical support including training of the staff at the host organization on a specific topic (total of actions: 5).
- *Bilateral visit/meeting* for mutual help, inter-comparison of models, common vision, test and round robin procedures, etc. (total of actions: 20)
- *Exchange of new personnel resources*: Students and early stage researchers willing to receive a research training in a SOPHIA host for a short period (2-6 weeks) (2 actions recorded).

Summary of Training actions

The SOPHIA training initiatives were based on:

- Internal Courses: Short hands-on training courses intended to be run on specific and targeted topics relevant for SOPHIA partner organizations: Workshop on analytical tools for PV material characterization by means of the CISSY at the BESSY synchrotron and X-ray emission absorption/spectroscopy (XES/XAS) and photoelectron spectroscopy (XPS, UPS, HIKE)
  - 2012: 15 students and young researchers from 11 different countries
  - 2014: 14 participants from 9 countries
- External Courses and Summer schools, courses having a wider scientific scope and involving external experts, addressing topics of relevance to PV research: ISUenergy summer universities in Falera, Switzerland which integrates different academic in Physics, Material Science, Material

Engineering, Architecture, Sociology, Political Science and Economics to provide students with a solid foundation in photovoltaics, solar thermal technologies, wind energy, solar architecture, sustainability, smart grids and energy storage., LED lightening system

- 2011: 63 Participants from 22 countries and 12 fields of study
- 2012: 62 participants from 27 countries and 12 fields of study
- 2013: 52 participants from 24 countries and 10 fields of study
- Guest lecture of SOPHIA expert commonly invited to deliver a lecture to an external group of experts/students .(number of offered lectures: 8)

SOPHIA Webinars:

The full potential of the wide research areas of common interest of SOPHIA consortium partners and the availability of top-class scientists ready to transfer knowledge with the combination of technological capabilities offered by the utilization of SOPHIA 48 PV research infrastructures has been further exploited by SOPHi@webinar, the e-learning platform of the SOPHIA project.

SOPHi@webinar, has been designed and powered by ENEA in collaboration with all SOPHIA project partners. The lectures offered by Sophi@webinar covered all the 8 topics focused by the project. Sophi@webinar also proposed online short courses organised through several webinars focused on a common theme:

- Short course on CPV-Concentrated Photovoltaics indoor/outdoor Characterization (UPM, FhG-ISE, ENEA, CEA-INES Jan 2015)
- Different BIPV Perspectives Part I & Part II: : European/non-European research and market outlook and Landscape, Building-Integrated Photovoltaics and Performance Modelling , (CEA-INES, ENEA, FhG-ISE, AIT Jan 2015)
- Short on line course on "crystallisation of silicon" (SINTEF, Nov. 2014);
- Characterisation of Thin Film Solar Cell Layers By X-Ray Based Spectroscopy (HZB, may 2014);
- OPV testing and Existing Standards (JRC, DTU May 2014);
- Defects in Crystalline and Multi-Crystalline Silicon Solar Cells (ECN, FhG-ISE, SINTEF July 2014) Uncertainty Estimations of PV Outdoor Measurements (DERlab, JRC, FH-ISE, FH-IWES, CREST, June 2013).

The on-line approach to knowledge exchange is very successful because time saving and reducing travel costs and it is widely diffusing for that. It creates a wider audience for training individuals in academies, research organization companies.

Several webinars (pdf, slides, videos) are also available on-line on Sophia Events page and Sophi@webinar portal. This is a great advantage also for those who, perhaps due to lack of time, would be unable to attend physical events.

Summary of offered webinars:

- 30 webinars organised since March 2013
  - around 2-4 events/month organised
  - involving more than 40 speakers in 16 different events
- 830 registrations of participants (+ >100 in live streaming)
  - more than 560 different scientists/researchers/professionals participated
  - widely represented by students and younger researchers
  - Majority of non-SOPHIA members.
- A balanced participation

- in respect to gender for both speakers and participants in comparison to events usually held physically has been achieved
- A very wide participation by country, covering also non-European countries (USA, Asia, South America, Australia, etc.)

Figure 6: SOPHi@webinar e-learning platform home page (http://uttp.enea.it/sophiawebinar)

List of deliverables submitted during the project lifetime:

D4.1: Human mobility and learning plan

D4.2: Report exchange of personnel and internal training courses

D4.3: Report summer Schools

1.3.5 NA 05 : Dissemination of knowledge; internal and external communication (WP Leader: Philippe Malbranche, CEA-INES)

A SOPHIA website www.sophia-ri.eu was implemented and became operational early in the project.

Some examples

- frontpage

- Events:

- TNA calls:

- News (of publications, workshops and meetings):

The plan for dissemination and communication targeting specifically the industry was based on the following pillars: the website; participation in workshops, specific events and conferences and dissemination through mailings, newsletters, newsfeed and social network posts using the communication tools of the project partners.

- The SOPHIA website is used as much as possible for the dissemination of the foreground, the activities of the SOPHIA consortium and the work that is conducted within the TNA activities.
- Targeted mailings have been separately sent to around 1500 contacts to boost the proposals for the TNA. Furthermore, targeted mailings have been sent to more than 2500 contacts to invite them to the final Workshop and the Symposium.
- EPIA Solaris monthly newsletter with an outreach of around 15,000 people in the PV community was used to effectively support the Plan. Additional news items were created for EPIA's website.
- Flyers, roll-up banners brochures, and posters have been printed in view of distribution during many events such as conferences and exhibitions and according to the expected participants in each event.

A "networking activities table" was used and finalized with all events and coordination activities organised. All the SOPHIA events are categorized according to their related WP, type of events, targeted audience (scientific or industrial), targeted topic(s), relation to one or several subtasks and deliverables, etc.

As final events, SOPHIA organised:

- a side-event at EU PVSEC, in Amsterdam in September 2014, as the final event "Part 1"
- a "Symposium on European PV Research Infrastructures" at INES on January 22, 2015, as the final event "Part 2". 104 participants from 75 organisations (industry, research and ministries), from 23 countries attended the symposium.



The agenda covered 4 aspects:

- Session I: The EU R&D framework in the field of solar photovoltaics
- Session II: Main achievements of the SOPHIA project for researchers and industrial companies
- Session III: Strategic Research and Innovation Agenda (SRIA)
- Session IV: Role of regions and member states for research infrastructures' development

All Presentations can be downloaded from the SOPHIA website: http://www.sophia-ri.eu/index.php?id=76 .

Besides the outcomes of the SOPHIA projects, strategic directions of solar research in Europe have been debated.

Figure 7: View of the symposiums

A **press conference** was organized to disseminate Sophia project, its objectives, main results and recommendations. Three well known PV media of global reach were present; PV-magazine, PV-tech and Recharge that published articles:

- http://www.pv-magazine.com/opinion-analysis/blogdetails/beitrag/industry-urges-european-pv-research-sector-to-wake-up_100017914/#axzz3QCpsfHMp
- http://www.pv-tech.org/news/solar_rd_needs_systemic_shock_to_avert_death_of_european_pv

List of deliverables submitted during the project lifetime:

D5.1: SOPHIA Internet website
D5.2: Progress report on the SOPHIA "Internet hub"
D5.3: Project identity set
D5.4: Plan for dissemination and promotion activities
D5.5: Plan for use and dissemination of foreground
D5.6: Progress report on dissemination to the scientific community
D5.7: Progress report on dissemination to industry
D5.8: Proceeding on the Interim Workshop
D5.9: Proceeding of the Final Forum
D5.10: Report on Dissemination activities

1.3.6 TNA 01 (WP7): Facilities for better experimentation and characterisation on materials and innovative technologies for PV (WP Leaders: Martha Lux-Steiner and Iver Lauermann, HZB)

Objectives

The objective of WP7 is to report on the results of the Trans National Access to Research Infrastructures program of SOPHIA with a focus on materials and innovative technologies (TNA 01), which, together with TNA 02 was one of the key features of the SOPHIA project. In this report an overview over the TNA 01 proposals and their evaluation and execution is given. The detailed report on TNA 01 is given in D7.1 (Report on the exchange of facilities in TNA01) together with the available individual reports submitted by the TNA 01 users.

Main achievements

Within TNA 01, a total of 24 research infrastructures (RI) were offered, which could be grouped according to the following technological topics of SOPHIA:

- Silicon material: 7
- Organic PV: 9
- Thin film PV: 4
- Modelling: 4

For these RIs, a total of 31 proposals were submitted and 28 of those received a positive evaluation. As of January 2015, 18 TNA visits have been completed including a final report.

After the first calls, the number of TNA 01 proposals was well below that expected by the SOPHIA members, which can be explained by the fact that the program had started without predecessor and was therefore not well known in the PV community. After increasingly promoting Sophia TNA at conferences, by direct mailings, and by holding training workshops, the number of proposals rose and an impressive number of TNAs have been completed by the end of the project. The scientific impact of all TNA visits is yet unknown, however, the number of scientific papers that will be published as a result of TNA will have a considerable share of the total number of papers originating from the SOPHIA project.

The additional impact on training and education of researchers about new instruments and methods relevant to their work should not be underestimated. Furthermore, new collaborations have been started and new European project proposal were started based on TNA visits.

Lessons learned and recommendations for future TNA

Although TNA users were mostly satisfied with the outcome of their TNA visits, many of the host organizations reported problems with the reimbursement of their TNA cost. This was due to the internal problem of calculating the access cost in a way that would be accepted by the EC. Since many partners in SOPHIA could not claim their real access cost because of that difficulty, a different funding scheme should be developed for future TNA programs. This could be e.g. the payment of a lump sum per visit or per hour of lab time without necessary justification of real cost. Otherwise it can be envisaged that many institutions will refuse to take part in future TN programs because they know that they will not be reimbursed.

Another problem with the SOPHIA TNA program was the insufficient information flow between proposers, coordinator and host institutions. Therefore in the future, there should be strict rules defining how all partners are informed about the progress of a TNA from proposal to evaluation and

the final report. Reporting on the outcome of a TNA visit within 6 weeks after completion should be mandatory (e.g. one rule could be: no compensation of travel cost without report).
In many cases delays in TNA project were caused by the slow evaluation process, therefore the evaluation of proposals should be done within a certain limited period, e.g. 6 weeks after reception. Another delay was caused by the slow negotiations between proposer and host; again, clear rules are needed to make the process swift and transparent. Host and proposer should agree on the visit within, e.g. 2 months of positive evaluation and should report the results of their negotiation to the coordinator. Publication of TNA results should be completed within 1 year of TNA completion, including acknowledgment of TNA-funding.

List of performed TNA projects (WP7 type)

The following WP7 TNA proposals have completed their experimentations in one of the Research Infrastructure proposed by the SOPHIA partners (sorted per topic).

Acronym	Organisation	Title	Topic	Host RI requested
Concell	Cyprus University	Photoluminescence and spectral response measurements of III-V triple junction devices	CPV	RSE
HiTOp	Martifer Solar S.A. Portugal	Characterization and optimization of CPV optics	CPV	UPM
Polmol	Antwerp University	Use of EPR at 263 GHz to unravel the formation of polaron states in thiazolo[5,4-d]thiazole (TzTz) – based small molecules	Organic PV	HZB - EPR
PLCuI	Aalto university, Espoo	Photoluminescence based imaging of copper concentration in silicon	Silicon material	Fraunhofer ISE
ZSO/K	University of Luxembourg, Laboratory for photovoltaics (LPV)	Development and characterization of sputtered Zn(S,O)/Cu2ZnSnSe4 heterojunctions	Thin Films	Cissy (HZB)
DEF-HYDFT	IES Madrid	Defects in ZnO using hybrid density functional theory	Modeling	Julich
ANSSAL	Delft Univ	Advanced Nanostructured Silicon-Based Films for Stable Absorber Layers	EPR spectroscopy	HZB
Thincad	University of Verona	Ultra Thin CdTe solar cells	Thin Films	HZB
Graphocell	Graphenea SA (S)	Graphene in organic photovoltaic cells	OPV	HZB
ComSil	NTNU	Study of compensated silicon materials via advanced characterization methods	Silicon	CEA-INES
Compenor	Disasolar	OPV module encapsulation with composite materials	OPV	Tecnalia
Compenor II	Disasolar	Durability study of OPV modules encapsulated in composite materials	OPV	Tecnalia
MUSAS-DEVICE	University of Rome "Tor Vergata"	Multiscale/Multiphysics device simulation of amorphous Silicon Solar cell	Modelling	Jülich
MUSAS-ATOMISTIC	University of Bremen	Multiscale Simulation of Amorphous Silicon Solar cell	Modelling	ENEA, ENEA Grid
Standardized OPV device stability evaluation	Imperial College London	Standardized stability evaluation of promising OPV devices from Imperial College	OPV	DTU (CLOP)
PrOxiTam	Catalan Institute of Nanoscience and Nanotechnology (ICN2-CSIC) (S)	Water-based Solution Processable Oxides as Recombination Layers for Tandem OPVs	OPV	DTU
ARTSOL	Padova University (I)	Accelerated Reliability Tests on organic SOLar cell	OPV	DTU
MD-Rut-DSSC	Institute for Nuclear Sciences VINCA (Serbia)	Metal Doped Rutile TiO2 as electrode in DSSC	Modelling	ENEA GRID
NanoSol	University of Erlangen (D)	Design and optimization of thin film solar cells with silver nanowires	OPV (thin films)	INES
HPSS	Karlstads Universitet (D)	High Performance Solar Silicon	silicon	Sintef
MOHP	Universidad Politécnica de Madrid	Modelling Organic Halide Perovskites	Modelling	Jülich JUROPA
CODE RESI	NMBU (N)	Correlation of defect luminescence and recombination in	Silicon	Fraunhofer ISE

		multicrystalline silicon		
LIBSOSAM	Silicor Materials (D)	Laser **I**nduced **B**reakdown **S**pectroscopy for **O**n-line control of **Si**-**Al** **M**elts	Silicon	CEA-INES
BASHEC	École Polytechnique Fédérale de Lausanne (CH)	Band Alignment at Silicon Heterojunction solar cells Electrical Contacts	Silicon	HZB
VeSil	Vesuvius (Czech)	Characterization of the effect of novel crucible coatings on silicon crystallization	Silicon	CEA-INES
FeTSi	NTNU	Iron transport in mc-Si	Silicon	Fraunhofer ISE
Solar Streetlight FASCOM	SUNPLUGGED	Compact Solar Streetlight PV module modelling	modeling	Tecnalia
BCU	PV Crystalox (GB)	Benchmarking, Characterizing and Understanding high-performance silicon properties during Al-BSF cell fabrication	Silicon	CEA-INES

List of deliverables submitted during the project lifetime:

D7.1: Report on the exchange of facilities in TNA01

1.3.7 TNA 02 (WP8) : Facilities to develop harmonised vision on performance and lifetime of PV modules (WP Leader : Gerald Siefer, ISE-IWES)

WP8 TNA projects deals with improvement of performance and lifetime of PV modules. The objective of WP8 is to give access to facilities in order to develop a harmonized vision on performance and lifetime of PV modules through transnational access projects (TNA). The practical management and organization of the TNA calls is done within workpackage NA01.

List of performed TNA projects (WP8 type)

The following WP8 TNA proposals have completed their experimentations in one of the Research Infrastructure proposed by the SOPHIA partners (sorted per topic).

Acronym	Organisation	Title	Topic	Host RI requested
BECAR	BECAR	Best prototype Efficiency Concentration and Acceptance angle chaRacterization	CPV	IES-UPM
DuSOp	Fullsun Photovoltaics Ltd	Thermal and Spectral Dependence of Dual Silicone Optics	CPV	UPM
cSiPID	Cyprus Univ.	Experimental tests for the understanding of the potential-induced degradation and relaxation in standard crystalline silicon photovoltaics	PV module	AIT
BRING-OUT	Voltinov	Blue Response Impact aNd aginG effect On modUle performance raTio	PV module	Fraunhofer-ISE
PID1500	VOLTINOV (F)	Study of the PID effect on modules serial connected until 1500Vdc	Module Lifetime	Fraunhofer ISE
ISCAEM	VOLTINOV (F)	Impact of Salt Corrosion on the Adhesion of Encapsulant and Module power	Module Lifetime	Fraunhofer ISE
PVUK-Compare	EON New Build & Technology GmbH (D)	Comparing PV Module Performance in the UK	Module performance	CREST
OUTMOD	Jülich	Outdoor cell and meteorological measurements for simulation chain verification	Module performance	CREST
ComPRI	Soitec Solar	Precompensation for Performance Ratio Increase of CPV-modules	CPV	IES-UPM
SPC-PV encapsulations	Polymer Competence Center Leoben GmbH	Strucutre-porperty correlation of polymeric PV encapsulations	Module performance	Fraunhofer ISE
BIF-PID	Jerusalem College of Technology (JCT) (Israel)	Stability of Bifacial P-type cells and modules against Potential Induced Degradation	Module performance	CEA-INES
BIFITROPIC	SUNENERGY Europe (D)	Bi-facial tropicalized module lifespan & performance	Module performance	CEA-INES
PVSensor II	PV Performance Labs Germany (D)	Characterization of solar radiation sensors for PV performance assessments	PV system performance	CREST
PoNG	Soitec (F)	Power Rating of Next Generation CPV Modules	CPV	Fraunhofer ISE

List of deliverables submitted during the project lifetime:

D8.1: Report on the exchange of facilities in TNA02

1.3.8 JRA 01 (WP9): Quicker lifetime prediction though accelerated ageing tests and improved failure analysis procedure (WP Leader : Jan Kroon, ECN)

Initial objectives

The lifetime of a PV module is critical for PV manufacturers, developers and end-users as it directly affects the energy yield and so cost of a PV system. The standards IEC61215, 61646 and 61730 are considered excellent for identification of major design issues, but they do not include sufficient testing to be able to predict outdoor performance and lifetime.

The objective of the PV Module Lifetime Prediction work-package in the FP7 project SOPHIA was to investigate and establish the research infrastructure needed to develop a standard for lifetime prediction based on a number of combined stress tests of commercially available PV modules.

The goal of this sequence is to provide a tool to identify failure mechanisms and predict lifetimes for different climatic conditions for different module types.

Results

A test-plan was designed with 14 different test conditions including damp-heat at different temperatures and relative humidity, thermal cycling at different temperatures, combined damp-heat and UV-testing and mechanical testing with preconditioning. The tests were performed on sets of three different types of wafer based Si modules including a module with heterojunction cells, a module with a thermoplastic encapsulant and a conventional module. Degradation of the modules was followed by characterisation at intermediate steps during testing. The results of the test plan were used to identify and model the degradation mechanism and relate the degradation rate in testing to an expected lifetime in the field. The methods used will be put forward as a proposal for a quality assurance standard for PV modules.

Conclusions and recommendations

The work in this WP has demonstrated the value of a large project with several partner institutes, because the results received in this work-sharing manner fit together very well. The number of tests and logistics would have made an experiment of this size impossible to be performed by a single institute within such a short time. Spreading the tests between several institutes makes this feasible. It also allows the institutes to learn from each other's approach to testing and characterisation and highlights the need for more standardisation of this type of tests and should ultimately lead to dedicated quality assurance plans for PV modules with aim to give a more accurate lifetime prediction in different climate zones. In order to achieve this goal, further development of improved module characterization tools and climate chambers with ability to combine environmental stresses is strongly required.

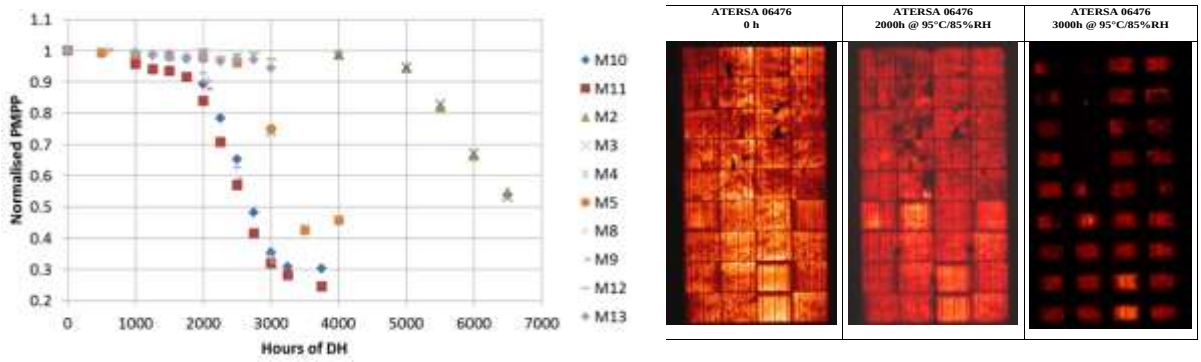


Figure 8: caption Plot of degradation in damp-heat for a tested module and EL images of module A following degradation during damp-heat testing.

List of deliverables submitted during the project lifetime:

D9.1: Listing of required and available testing at the various partners
D9.2: Round-robin: definition of test samples and test procedure
D9.3: Reviewing the test criteria for interconnect and encapsulation quality
D9.4: Aging testing on test samples completed
D9.5: Description of new test methodologies for lifetime prediction
D9.6: Modelling and verification of new test methodologies

1.3.9 JRA 02 (WP10): Greater accuracy of PV modules rated power and energy output prediction of PV modules and systems (WP Leader: Jens Merten, CEA-INES)

Module & System Performance

Initial objectives

A performance model round robin has been performed with the aim to evaluate the uncertainty of the various module productivity models and to split the uncertainty coming from the thermal module temperature models and the electrical models of the module power. Several partners of the European project SOPHIA predicted the module energy production and back side temperature.
Several types of modeling approaches for the electrical models are used during this round robin: neural networks, equivalent circuits, and empirical energy yield models. Furthermore, several thermal models are assessed which determine the module back temperature: the NOCT model, and a thermal model based thermal analog equivalent circuits which has been developed for the temperature modeling of PV modules integrated into buildings.

Experiments/Results

Outdoor monitoring data of different module technologies and locations have been provided by the project partners and uploaded to a centralized database. After a careful check, finally only five datasets with excellent data quality have been selected. Three months of data have been used to train and parameterize the models. Then, each model predicts the module power for each data point of the following twelve months. The assessment of the models' output is done by one single SOPHIA partner for all models.

The electrical models tested were the Energy Yield Model, the MotherPV method and Neural Network. Temperature models tested were NOCT-Model, Analogical electrical equivalent circuits based on TRNSYS, Linear temperature function.
One of the main results is the excellent precision of modelled productivity, which can be only achieved when the module is characterised individually and the data quality is excellent. The power output errors (POE) where less than 1% for wafer based modules and less than 3% for thin film silicon modules. Regarding spectral effects, the use of short circuit current data for the measurement of the solar irradiation instead of a pyranometer does not improve quality of the model. Regarding the temperature effect, the use of modeled module temperature instead of measured temperature only slightly increases the error in output prediction. The errors from simplified linear temperature models cannot be reduced using more sophisticated models.

Recommendations for the future joint research activities

Further joint research activities should establish methods for precise modeling the productivity of complete PV systems which are assembled by PV modules which cannot be characterised individually. This requires a statistical characterization of sample batches of PV modules and a validation with test data from real size systems. On module level, a simplified performance evaluation parameter, for example a “module performance ratio” should be established, which will be only acceptable when it can be determined from cheap and simple lab measurements.

CPV

Initial objectives

Concentrator Photovoltaics (CPV) is a technology that has just started to enter the market. Although under development CPV still suffers of a lack of international standards. The International Electrotechnical Commission technical committee 82 working group 7 (IEC TC82 WG7) is responsible for the development of standards for CPV. The main goal of the joint research activities related to CPV within the SOPHIA project was to support these activities also with valid input and also real data.

Experiments/Results

The CPV JRA activities within SOPHIA were related to three topics:
- specification and influence of tracking accuracy (CPV uses trackers to assure optimum alignment of the modules to the sun)
- setting up of a spectral recording network and intercomparison of spectrally sensitive irradiance measurement devices (high concentration CPV uses multi-junction cells which show a higher dependence of their performance on changes in spectrum)
- definition of power rating procedures and testing of these procedures through a CPV module round robin (there is not yet an IEC standard related to power rating of CPV)

The focus of the SOPHIA CPV activities was on the latter point, which is related to the power rating of CPV. In this context a CPV module round robin has been established. At all stages of the round robin the IEC TC82 WG7 has been involved, including e.g. the formulation of the round robin guidelines. Initial results show very promising agreement between measurements at different partners’ sites with a maximum deviation of 4 %. The work within SOPHIA has helped to allow the IEC TC82 WG7 to officially submit the current draft for power rating of CPV modules and systems as new work item proposal (NWIP) to the IEC.

Recommendations for future JRAs

The work within SOPHIA has clearly demonstrated that joint research activities of different partners can serve as a strong instrument to accelerate standardisation work. The CPV module round robin set up and performed within SOPHIA helped to **define and test** procedures that now are implemented in the current draft standard for power rating of CPV. The main recommendation for future JRAs related to CPV is to give further support to intercomparison campaigns as started within SOPHIA. This includes a continuation of the efforts related to comparison of spectral measurements as this is still one of the impact factors on the power rating of CPV which's potential influence on measurement uncertainty is not fully quantified. Additionally the CPV module round robin performed within SOPHIA can only be seen as a good starting point: It involved only modules from one manufacturer and it strongly recommended that such efforts should be performed on a regular base with different module technologies.

BIPV

Initial objectives

The main objective of the activities on BIPV topic in the SOPHIA project was to determine the impact of the installation method of BIPV modules on their energy output. More precisely, these actions aimed to realize:

- A benchmark of BIPV system testing and modelling methods.
- A white paper on BIPV requirements considering: energy output prediction, regulations, related building functions, cost compensation…

Figure 9: Test benches and experimental houses at CEA site, Fraunhofer ISE site and TECNALIA site

Experiments/Results

In order to achieve these results, various actions were led by the experts through the joint research activities and the networking activities.

- Modelling guidelines were proposed based on a state of art of suitable modelling methods considering thermal, optical and electrical behaviours of BIPV systems.
- Characterization guidelines and specific requirements of BIPV products were also defined based on outcomes of the first INES workshop on BIPV.
- A benchmark of modelling methods was performed and presented during a plenary session at 29th EU PVSEC (Plenary session, 6DP2.3, 09/25, 9.50 - 12.10). This comparison showed that all models examined results in satisfying prediction of module temperatures. A ranking of the models was presented according to their impact on the accuracy of energy output prediction. It was noticed that a higher accuracy of the thermal model doesn't lead to a higher accuracy of the prediction of the energy output. Finally, the linear model is a satisfactory method for preliminary performance determination.
- Moreover, a common database was developed in order to share BIPV systems tests results and for models validation.

List of deliverables submitted during the project lifetime:

D10.1: Guidelines for quality management
D10.2: Specific requirements for BIPV products characterisation
D10.3: Set up of the database and its internet access
D10.4: Software tool (specifications, guidelines) for data analysis
D10.5: Establishment of indoor measurement protocols and organisation of the Round Robin tests
D10.6: Recommended practices for power measurement and measurement uncertainty
D10.7: Cross-calibration studies with various sun simulators and preconditioning studies
D10.8: Results of the second Round Robin test and recommended practices
D10.9: Establishing an evaluation framework for modeling tasks
D10.10: Model verification with outdoor test data
D10.11: Requirement for Spectral irradiance measurements
D10.12: Guidelines for power rating of CPV systems
D10.13: Report on the impact of tracking and mechanical errors on the energy estimations
D10.14: Guidelines on power and energy rating of BIPV systems
D10.15: Evaluation of energy output of BIPV systems

1.3.10 JRA 03 (WP11): Improved Material characterisation procedures (WP Leader: Wilhelm Warta, ISE-IWES)

Thin films and TCOs

Initial objectives

Quicker characterisation of transparent TCOs for thin film devices by defining a figure of merit (FOM) including transmission, conductivity and scattering properties.

Characterisation of tandem cells in a round robin to determine the uncertainty of efficiency measurements.

The use of x-ray based surface analysis (XPS) for the characterization of compound semiconductor thin films.

Electron Paramagnetic Resonance (EPR) characterization of thin films: Identification and quantification of defects in thin film silicon.

Development of a pre-treatment procedure for thin film modules to increase the comparability of efficiency measurements

Experiments/Results

The definition of a figure of merit for TCOs was described in a report which will be used as starting point for future discussion.

XPS was used for the correlation of surface, interface and bulk properties of chalcopyrite thin film solar cells with device parameters. Especially the presence of sodium ions on the absorber surface was found to be correlated with surface oxidation, which has an impact on solar cell performance.

EPR was used for the identification of defects and the correlation of defect density with thin film silicon solar cell efficiencies. Visitors from various universities used the possibility of trans-national access to examine their samples in EPR@HZB lab.

The tandem round robin showed good agreement of the results of wavelength dependent current measurements and efficiency measurements at the different partner laboratories.

Recommendations for the future joint research activities

One outcome of SOPHIA regarding thin film PV was the importance of common standards for characterisation of devices, especially thin film tandem solar cells. This work should be continued in the future. The same is true for the pre-treatment (light soaking or forward biasing) of thin film modules, which can have a large impact on the measured efficiency of devices and which is far from being understood. In order to improve the comparability of flasher solar simulator-based characterisation of thin film modules, flashers should offer the possibility of altering the pulse length in order to account for metastabilities.

Other joint research activities for the future are the development of TCOs (with higher transmission, better conductivity, and certain scattering properties) based on current and new materials, the improvement of light management in thin film devices and the improvement of encapsulation materials, especially for flexible devices.

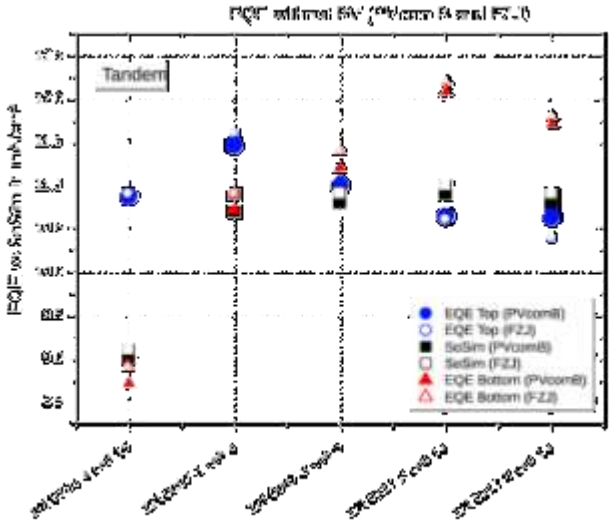


Figure 10: Comparison of tandem cell short circuit current densities using different solar simulators and measurement techniques

Silicon Materials

Initial objectives

The activity on Si materials is centered to the qualification of new emerging material and cell types by improved techniques and procedures. The two main objectives for this activity were:
1) The quality enhancement of R&D available to supporting industry. For that round robins should assure comparability of results on European level and the provision of data for new parameters.
2) The generation of data bases for silicon material R&D on metrology, materials and specifications.

Experiments/Results

In measurement round robins an extensive comparison for a wide range of Si-material related variables was done. Results for IV-characteristics, quantum efficiencies and reflectivities on industrial solar cells and precursors were published (see P. Manshanden et al., EU-PVSEC 2013). Intercomparisons of impurity detection (Inductively Coupled Plasma Mass Spectroscopy ICP-MS), carrier mobilities in compensated silicon, the demanding measurement of bifacial cells and of carrier lifetime complement this activity. Detailed overviews on (i) imaging techniques for material parameters, (ii) different available silicon materials and (iii) solar grade silicon specifications were elaborated. Results were disseminated and discussion stimulated in the frame of a large workshop

on “Challenges for Photovoltaic Silicon Materials” (Rome, Oct. 2013) as a worldwide platform for industry and research groups to discuss programs and future targets. A survey about scenarios for strongest cost reduction was conducted among experts during preparation of workshop and reported in “Solar Energy Materials & Solar Cells” 130 (2014) 629.

Recommendations for the future joint research activities

The development and production of silicon material suitable for high efficiency solar cell technologies is at present seen as an important target by the majority of market contributors. A strategy to bring the leadership in cost effectiveness back to Europe is needed. Europe has already a wealth of individual centres of excellence, where material development work towards this aim can be done.

In silicon materials research, networks of people are needed more than new hardware. It is by linking scientists that the challenge of finding a low-cost material for 23% efficient cells can be met and procedures for reliably and quickly evaluating silicon materials can be established. Industry has to be kept close to the network. Ownership models for newly generated intellectual property have to be developed which are suited to attract companies to entering into a contract with the network and providing co-funding. Preferably, several companies may jointly share this relationship to the network.

Important topics of the network could be n-type silicon and directionally solidified material of quality and/or crystal structure as close as possible to single crystalline silicon. Thus information flow between the two approaches to high efficiency should be facilitated.

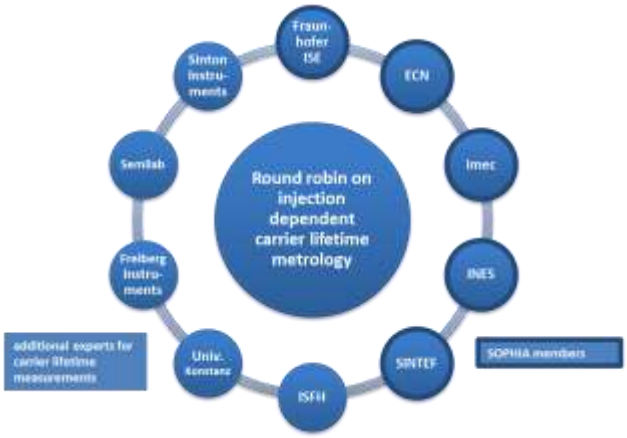


Figure 11: Consortium for comprehensive round robin on carrier lifetime metrology. In addition to the SOPHIA-partners international experts were included in this activity which complemented the expertise on lifetime measurements of the SOPHIA partners

Organic Photovoltaics

As a technology on a verge of industrialization, organic photovoltaics (OPV) are in a critical need for fast screening tools, harmonized characterization procedures and product design/performance qualification protocols. Thus, in the framework of SOPHIA the OPV team has set objectives to aid the process of establishing standards and protocols for device designs, characterization and stability testing.

In that regard four interlaboratory experiments were conducted, where various OPV samples were produced and shared among partners and characterized with various techniques. The first two studies, which involved sharing and accurate determination of performance for various samples, addressed the architectural challenges of the samples and the availability of accurate testing

equipment and reproducibility of test procedures in different laboratories. The third study focused on lifetime determination and prediction for various OPVs by comparing the sample performance under moderate and accelerated ageing conditions. The final study analyzed the links between the barrier properties of the encapsulation material, the intrinsic stability of the absorbing polymer and the lifetime of the complete devices. The aim of the latter was to rate the lifetime of the final product based on the individual performance of its components. All four studies were conducted in collaboration with EERA partners. The results were also published in articles and communicated to standardization committees via the annual International Symposiums of OPV Stability (ISOS).

The studies revealed a number of important issues. Significant deviations of test results during accurate characterization of samples among different laboratories were recorded, which were caused by deficit of appropriate testing equipment and lack of experience. In addition, while the significant amount of data generated throughout the SOPHIA project initiated the process, the development of RELIABLE protocols for OPV characterization and lifetime testing required much larger set of statistical data which was not possible to obtain within the given time period and resources.

Thus, based on the experience gained within SOPHIA the following is recommended as the next logical step towards further development of the process for establishing standard characterization tools and protocols for OPV products and harmonizing the test procedures among the laboratories:

- Facilitation of interlaboratory experimental projects: Establishment and funding of (research level) committees for coordinating interlaboratory (round robin) studies
- Funding for equipment for characterization and ageing test is highly encouraged
- Facilitation of projects, which will establish online tools for OPV characterization and lifetime tests and will create centralized data collection tools (databases)
- Supporting educational webinars and workshops related to OPV characterization is recommended

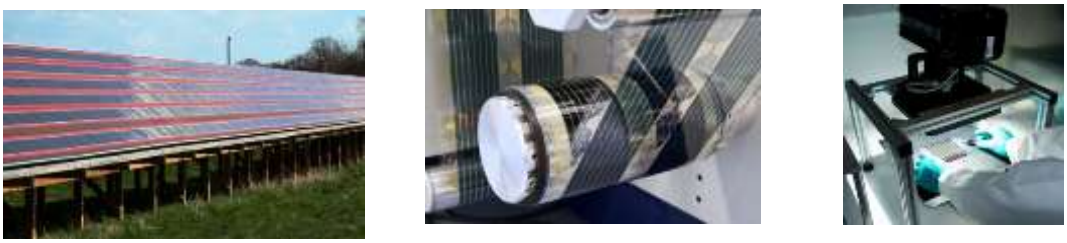


Figure 12: Production of solar organic tape

List of deliverables submitted during the project lifetime:

D11.1: Overview report on most prominent imaging techniques
D11.2: Data base of different available alternative silicon materials
D11.3: Specifications for solar-grade silicon
D11.4: Description of sample architecture, materials classes and test devices
D11.5: Synthesis of results from round robin results to establish key parameters
D11.6: Definition of a figure of merit
D11.7: Validation of characterization procedure for fast tandem call IV measurement
D11.8: Correlation of surface, interface and bulk properties with device parameters
D11.9: Identification of defect, correlation of defect density and protocol for routine characterization

1.3.11 JRA 04 (WP12): Improvement and validation of software infrastructure (WP Leader: Jürgen Hüpkes, Julich)

Workpackage context and objectives

PV simulation tools are used all across Europe, to simulate every kind of PV technology at different levels of the production chain; materials, cells, modules, up to complete, installed systems. Expertise in each of these tools is usually very specific, focusing on one technology at one production level. As a result, communication between different tools is difficult and time consuming, or even impossible. With the ever-increasing uptake of PV, and consequent installation of large PV systems, the ability to pass simulation data along the production chain, to look at the cost-effectiveness of changes on a cell or module level in terms of the overall system cost and output, is becoming necessary.
Within this workpackage, the aim was to improve communication between simulation tools, and thus increase the efficiency of simulations along the entire production chain by:

(1) Development of standard data formats and content for all simulation tools;
(2) Development, implementation and testing of a central 'universal' library, via which all simulation tools can easily communicate, using the standard data formats.

Main Achievements

(1) We defined standard data formats and content required to pass data between I-V based simulation programs at cell, module, and system levels, have been developed. These include data that is passed directly from one simulation program to another, as well as necessary user-input data (e.g., module geometry, electrical configuration, weather data, etc).

(2) We developed, implemented and tested a central 'universal' library to facilitate data transfer between I-V based PV simulation tools, at cell, module, and system level.

(2.1) Library Description

A proof of concept of this library has been written, using the Octave programming language. The library currently allows I-V curves or PV parameters obtained from IV curve fitting at any illumination intensity or temperature to be imported or exported in a standard format, significantly simplifying data exchange procedures between any simulation programs. Both experimental and modelled data can be exchanged.

A schematic of the library is shown in Figure 13 Initial simulation data from simulation program 1, in this case I-V curves simulated at a range of temperatures and illuminations, (top left) is converted to the library format. Fitting and interpolation of these curves can be performed with the library tools, providing I-V data in the required resolution and format for any other simulation program.

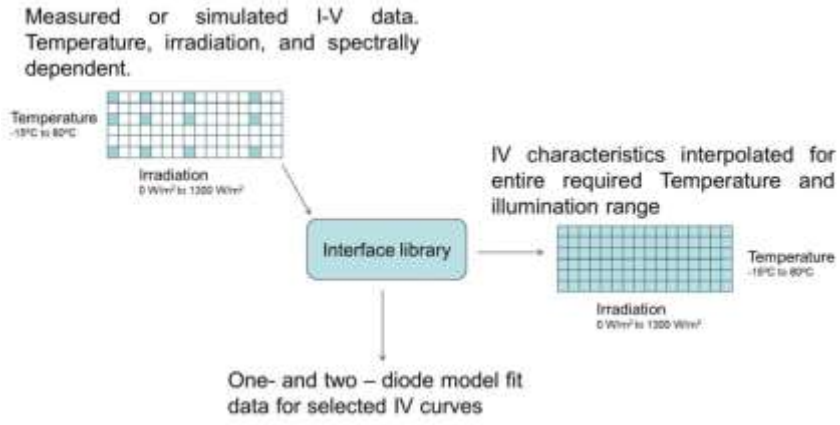


Figure 13: Schematic representation of the initial interface library. The library is provides a standard format to pass IV curve data or IV parameters obtained from one- or two-diode fitting of the data for between any simulation programs within the desired temperature and illumination range.

(2.2) Implementation and testing

The individual simulation tools have been successfully integrated into a simulation chain by use of the universal library described above. The daily power output, as well as the annual energy output for three outdoor PV systems, each using different PV technologies (amorphous silicon, CIGS, and silicon heterojunction), were predicted from cell level simulations, and measured data. The simulated I-V data has been compared with experimental data at cell, module, and system level. The final calculated daily power output over time has been compared with experimental data.

Figure 14 shows schematically the simulations that were performed, the data (simulated and measured) that was exchanged using the interface library, and the comparisons that were made.

There are three main advantages to this library:

- All required information about data content and standards is known, reducing the possibility for errors in data exchange and interpretation
- Without this library, a specific interface to exchange data must be written for every pair of programs that exchange data. Using this library, every simulation program must only write a single interface to the library, and then communication with all other programs that use the library is possible.
- Due to the fitting and interpolation procedures provided by the library, differences in the speed and complexity of each simulation program used in the simulation chain do not matter.

In summary, data exchanged using the library was preferable for the researchers, as all required information was standardized, clear and available to all researchers. This made data formatting, fitting and interpolation procedures easy to implement and interpret by all parties. Additionally, only one data format conversion was required (to / from the library format). This meant that data exchange between simulation programs was faster, easier, and less error prone than the manual data transfer.

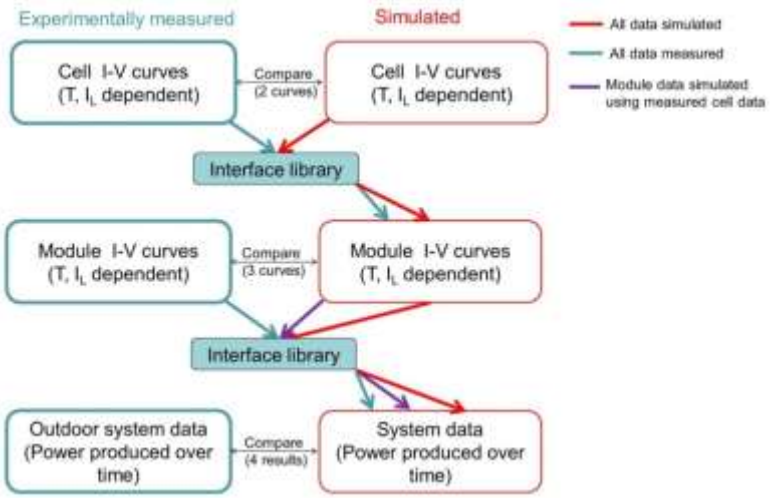


Figure 14: Data passing up the PV chain using the universal interface library, providing access to the system annual energy yield from both simulated and measured cell level data.

List of deliverables submitted during the project lifetime:

D12.1: Definition of data interfaces between the different modelling steps
D12.2: Report on models with respect to experimental verification
D12.3: Implementation of data bases and interfaces between different modelling tools
D12.4: Report on modelling of the value chain and energy rating

1.4 Potential impact and dissemination and exploitation of results

1.4.1 Potential impact

The main impact of this project is that is has created a culture of collaboration throughout the main research institutes, which will be extended under various forms beyond the end of this project. This is the main general outcome of this first project of its kind.

Collaboration has been effective through the following actions:

a. Collaboration in the way of offering access to internal infrastructures to external researchers

48 test platforms from 17 European centers made available through 8 calls for proposals. Advertisement for the TNA call for proposals has been sent eight times to hundreds of PV scientists. These invitations provided a link to the website, which clearly indicates what the different platforms are and which partner can offer the various type of services. Hence, the awareness and European RI knowledge has significantly grown within the PV community.

68 research proposals have been submitted in total. Most of the proposants did not know the RI where they applied, before this TNA opportunity.

- 52 free access to research infrastructures granted ;
- 42 experimentations conducted.

As around 60 contacts have been initiated between various organisations (R&D center / university / industry), it can be expected that of these organisations will make a follow-up after the SOPHIA project in order to fulfill their needs for research in a contractual relationship.

b. Collaboration for increased know-how exchange, through training and networking activities:

- SOPHIA has proposed a better identification of the knowledge needs among partner organizations, than previously through targeted questionnaires, B2B interview, circular emails have been regularly distributed among consortium partners and non-SOPHIA interested scientists/researchers, professionals, students.
- 30 exchanges of scientists/researchers and students have sustained cross-border collaborations among organizations and individuals in knowledge sharing.
- The availability of top-class scientists ready to transfer knowledge, and the combination of scientific expertise with technological capabilities offered by SOPHIA 48 PV research infrastructure offered opportunities to attend workshops/ training courses and webinars on topics range from Si technology to OPV Organic Photovoltaics, TF Thin Film Technology, CPV Concentrated Photovoltaics, and they include Material and Cell Characterization and Modelling, Lifetime prediction and reliability, Module and System Performance: data base and procedures, BIPV & Smart Building Integrated Photovoltaics, architectures, Safety and Conversion
- 30 webinars in 16 different events has been proposed by SOPHi@Webinar the e-learning platform. Outstanding lectures covering topic on cSi, thin film, organic, advanced concepts photovoltaic technologies, BIPV, CPV etc. were offered to more than 830 participants widely represented by students and younger researchers/professionals with a more balanced participation by gender for both speakers and participants with respect to events usually held physical
- On line approach has also overcome the time-zone barrier with a very wide participation by country, covering also non-European countries (USA, Asia, South America, Australia, etc.)
- 18 workshop joined to 30 organized webinars assured access to around 1,100 participants to access to comprehensive information in utilizing the infrastructure/technique/scientific protocol with information on different technical/scientific aspects and vantage/disadvantage on the utilization of specific PV research infrastructure/techniques and research protocols.

c. Collaboration using common tools such as databases

In total, 11 common databases have been developed in the field of capabilities, measurements and modelling. These databases are accessible to the partners after the SOPHIA project. With respect to the lessons learned and conclusions from SOPHIA project in the field of databases, it can be seen that the data acquisition and administration are the most critical issues in this research work. In order to avoid any troubles and/or misunderstanding by working with large amounts of measured data, various points had to be controlled in the data processing phase: continuity of measured data, timestamp synchronization of measured data, anomaly detection (outlier/change/deviation detection), data cleaning, outliner analysis and sequence data. Despite its obvious disadvantages as an automated filtering tool, the other visual data plotting is needed in order to allow rapid site verification without having to go into great detail.

The purpose of the data-bases was to facilitate continuation of work based on the outcome of the activities carried out in the framework of the SOPHIA project. The impact of this continuation was much stronger than only the access of publications since the data-bases are directly (data can be used as they are) and immediately (without the usual delay caused by writing and reviewing articles) accessible. Furthermore these data serve as standard providing a unique starting point for all scientists in the European Research Infrastructure.

d. Collaboration in order to be more efficient in research activities

The Round Robin Testing carried out in different SOPHIA activities (Joint Research actions as well as Networking Activities) contributed to the harmonisation of the measurement and testing procedures used in the different laboratories. Furthermore the subsequent improvement to best practices strengthened the European Research Infrastructure for the international competition, which is becoming more and more challenging since the leading PV-markets and production capacities moved to America and Asia.

5 Round Robins have been carried out (in SI material, OPV, thin films and CPV).

Round Robin tests are an excellent base for the evaluation of standards. The scientific base of standards are mutual agreements of the best practice, the abundance of appropriate test equipment and well elaborated error ranges for the definition of test procedures and pass - fail criteria. Such an unique platform as a big EU-project brings together the best laboratries in the EU and allows big steps towards common test methods used as input to global standardisation. Some Round Robin exercises set up by SOPHIA showed a high attractivity for other partners worldwide (e.g. Taiwan, Korea, USA) reinforcing the global impact of the SOPHIA initiative. Round Robin tests are an excellent base for the evaluation of standards. The scientific base of standards are mutual agreements of the best practice, the abundance of appropriate test equipment and well elaborated error ranges for the definition of test procedures and pass - fail criteria. Such an unique platform as a big EU-project brings together the best laboratries in the EU and allows big steps towards common test methods used as input to global standardisation. Some Round Robin exercises set up by SOPHIA showed a high attractivity for other partners worldwide (e.g. Taiwan, Korea, USA) reinforcing the global impact of the SOPHIA initiative.

1.4.2 Dissemination and exploitation of results

In order to promote the SOPHIA Project and facilitate the dissemination of its outcomes, the following tools were put in place and activities carried out:

- Logo, templates, brochure, roll up banners
- Website
- Partners websites, newsletters, targeted emails
- Email Lists with industry and research contacts
- Dissemination during targeted and existing workshops (national or international) – Papers, oral presentations and posters
- Webinars
- Public events (interim event, a final workshop and a final Symposium on EU PV research Infrastructures)
- Press conference – articles on important PV magazines
- Press releases

Over the whole duration of the project, multiple dissemination activities have been carried out towards different stakeholders, in order to increase the outreach of the project and its foreground. The dissemination activities followed the *"Plan dissemination and promotion activities"*. The PV industry and the scientific community were acknowledged as first priority target group together with decision making bodies at national and European level.

Dissemination activities related to the website were considered of core importance and therefore this tool was used to the maximum possible. The website was populated with details of internal and external workshops (the latter including webinars and public events) under the framework of Networking Activities (NAs), promoted the public deliverables of the project but also the Transnational Access (TNA) which added another layer of visibility about the happenings of the project. Sophia website was further improved to become more interactive and appealing to the user.

Over the last 4 years various workshops were held, with the presentations made at several of them put on the project website, www.sophia-ri.eu. Papers were submitted to scientific journals and technical presentations of SOPHIA results were made at international conferences, including the European Photovoltaic Conference and Exhibition (EU PVSEC) and the Intersolar Europe.

Processes to improve information flow between the partners had bedded down, for example, partners updated a central 'Networking Activities database' which included details of their dissemination activities. A detail reporting is presented below.

Hence, a very challenging and ambitious target of the SOPHIA project was reached, which was to enlarge as much as possible the group of experts, researchers and any relevant stakeholders, share knowledge and results for the benefit of the PV Research and consequently the PV technology.

1.5 Consortium and contact information

Coordinator

M. Philippe MALBRANCHE, CEA-INES, philippe.malbranche@cea.fr

Partners

1. CEA-INES, Commissariat à l'énergie atomique et aux énergies alternatives, France
2. ISE IWES, Fraunhofer Gesellschaft zur Foerderung der angewandten forschung e.v, Germany
3. ECN, Stichting energieonderzoek Centrum Nederland, Netherlands
4. IMEC, Interuniversitair Micro-electronica Centrum VZW, Belgium
5. RISOE DTU, Danmarks Tekniske Universitet, Denmark
6. JRC, Joint Research Centre - European Commission, Belgium
7. HZB, Helmholtz-Zentrum Berlin fur materialien une energie GmbH, Germany
8. Jülich, Forschungszentrum Juelich GmbH, Germany
9. UPM, Universidad Politecnica de Madrid, Spain
10. ENEL, ENEL Ingegneria e Ricerca SPA, Italy
11. RSE, Ricerca sul Sistema energetico - RSE SPA, Italy
12. CREST, Loughborough University, United Kingdom
13. ENEA, Agencia Nazionale per le nuove technologi, l'energia e lo svilippo economico sostenibile, Italy
14. VTT, Teknologian Tutkimuskeskus VTT, Finalnd
15. SINTEF, Stiftelsen SINTEF, Norway
16. AIT, Austrian Institute of Technology GmbH, Austria
17. EPIA, European photovoltaic Industry Association, Belgium
18. EUREC, EUREC EESV, Belgium
19. TECHNALIA, Fundacion Technalia Research & Innovation, Spain
20. DERLAB, European Distributed Energy Ressources Laboratories e.V, Germany

Acknowledgements

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement N° 262533 SOPHIA.

2 Use and dissemination of foreground

2.1 Section A: Dissemination (Public)

2.1.1 List of scientific publications (A1) – Public

Template A1: List of project publications (peer reviewed publications), starting with the most important ones											
No	**WP**	**Title**	**Main authors**	**Title of the periodical or the series**	**Number, date or frequency**	**Publisher**	**Place of publication**	**Date of publication**	**Relevant pages**	**Permanent identifiers* (if available)**	**Is/Will open access** provided to this publication?**
1	10.1039/c3cp54635g	Electronic structure of positive and negative polarons in functionalized dithienylthiazolo-[5,4-d]thiazoles: a combined EPR and DFT study	Yun Ling, Sarah Van Mierloo, Alexander Schnegg, Matthias Fehr, Peter Adriaensens, Laurence Lutsen, Dirk Vanderzande, Wouter Maes, Etienne Goovaerts and Sabine Van Doorslaer,	Physical Chemistry Chemical Physics	Vol 16, Issue 21	Royal Society of Chemistry	United Kingdom	01/01/2014	10032		No

2	10.1016/j.renene.2013.09.034	Round Robin Performance Testing of Organic Photovoltaic Devices	Suren A. Gevorgyana, Oihana Zubillagab, José María Vega de Seoaneb, Maider Machadob, Elif Alturk Parlakc, Nesrin Torec, Eszter Voroshazid, Tom Aernoutsd, Harald Müllejanse, Giorgio Bardizzae, Nigel Taylore, Wiljan Verheesf, Jan M. Kroonf, Pasquale Morvillog, Carla Minarinig, Francesco Rocag, Fernando A. Castroh, Stéphane Crosi, Balthazar Lechênei, Juan F. Trigoj, Cecilia Guillénj, Jose Herreroj, Birger Zimmermannk, Subarna Babu Sapkotak, Clemens Veitk, Uli Würfelk, Pabitra S. Tuladharl, James R. Durrantl, Stefan Winterm	Renewable Energy	Vol 63	Elsevier BV	The Netherlands	01/03/2014	376-387		No

3	http://www.sciencedirect.com/science/article/pii/S0141391014002729	Interlaboratory indoor ageing of roll-to-roll and spin coated organic photovoltaic devices: Testing the ISOS tests	Suren A. Gevorgyan, PhD; Michael Corazza; Morten V Madsen; Giorgio Bardizza; Alberto Pozza; Harald Müllejans; James C Blakesley; George F Dibb; Fernando A Castro; Juan F Trigo; Cecilia M Guillén; Jose R Herrero; Pasquale Morvillo; Maria G Maglione; Carla Minarini; Francesco Roca; Stéphane Cros; Caroline Seraine; Chun H Law; Pabitra S Tuladhar; James R Durrant; Frederik C Krebs	Polymer Degradation and Stability	Vol 109	Elsevier BV	United Kingdom	01/11/2014	162-170		No
4	10.1016/j.solener.2014.02.021	Genetic programming for photovoltaic plant output forecasting Solar Energy	M. Russoa, G. Leottab, P.M. Pugliattib, G. Gigliuccic	Solar Energy	Vol 105	Elsevier	United Kingdom	01/07/2014	264-273		No
5	10.1002/pip.2436	A new 2D model for the electrical potential in a cell stripe in thin-film solar modules including local defects	Bart E. Pieters and Uwe Rau	Progress in Photovoltaics : Research and Applications	Volume 23, Issue 3	Wiley Online Library	United Kingdom	01/03/2015	331-339		No
6	http://dx.doi.org/10.1016/j.solmat.2014.07.045	Challenges for photovoltaic silicon materials	Gianluca Coletti , Ivan Gordon , Martin C. Schubert , Wilhelm Warta , Eivind Johannes	Solar Energy Materials and Solar	Vol 130	Elsevier BV	The Netherlands	01/11/2014	629-633		No

			Ovrelid , Anis Jouini , Mario Tucci , Giampiero de Cesare	Cells							
7	http://dx.doi.org/10.1016/j.solmat.2014.07.021	Worldwide outdoor round robin study of organic photovoltaic devices and modules and modules	Morten V. Madsen , Suren A. Gevorgyan , R. Pacios , J. Ajuria , I. Etxebarria , Jeff Kettle , Noel D. Bristow , Marios Neophytou , Stelios A. Choulis , Lucimara Stolz Roman , Teketel Yohannes , Andrea Cester , Pei Cheng , Xiaowei Zhan , Jiang Wu , Zhiyuan Xie , Wei-Chen Tu , Jr-Hau He , Christopher J Fell , Kenrick Anderson , Martin Hermenau , Davide Bartesaghi , L. Jan Anton Koster	Solar Energy Materials and Solar Cells	Vol 130	Elsevier	The Netherlands	01/11/2014	281-290		No
8	NA	Measurement and comparison of models of temperature variations in Si-Het and CIGS mini modules	I.R. Cole, B. Kubicek, B. Pieters, R. Varache, F. Frederich, C. Kaufmann	Work in progress. Journal to be decided	NA	NA	NA	NA	NA		NA
9	NA	Standardised interface library for I-V based simulation tools	B. Pieters, I.R. Cole, T. Betts, B. Kubicek, M. Goerig	Work in progress. Journal to be decided	NA	NA	NA	NA	NA		NA

* A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).

** Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

Template A1: List of project publications (project paper in proceedings of a conference/workshop)

No	DOI	Title	Author(s)	Proceedings	Date of publication	Start date of Conference / Workshop	End date of Conference / Workshop	Publisher	Publisher location	ISBN	URL	Relevant pages	Is/Will open access** provided to this publication?
1	10.4229/27thEUPVSEC2012-5AV.2.42	Numerical analysis of the impact of environmental conditions on the BIPV systems, an Overview of BIPV Modelling in Sophia Project	Y.B. Assoa, W. Sprenger, M. Misara, F. Roca, L. Mongibello, B. Kubicek, M. Wagner, S. Zamini, J. Merten, A.J. Carr, M. Machado	27th European Photovoltaic Solar Energy Conference and Exhibition	28/09/2012	24/09/2012	28/09/2012	WIP	München, Germany	3-936338-28-0	NA	4143-4149	No
2	10.4229/27thEUPVSEC2012-3CV.1.56	2D - Finite element model of a cigs module	G.J.M. Janssen, L.H. Slooff, E.E. Bende	27th European Photovoltaic Solar Energy Conference and Exhibition	28/09/2012	24/09/2012	28/09/2012	WIP	München, Germany	3-936338-28-0	NA	2368-2371	No
3	10.4229/28thEUP	Round Robins Of Solar Cells To Evaluate	P. Manshanden, N.J.C.M. van der	28th European	30/09/201	30/09/2013	04/10/2013	WIP	München,	3-936338-	NA	861-	No

	VSEC2013-2BO.4.2	Measurement Systems Of Different European Research Institutes	Borg, M. Bliss, B. Mihaylov, R. Gottschalg, M. Izzi, M. Tucci, F. Roca, M. Pellegrino, A. Romano, G. Graditi, J. Hohl-Ebinger, W. Warta, M. Debucquoy, O. El Daif, I. Gordon, J. Champliaud, A. Jouini, J. Glatz-Reichenbach, K. Bothe, A. Herguth	Photovoltaic Solar Energy Conference and Exhibition	3				Germany	33-7		866	
4	NA	Thermal and electrical analysis of BIPV systems in the Sophia Project	Y.B. Assoa, W. Sprenger, M. Misara, F. Roca, L. Mongibello, B. Kubicek, M. Wagner, S. Zamini, J. Merten, A.J. Carr, M. Machado	29th European Photovoltaic Solar Energy Conference and Exhibition	26/09/2014	22/09/2014	26/09/2014	WIP	München, Germany	3-936338-34-5	NA	NA	No
5	10.4229/27thEUPVSEC2012-4CO.12.5	Harmonised Procedures on Photovoltaic Modules Long-Term Energy Yield Measurements and Performance Evaluation under Outdoor Conditions	D. Craciun, V. Helmbrecht, S. Tselepis, A. Kyritsis, N. Hatziargyriou, K. Latoufis, S. Misara, P. Funtan, P. Strauß, A. Ellis, R. Bründlinger	27th European Photovoltaic cSolar Energy Conference and Exhibition	28/09/2012	24/09/2012	28/09/2012	WIP	Frankfurt, Germany	3-936338-28-0	NA	3074-3081	No
6	NA	Changes of solar cell parameters during damp-	J. Zhu, R. Gottschalg, M. Koehl, S. Hoffmann, K.A.	WPEC, The 6th World Conference	09/02/2015	23/11/2014	27/11/2014	WCPEC-6 Registration Secretariatc/	Umeda Daibiru 4F, 3-3-10,		wcpec6.com	7WePo.10.5	No

		heat exposure	Berger, S. Zamini, I.J. Bennett, E. Gerritsen, P. Malbranche, P. Pugliatti, A. Di Stefano, F. Aleo, D. Bertani, F. Paletta, F. Roca, G. Graditi, M. Pellegrino, O. Zubillaga, P. Cano, A. Pozza and T. Sample	on Photovoltaic Energy Conversion, Kyoto (Japón), November 2014				o JTB Communications, Inc.	Umeda, Kita-ku				
7	NA	Comparative Assessment of Module Productivity Models	T.Betts, N.Dekker, R. Emmerich, R.Gottschalg, J. Merten*, S. Misara, Paola Pugliatti, G. Razongles, F.Roca, B.Ya Assoa, S. Zamini	EU PVSEC 2014 29th European Photovoltaic Solar Energy Conference and Exhibition	26/09/2014	22/09/2014	26/09/2014	WIP	NA	NA	NA	NA	No
8	NA	IEA PVPS Task13 & EU FP7 SOPHIA - Performance & Reliability of PV Systems: Life time estimation of PV-Modules	K.A. Berger, Austrian Institute of Technology, Energy Department (AIT), Austria	12th Austrian PV Conference, Linz, Austria, Nov. 5th, 2014 (oral, invited, in German)	05/11/2014	03/11/2014	05/11/2014	Photovoltaic Austria Federal Association	Bundesverband PHOTOVOLTAIC AUSTRIA Neustiftgasse 115A/19 1070 Wien		http://www.pvaustria.at/wp-content/uploads/2013/07/2014-PV-Tagung-Fotonachschau-Programm.pdf		No
9		Predicting PV module	Jiang Zhu, Ralph Gottschalg, Louisa	Reliability of	24/09/201	22/09/2014	24/09/2013	SPIE	NA	NA	http://proceedings.spi	882503	No

	10.1117/12.2027754	service life	Kropp, Michael Koehl, Stephan Hoffmann, Karl-Anders Weiss, Karl A. Berger, Shokufeh Zamini, Ian Bennett, Eric Gerritsen, Philippe Malbranche, Lionel Sicot, Paolamaria Pugliatti, Francesco Aleo, Fabrizio Paletta, Franco Roca, Giorgio Fraditi, Michele Pellegrino, Oihana Zubilaga Alcorta, Paco Cano, Stathis Tselepis, Alberto Pozza, Tony Sample	Photovoltaic Cells, Modules, Components, and Systems VI	3						edigitallibrary.org/proceeding.aspx?doi=10.1117/12.2027754		
10	NA	Uncertainties in Energy Yield Estimation due to Module Characterisation Uncertainty As Borne Out By the Sophia c-Si Module Inter-Comparison	B. Mihaylov, J.W. Bowers, T.R. Betts, R. Gottschalg, T. Krametz, R. Leidl, K.A. Berger, S. Zamini, N. Dekker, G. Graditi, F. Roca, M. Pellegrino, G. Flaminio, P.M. Pugliatti, A. Di Stefano, F. Aleo, G. Gigliucci, W. Ferrara, G. Razongles, J. Merten, A. Pozza, A.A. Santamaría	WPEC, The 6th World Conference on Photovoltaic Energy Conversion, Kyoto (Japón), November 2014	09/02/2015	23/11/2014	27/11/2014	WCPEC-6 Registration Secretariat c/o JTB Communications, Inc.	Umeda Daibiru 4F, 3-3-10, Umeda, Kita-ku Osaka City, 530-0001 Japan		wcpec6.com	J3WeO.9.2	No

			Lancia, S. Hoffmann, M. Koehl, A. Gerber, J. Noll, F. Paletta, G. Friesen and S. Dittmann										
11	NA	Investigation of thermo-mechanical stresses on PV modules: A collaborative research within the European photovoltaic infrastructure research project SOPHIA	K.A. Berger, B. Kubicek, G. Újvári, R. Leidl, T. Krametz, S. Zamini, S. Hoffmann, M. Koehl, A. Pozza, T. Sample, D. Bertani, F. Paletta, I.J. Bennett, E. Gerritsen, P. Malbranche, J. Zhu, R. Gottschalg, P. Pugliatti, A. Di Stefano, F. Aleo, F. Roca, G. Graditi, M. Pellegrino, O. Zubillaga and P. Cano	WPEC, The 6th World Conference on Photovoltaic Energy Conversion, Kyoto (Japón), November 2014	09/02/2015	23/11/2014	27/11/2014	WCPEC-6 Registration Secretariat c/o JTB Communications, Inc.	Umeda Daibiru 4F, 3-3-10, Umeda, Kita-ku Osaka City, 530-0001 Japan		wcpec6.com	7Th O.3.3	No
12	10.4229/28thEUPVSEC2013-4AV.6.27	PV Roof Integrated Systems vs. Best- and Worst-Cases: Novel Measurement for Long-Term- Outdoor Measurement of PV Roof-Top Integrated Systems (Electrical, Thermal and MEchanical Behaviors)	Julian Firges, Peter Funtan, Norbert Henze, Maria Roos, Siwanand Misara	EU PVSEC 2013, 28th European PV Solar energy Conference an dexhibiton, Sept. 2013, Paris	04/10/2013	30/09/2013	04/10/2013	WIP	Paris, France	3-936338-33-7	NA	34445-3451	No

13	NA	Results from SOPHIA combined Stress testing. SOPHIA JRA01 WP9: Quicker lifetime prediction (Ageing tests and failure analysis)	K.A. Berger, Austrian Institute of Technology, Energy Department (AIT), Austria	SOPHIA WS PV Module Reliability, Freiburg, June 3rd, 2014 (oral, invited)	27/06/2014	03/06/2014	04/06/2014	Fraunhofer Institute for Solar Energy Systems ISE	Heidenhofstr. 2 79110 Freiburg Germany	-	http://www.pv-reliability.com/pv-module-reliability-workshop-2014	Block 4a	No
14	10.4229/EUPVSEC20142014-7AV.6.42	Strategic vision on Pv Research Infrastructure in Europe	Jan M.Kroon, Maarten de Bruijne, Ian Bennett (ECN), Greg Arrowsmith (EUREC), Philippe Malbranche, Jens Merten, Brigitte Ya-Assoa (CEA/INES), Nigel Taylor (JRC), Suren Georgyvan (DTU), Iver Lauermann (HZB), Jurgen Huepkes, Yael Augarten (FZ Jülich), Gerald Siefer, Michael Köhl, Wilhelm Warta (ISE), Franco Roca (ENEA), Ioannis-Thomas Theologitis (EPIA)	EU PVSEC 2014 29th European Photovoltaic Solar Energy Conference and Exhibition	26/09/2014	22/09/2014	26/09/2014	NA	NA	NA	NA	NA	No
15	10.4229/29thEUPVSEC2014-7AV6.42	PV Module Lifetime Prediction and Quality Assurance as addressed by SOPHIA	I.J. Bennett (ECN), J. Zhu, R. Gottschalg (CREST), M. Koehl , S. Hoffmann (ISE), K. A. Berger, S. Zamini (AIT), E. Gerritsen, P.	EU PVSEC 2014 29th European Photovoltaic Solar Energy	26/09/2014	22/09/2014	26/09/2014	NA	NA	3-936338-34-5	NA	NA	No

			Malbranche (CEA INES), P. Pugliatti , A. Di Stefano , F. Aleo (ENEL) , D. Bertani , F. Paletta (RSE), F. Roca (ENEA), G. Graditi7, M. Pellegrino7, O. Zubillaga , P. Cano (Tecnalia) , A. Pozza , T. Sample (JRC)	Conference and Exhibition									
16	10.4229/EUPVSEC20142014-7AV.6.61	SOPHIaWebinar the advanced e-learning platform of the Photovoltaic European Research Infrastructure 7FP-SOPHIA Project	Francesco Roca*,Luigi Pavia,David Casaburi, Giuseppe Cipolletta; Sonia Pirozzi, Anna Vita; Francesco Beone, Maurizio Steffé (ENEA) Y. Augarten Jürgen Hüpkes (FZ-Jülich) Iver Lauermann (HZB) , Ian Bennett, Maarten de Bruijne, Jan Kroon (ECN) Suren Gevorgyan (DTU) , Siwanand Misara (FH-IWES), Tanja Pettersen (SINTEF) ; Nigel Taylor (JRC), Michael Koehl,Martin Schubert , Gerald	EU PVSEC 2014 29th European Photovoltaic Solar Energy Conference and Exhibition	26/09/2014	22/09/2014	26/09/2014	NA	NA	3-936338-34-5	NA	NA	No

			Siefer (FH-ISE), Brigitte Ya Assoa, Fabien Bergeron, Jens Merten,Philippe Malbranche (CEA-INES)										
17	10.4229/EUPVSEC20142014-5DO.9.3	Results of the Sophia Module Intercomparison Part-1: Stc, Low Irradaince Conditions and Temperature Coefficients Measurements of C-Si Technologies	B. Mihaylov, J.W. Bowers, T.R. Betts, R. Gottschalg, T. Krametz, R. Leidl, K.A. Berger, S. Zamini, N.J.J. Dekker, G. Graditi, F. Roca, M. Pellegrino, G. Flaminio, P.M. Pugliatti, A.G.F. Di Stefano, F. Aleo, G. Gigliucci, W. Ferrara, G. Razongles, J. Merten, A. Pozza, A. Santamaria Lancia, S. Hoffmann, M. Köhl, A. Gerber, J. Noll, F. Paletta, G. Friesen, S. Dittmann	29th European Photovoltaic Solar Energy Conference and Exhibition	26/09/2014	22/09/2014	26/09/2014	NA	NA	3-936338-34-5	NA	2443 - 2448	No
18	NA	Novel insights into the structural and electrical properties of metastable defects in hydrogenated amorphous silicon.	Melskens, Jimmy; Baldansuren, Amgalanbaatar; Schnegg, Alexander; Lips, Klaus; Plokker, Maarten; Eijt, Stephan; Schut, Henk; Fischer, Marinus; Zeman,	The International Workshop on Positron Studies of Defects 2014 (PSD-14) Kyoto,	19/09/2014	14/09/2014	19/09/2014	NA	NA	NA	NA	NA	No

			Miro; Smets, Arno	Japan									
19	NA	Novel insights into the structural and electrical properties of metastable defects in hydrogenated amorphous silicon	Melskens, Jimmy; Baldansuren, Amgalanbaatar; Schnegg, Alexander; Lips, Klaus; Plokker, Maarten; Eijt, Stephan; Schut, Henk; Fischer, Marinus; Zeman, Miro; Smets, Arno	29th EU PVSEC Amsterdam, Netherlands	25/09/2014	23/09/2014	25/09/2014	WIP	München, Germany	3-936338-28-0	NA	NA	No
20	NA	Temperature effects on two stage optics made of silicone	M. Victoria, S. Askins, I. Antón, G. Sala, G. Duggan	CPV-10 Conference	01/11/2014	07/04/2014	09/04/2014	AIP	Melville, NY	NA	www.aip.org	NA	Yes
21	NA	Ultra-violet radiation testing of PV-modules and components	Michael Köhl	Conference presentation	21/10/2014	21/10/2014	22/10/2014	NA	NA	NA	NA	NA	No
22	NA	Ultra-violet readiation resting of PV-modules and components	Michael Köhl	Atlas / CEI Asia Solar Energy Durability Conference	19/11/2014	19/11/2014	23/11/2014	NA	NA	NA	NA	NA	No
23	NA	Ultra-violet radiation testing of various back-sheets for PV-modules	Michael Köhl, Amal Ballion	6th World Conference on Photovoltaic Energy Conversion	23/11/2014	23/11/2014	27/11/2014	NA	NA	NA	NA	NA	No
24	NA	Round Robin testing of various back-sheets for	Michael Köhl, Amal Ballion, Yu-Hsien	EUPVSEC	15/02/201	14/09/2015	18/09/2015	NA	NA	NA	NA	NA	No

		PV-modules with different ultra-violet radiation sources and sample temperatures	Lee, Hung-Sen Wu, Kurt Scott, Stephen Glick, Peter Hacke, Hyun Jin Koo	2015	5								
25	NA	Ultra-violet radiation Round Robin testing of various back-sheets for PV-modules	Michael Köhl, Amal Ballion. Yu-Hsien Lee, Hung-Sen Wu, Kurt Scott, Stephen Glick, Peter Hacke	42nd IEEE PVSC	30/01/2015	14/06/2015	19/06/2015	NA	NA	NA	NA	NA	No
26	10.4229/28thEUPVSEC2013-5BV.4.32	Along the Value Chain: from Materials to System Performance	Y. Augarten, W. Sprenger, B.E. Pieters, R. Varache, O. Bakaeva, G.J.M. Janssen, Y. Guanchao, F. Friedrich, M. Schmid, M. Celino, J. Hüpkes	EU PVSEC 2014 29th European Photovoltaic Solar Energy Conference and Exhibition	25/09/2014	23/09/2014	25/09/2014	WIP	München, Germany	3-936338-28-0	http://www.photovoltaic-conference.com/conference/conference-proceedings.html	NA	Yes, for 6 months after the publication
27	10.4229/28thEUPVSEC2013-5BV.4.32	Modeling Infrastructure Along the Value Chain: from Materials to System Performance	Y. Augarten, W. Sprenger, B. Pieters, R. Varache, O. Bakaeva, G. Janssen, Y. Guanchao, F. Friedrich, M.Schmid, M. Celino, J. Hüpkes	EU PVSEC 2013 28th European Photovoltaic Solar Energy Conference and Exhibition	03/09/2013	03/09/2013	04/09/2013	WIP	Paris, France	3-936338-33-7	https://www.eupvsec-proceedings.com/	3949 - 3952	No
28	10.1063/1.4753853	Intercomparison Of Spectroradiometers For Solar Spectral Irradiance Measurements.	R. Galleano & W. Zaaiman (JRC), P. Morabito & A. Minuto (RSE),	8th International Conference	01/01/2012	16/04/2012	18/04/2012	American Institute of Physics (AIP)	Melville, NY	978-0-7354-1086-2	http://proceedings.aip.org/resource/2/apcpc	139-142	No

		Preliminary Results.	A. Spena & S. Bartocci(University of Tor Vergata, Rome), R. Fucci & G. Leanza (ENEA), D. Pavanello & A. Virtuani (SUPSI-ISAAC), D. Fasanaro & M. Catena(ENEL), M. Norton(University of Cyprus)	on Concentrating Photovoltaic Systems - AIPConf. Proc. 1477							s/1477/1/139_1		
29	10.4229/EUPVSEC20142014-4CO.13.2	SOPHIA CPV Module Round Robin: Power Rating at Csoc	M. Steiner & G. Siefer (Fraunhofer ISE), M. Baudrit & C. Dominguez (CEA), I. Anton (UPM), F. Roca (ENEA), P. M. Pugliatti & A. G. F. Di Stefano (ENEL), R. P. kenny (JRC), P. Morabito (RSE), E. Roman (TECNALIA), M. Muller (NREL)	29th European Photovoltaic Solar Energy Conference and Exhibition	24/09/2014	22/09/2014	26/09/2014	NA	Amsterdam, The Netherlands	3-936338-34-5	http://publications.jrc.ec.europa.eu/repository/handle/JRC67208	NA	No
30	10.4229/EUPVSEC20142014-4CO.13.2	Evaluation of the SOPHIA CPV Module Round Robin Power Rating at CSOC	G. Siefer & M. Steiner (Fraunhofer ISE) , M. Baudrit & C. Dominguez (CEA), I. Antón (UPM), F. Roca & R. Fucci (ENEA), P.M. Pugliatti & A. Di Stefano (ENEL E&R), R. Kenny & M. Norton (JRC ESTI), A.	CPV-11 11th International Conference on Concentrator Photovoltaics	13/04/2015	13/04/2015	15/04/2015	NA	Aix-les-Bains, France	3-936338-34-5	NA	NA	No

			Minuto & P. Morabito (RSE), M. Muller (NREL)										
31	NA	Spectral network based on component cells under SOPHIA European project	R. Nùnez, I. Antón, S. Askins & G. Sala (UPM), C. Dominguez & P. Voarino (CEA), M. Steiner & G. Siefer (Fraunhofer ISE) , R. Fucci & F. Roca (ENEA), A. Minuto & P. Morabito (RSE)	CPV-11 11th International Conference on Concentrator Photovoltaics	13/04/2015	13/04/2015	15/04/2015	NA	Aix-les-Bains, France	NA	NA	NA	No
32	NA	Density Functional Tight Binding modeling of amorphous silicon and related materials.	Massimo Celino (ENEA), Gabriele Penazzi, Thomas Frauenheim (Bremen University)	EUPVSEC-2015 31st European Photovoltaic Conference and Exhibition	18/09/2015	14/09/2015	18/09/2015	NA	Hamburg, Germany	NA	NA	NA	No
33	NA	Electronic Structure and Optical Properties of Doped Rutile TiO2	Massimo Celino, Simone Giusepponi (ENEA) , Radojka Vujasin , Jasmina Grbović Novaković , Nikola Novaković (VINČA Institute of Nuclear Sciences, Serbia)	EUPVSEC-2015 30th European Photovoltaic Conference and Exhibition	18/09/2015	14/09/2015	18/09/2015	NA	Hamburg, Germany	NA	NA	NA	No
34	NA	SOPHi@webinar, the e-learning platform of the	Francesco Roca , David Casaburi,	EUPVSEC-2015 30th	18/09/201	14/09/2015	18/09/2015	NA	Hamburg,	NA	NA	NA	NA

		FP7-SOPHIA Project: obtained results and perspective for its future exploitation	Giuseppe Cipolletta, Luigi Pavia, Francesco Beone, Giorgio Mencuccini, Anna Vita (ENEA) Iver Lauermann (HZB), Ignacio Antón Hernández(UPM), Brigitte Ya Assoa(CEA), Fabien Bergeron(CEA), Suren Gevorgyan(DTU) , Jürgen Hüpkes (FZ-Juelich), Michael Koehl (FhG-ISE), Jan Kroon(ECN), Jens Merten(CEA), Tanja Pettersen(SINTEF) , Martin Schubert(FhG-ISE) , Gerald Siefer(FhG-ISE), Ioannis-Thomas Theologitis(EPIA), Philippe Malbranche (CEA)	European Photovoltaic Conference and Exhibition	5				Germany				

** Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

2.1.2 List of dissemination actions (A2) - Public

Template A2: List of dissemination activities								
No	**Type of activities***	**Main leader**	**Title/ Subject/ Reference**	**Actual/ planned date or status**	**Place**	**Type of audience****	**Size of audience**	**Countries addressed**
1	Press releases	DERlab	Article on Modelling Workshop in DERlab Activity Report 2012/2013: Verifying the Models for PV Performance	01/04/2013	Kassel, Germany	Scientific Community (higher education, Research), Industry	15000	World
2	Web sites/Aplications	DERlab	Application deadline for PV Research Projects within SOPHIA	31/03/2014	www.der-lab.net	Scientific Community (higher education, Research)	1500	World
3	Organisation of Workshops	DERlab	Uncertainty Estimations of PV Outdoor Measurements (Helmbrecht, DERLAB, H. Müllejans , JRC Sprenger FH-ISE, R. J. Kirchhof FH-IWES Gottschalg. CREST) Registered participant SOPHIA 26/NONSOPHIA 33 + 10 SOPHIA/ 31 NON SOPHIA in streaming	14/06/2013	Sophiawebinar (hosted by ENEA)	Scientific Community (higher education, Research)	100	World
4	Organisation of Workshops	CEA-INES	BIPV Workshop - What are the requirements of PV in buildings?	29/08/2013	Le Bourget du Lac, France	Scientific Community (higher education, Research), Industry	43	European countries and Australia
5	Organisation of Workshops	EPIA	SOPHIA information desk at the EPIA Workshop 'From PV Quality and Bankability'	19/06/2013	Munich, Germany	Scientific Community (higher education, Research), Industry, Civil	150	World

						Society		
6	Organisation of Workshops	EPIA	Interim workshop : Coordinated European R&D- Keystone for the reinforcement of the PV ndustry	20/06/2013	Munich, Germany	Scientific Community (higher education, Research), Industry, Civil Society	74	European countries
7	Organisation of Workshops	CEA-INES	Workshop on PV performance modelling	21/02/2013	Chambéry, France	Scientific Community (higher education, Research)	30	World
8	Organisation of Workshops	Jülich	PV Modelling infrastructure: The modeling chain	12/10/2011	Berlin, Germany	Scientific Community (higher education, Research)	30	World
9	Organisation of Workshops	HZB	Workshop on Innovative Thin Film Device Structures	10/10/2011	Berlin, Germany	Scientific Community (higher education, Research)	25	European countries
10	Organisation of Workshops	Jülich	Euro-Regional workshop on Characterization and Modeling	16/09/2013	Monschau, Germany	Scientific Community (higher education, Research)	17	World
11	Posters	Jülich	Modeling Infrastructure Along the Value Chain: from Materials to System Performance	30/09/2013	Paris, France	Scientific Community (higher education, Research), Industry, Civil Society	1000	World
12	Oral presentation to a scientific event	EUREC	Presentation of SOPHIA project to PV specialisation EUREC Masters students	02/05/2012	Newcastle, UK	Scientific Community (higher education, Research)	50	UK
13	Organisation of Workshops	DTU	OPV Workshop (organizers P.Sommers (DTU), F.Roca (ENEA))	01/11/2011	Portici, Italy	Scientific Community (higher education, Research)	46	European Community, Italy (local participants)

14	Organisation of Workshops	CEA-INES	SOPHIA project 2nd Workshop on BIPV	15/09/2014	Le Bourget du lac, France	Scientific Community (higher education, Research), Industry, Civil Society	100	Europe, USA, Japan
15	Organisation of Workshops	HZB	International Summer University ISUenergy 2011	21/08/2011	Falera, Switzerland	Scientific Community (higher education, Research), Industry	63	World
16	Organisation of Workshops	HZB	International Summer University ISUenergy 2012	19/08/2012	Falera, Switzerland	Scientific Community (higher education, Research), Industry	62	World
17	Organisation of Workshops	HZB	International Summer University ISUenergy 2013	25/08/2013	Falera, Switzerland	Scientific Community (higher education, Research), Industry	52	World
18	Organisation of Workshops	HZB	International Summer University ISUenergy 2014	24/08/2014	Falera, Switzerland	Scientific Community (higher education, Research), Industry	54	World
19	Organisation of Workshops	ECN	Challenges for Photovoltaic Silicon Materials	07/10/2013	Rome, Italy	Scientific Community (higher education, Research), Industry	150	Europe
20	Organisation of Conference	HZB	6th Thin-Film Week "Lecture Preconditioning of thin-film modules“	01/04/2014	Berlin, Germany	Scientific Community (higher education, Research), Industry	150	World
21	Web sites/Applications	EPIA	News to announce 1st TNA call (mailings + EPIA SOLARIS newsletter)	01/12/2011	http://www.epia.org/home/	Scientific Community (higher education, Research), Industry	15000	World
22	Web sites/Applications	EPIA	News to announce 2nd TNA call (mailings + EPIA SOLARIS newsletter)	01/06/2012	http://www.epia.org/home/	Scientific Community (higher education, Research), Industry	15000	World

23	Web sites/Applications	EPIA	News to announce 3rd TNA call (mailings + EPIA SOLARIS newsletter)	01/10/2012	http://www.epia.org/home/	Scientific Community (higher education, Research), Industry	15000	World
24	Web sites/Applications	EPIA	News to announce 4th TNA call (mailings + EPIA SOLARIS newsletter)	01/01/2013	http://www.epia.org/home/	Scientific Community (higher education, Research), Industry	15000	World
25	Web sites/Applications	EPIA	News to announce 5th TNA call (mailings + EPIA SOLARIS newsletter)	01/03/2013	http://www.epia.org/home/	Scientific Community (higher education, Research), Industry	15000	World
26	Web sites/Applications	EUREC	Mailing to announce 6th TNA call	07/10/2013	Online, (Brussels)	Scientific Community (higher education, Research), Industry	15000	World
27	Web sites/Applications	EPIA	News to announce 7th TNA call (mailings + EPIA SOLARIS newsletter)	01/02/2014	http://www.epia.org/home/	Scientific Community (higher education, Research), Industry	15000	World
28	Posters	EPIA	PV Global Industry Outlook; PV Global Technology Trends: Identifying Technological and Economic Drivers	30/09/2013	Paris, France	Scientific Community (higher education, Research), Industry	2000	World
29	Oral presentation to a scientific event	Jülich	Exchange of researchers between HZB and Jülich - Modelling of solar cells	02/12/2013	Juelich, Germany	Scientific Community (higher education, Research)	4	European community
30	Oral presentation to a scientific event	CEA-INES	Exchange of researchers between CEA and Jülich - Expert knowledge Exchange	27/03/2014	CEA, Le Bourget du Lac, France	Scientific Community (higher education, Research)	4	European community
31	Oral presentation	Jülich	Exchange of researchers between ENEA and Jülich - Expert knowledge	26/03/2014	Portici, Italy	Scientific Community (higher education,	40	European community

	to a scientific event		Exchange, Thin film			Research)		
32	Web sites/Aplications	DERlab	SOPHIA Transnational access call	01/12/2011	http://der-lab.net/	Scientific Community (higher education, Research), Industry	5000	World
33	Oral presentation to a scientific event	DERlab	To ISGAN/ENARD workshop to smart grid community	01/01/2012	ISGAN/ENARD workshop, Washingon, USA	Scientific Community (higher education, Research), Industry	100	World
34	Oral presentation to a scientific event	ISE-IWES	SOPHIA CPV Module Round Robin: Power Rating at CSOC	01/04/2014	Albuquerque, USA	Scientific Community (higher education, Research), Industry	250	World
35	Oral presentation to a scientific event	ISE-IWES	SOPHIA CPV module round robin to IEC TC82 WG7 via webex	25/09/2013	San Jose, USA	Scientific Community (higher education, Research), Industry	30	World
36	Oral presentation to a scientific event	AIT	Exchange of personnel between AIT and EUREC - Short term metastable effect in amorphous silicon solar modules	10/12/2012	Vienna, Austria	Scientific Community (higher education, Research)	10	European community
37	Oral presentation to a scientific event	Jülich	Exchange of researchers between CEA and Jülich - Thin film	07/07/2014	Le Bourget du Lac, France	Scientific Community (higher education, Research)	5	European community
38	Oral presentation to a scientific event	Jülich	Exchange of researchers between CREST and Jülich - Modelling	01/07/2014	Loughborough, UK	Scientific Community (higher education, Research)	4	European community

39	Organisation of Workshops	ISE-IWES	2nd Sophia Workshop on PV-Module Reliability	03/05/2012	Lago die Lugano, Switzerland	Scientific Community (higher education, Research), Industry	100	World
40	Organisation of Workshops	ISE-IWES	3rd Sophia Workshop on PV-Module Reliability	06/05/2013	Chambéry, France	Scientific Community (higher education, Research), Industry	100	World
41	Organisation of Workshops	ISE-IWES	4th Sophia Workshop on PV-Module Reliability	03/06/2014	Freiburg, Germany	Scientific Community (higher education, Research), Industry	75	World
42	Organisation of Workshops	HZB	Workshop on analytical tools for PV	29/10/2012	Berlin, Germany	Scientific Community (higher education, Research)	15	World
43	Organisation of Workshops	HZB	Second workshop on analytical tools for PV	25/06/2014	Berlin, Germany	Scientific Community (higher education, Research)	20	World
44	Web sites/Applications	DTU	Dissemination of TNA 7th call on local website	20/03/2014	plasticphotovoltaics.rog, Denmark	Scientific Community (higher education, Research), Industry	20000	World
45	Web sites/Applications	ENEA	News to announce 7th TNA call	01/02/2014	Mailing list and phone calls	Scientific Community (higher education, Research), Industry	5000	World
46	Web sites/Applications	ENEA	Realization and developement of SOPHi@webinar web site e-learning platformand (access to video and ppt Oral presentation to a scientific event of speakers)	10/06/2014	Mails list, B2B interaction and phone call	Scientific Community (higher education, Research), Industry	600	World
47	Organisation of	JRC	4th International Spectroradiometer and Broadband Intercomparison	19/05/2014	Torrejón de Ardoz, Spain	Scientific Community (higher education,	16	Europe & Japan

	Workshops					Research)		
48	Organisation of Workshops	ENEA	Sophiawebinar: Application of focussed ion beam in advanced photovoltaics. Speakers V. la Ferrara, G. Nenna (ENEA)	26/03/2013	Sophiawebinar (hosted by ENEA)	Scientific Community (higher education, Research)	25	Europe
49	Organisation of Workshops	Jülich	Sophiawebinar:Transparent ZnO contacts for silicon thin film solar cells . Speaker Jürgen Hüpkes; FZ Jülich	18/06/2013	Sophiawebinar (hosted by ENEA)	Scientific Community (higher education, Research)	62	World
50	Organisation of Workshops	IMEC	Sophiawebinar:From nanoscale to gigawatt. Ounsi El Daif, IMEC-PV	24/06/2013	Sophiawebinar (hosted by ENEA)	Scientific Community (higher education, Research)	41	World
51	Organisation of Workshops	SINTEF	SophiaWebinar: Defects in Crystalline and multi-crystalline Silicon Solar Cells Speakers G.Coletti,ECN G.Stokkan, SINTEF, M.Schubert,FH-ISE	05/07/2013	Sophiawebinar (hosted by ENEA)	Scientific Community (higher education, Research), Industry	62	World
52	Organisation of Workshops	CEA-INES	SophiaWebinar: Advanced Module characterisation based on I/V measurements	15/11/2013	Sophiawebinar (hosted by ENEA)	Scientific Community (higher education, Research), Industry	64	World
53	Oral presentation to a scientific event	Jülich	Jülich TCO Group leader offered a seminary (on site) ion Transparent ZnO contacts for silicon thin film solar cells to a local audience of researchers/ students	26/03/2014	Portici, Italy	Scientific Community (higher education, Research)	40	Italy
54	Organisation of Workshops	ECN	Interactive training course on EL & DLIT characterisation of PV modules	26/06/2013	Petten, The Netherlands	Scientific Community (higher education, Research), Industry	15	European community

55	Organisation of Workshops	SINTEF	Short on line course on "Crystallization of Silicon"	13/11/2014	Sophiawebinar (hosted by ENEA)	Scientific Community (higher education, Research)	71	World
56	Organisation of Workshops	CEA-INES	Different BIPV perspectives (part I)	12/01/2015	On line,Sophiawebinar (host ENEA)	Scientific Community (higher education, Research), Industry	62	World
57	Organisation of Workshops	ENEA	Different BIPV perspectives (part II)	29/01/2015	On line,Sophiawebinar (host ENEA)	Scientific Community (higher education, Research), Industry	80	World
58	Organisation of Workshops	ENEA	Short course on CPV-Concentrated Photovoltaics: indoor/outdoor	30/01/2015	On line,Sophiawebinar (host ENEA)	Scientific Community (higher education, Research), Industry	100	World
59	Oral presentation to a scientific event	ENEA	Exchange of researchers between ENEA and CEA-INES (indoor characteriztion of CPV solar cells and components) (2 days)	29/01/2015	Chambery, France	Scientific Community (higher education, Research), Industry	8	Europe
60	Oral presentation to a scientific event	ENEA	Exchange of researchers betweenENEA and HZB Berlin on microlenses focal lenght characterization and microlenses relization via Inkjet printing (3 days)	26/01/2015	Berlin, Germany	Scientific Community (higher education, Research), Industry	8	Europe
61	Organisation of Workshops	ENEA	Techncial/scientific support to offer on-line ISOS-7 to any interested SOPHIA/CHEETAH/EERA participant	06/08/2014	On-site Barcelona, Spain On line,Sophiawebinar (host ENEA)	Scientific Community (higher education, Research), Industry	45	World
62	Organisation of Workshops	JRC	Best practices for power measurement of PV modules	02/07/2014	Ispra, Italy	Scientific Community (higher education, Research), Industry	35	Europe & North Africa

63	Posters	ENEA	SOPHIaWebinar the advanced e-learning platform of the Photovoltaic European Research Infrastructure 7FP-SOPHIA Project	22/09/2014	Amsterdam, The Netherlands	Scientific Community (higher education, Research), Industry	2000	World
64	Posters	Jülich	Comparison of Experimental and Simulated Cell, Module and System Data, Using a Standardized Simulation Interface	24/09/2014	Amsterdam, the Netherlands	Scientific Community (higher education, Research), Industry	1500	World
65	Oral presentation to a scientific event	Jülich	Incorporating the influence of the scanning probe in rigorous simulations by fast post processing methods	24/01/2014	Manchester, UK	Scientific Community (higher education, Research)	70	European community, Japan
66	Oral presentation to a scientific event	Jülich	Simulation based assessment of the impact of contacts and interdot coupling strength on the photovoltaic performance of quantum dot arrays	27/05/2014	Lille, France	Scientific Community (higher education, Research)	1500	World
67	Oral presentation to a scientific event	Jülich	Nanotechnology for thin-film/EUREC masters course	28/04/2014	Newcastle Upon Tyne, UK	Scientific Community (higher education, Research)	1500	World
68	Oral presentation to a scientific event	Jülich	Photovoltaic performance of quantum dot arrays, impact of coupling parameters	07/08/2014	Marseille, France	Scientific Community (higher education, Research)	100	European community, Algeria, Japan, Australia, Czech republic, Russia
69	Organisation of Workshops	CEA-INES	Workshop on Building Integrated Photovoltaics BiPV integration conditions (oriented to the French case)	21/03/2014	Le Bourget du lac, France	Scientific Community (higher education, Research), Industry	30	European countries

70	Organisation of Workshops	CEA-INES	BIPV session - Energy Forum conference on Advanced Building Skin	28/10/2014	Bressanone, Italy	Scientific Community (higher education, Research), Industry	400	World
71	Organisation of Workshops	DTU	Stability testing of OPVs and related standards	06/05/2014	Online	Scientific Community (higher education, Research), Industry	80	World
72	Oral presentation to a scientific event	DTU	Presenting round robin studies within SOPHIA OPV topic at ISOS-5 conference	07/12/2012	Eindhoven, The Netherlands	Scientific Community (higher education, Research), Industry	70	World
73	Oral presentation to a scientific event	DTU	Presenting lifetime round robin studies within SOPHIA OPV topic at ISOS-6 conference	11/12/2013	Chambéry, France	Scientific Community (higher education, Research), Industry	70	World
74	Organisation of Workshops	CEA-INES	Materials and processes for encapsulation of OPV devices (Session at ISOS-6)	11/12/2013	Chambéry, France	Scientific Community (higher education, Research), Industry	70	World
75	Oral presentation to a scientific event	ENEA	Exchange of researchers between HZB and ENEA - CPV, microlens, ink-jet, ARS-Angular eflectance Spectroscopy	21/05/2014	Portici, Italy	Scientific Community (higher education, Research), Industry	15	Italy,Germany
76	Organisation of Workshops	DTU	SophiaWebinar: Stability testing of OPVs and related standard. Joint CHEETAH/SOPHIA/EERA Initiative. Speaker G Bardizza, T. Sample (JRC) Chair G. Gevorgyan (DTU)	06/05/2014	Sophiawebinar (hosted by ENEA)	Scientific Community (higher education, Research), Industry	97	World
77	Organisation of Workshops	ENEA	SophiaWebinar Wet-Chemistry Deposition Of Semiconductor Nanostructures For Ir Photovoltaics :	09/05/2014	Sophiawebinar (hosted by ENEA)	Scientific Community (higher education, Research), Industry	37	Europe

			joint CHEETAH/SOPHIA					
78	Organisation of Workshops	HZB	SophiaWebinar: Extraction of Refractive Index Data From Optical Measurements of Flat, Rough And Inhomogeneous Thin Films . Joint CHEETAH/SOPHIA Webinar	22/05/2014	Sophiawebinar (hosted by ENEA)	Scientific Community (higher education, Research), Industry	82	World
79	Organisation of Workshops	HZB	SophiaWebinar: Characterizationof Thin Film Solar Cell Layers By X-Ray Based Spectroscopy Joint CHEETAH/SOPHIA on-line short course	23/05/2014	on site Berlin on line Sophiawebinar (hosted by ENEA)	Scientific Community (higher education, Research), Industry	50	World
80	Oral presentation to a scientific event	SINTEF	Exchange of researchers between ISE-IWES and SINTEF - cSi defects Char	01/10/2014	Lillestrøm/Oslo, Norway	Scientific Community (higher education, Research), Industry	20	World
81	Oral presentation to a scientific event	JRC	Bilateral visit JRC/DTU on Best practice on OPV Solar Cells Caracterization	19/05/2014	Ispra, Italy	Scientific Community (higher education, Research), Industry	20	Europe
82	Web sites/Applications	DERlab	Technical Guidelines on Long-term Photovoltaic Module Outdoor Tests	01/02/2012	https://shop.der-lab.net/shop-1/index.php	Scientific Community (higher education, Research), Industry	15000	World
83	Exhibitions	EPIA	Information desk – booth at EU PVSEC/European PV Solar Energy Conference and Exhibition. Discussing and exchanging on request about SOPHIA project/objectives/activities and TNA calls.	01/09/2011	Hamburg, Germany (26th EU PVSEC)	Scientific Community (higher education, Research), Industry	20000	World

84	Exhibitions	EPIA	Information desk – booth at EU PVSEC/European PV Solar Energy Conference and Exhibition. Discussing and exchanging on request about SOPHIA project/objectives/activities and TNA calls.	01/09/2012	Frankfurt, Germany (27th EU PVSEC)	Scientific Community (higher education, Research), Industry	20000	World
85	Posters	DERlab	Harmonized procedures on Photovoltaic modules long-term energy yield measurement and performance evaluation under outdoor conditions	01/09/2012	Frankfurt, Germany (27th EU PVSEC)	Scientific Community (higher education, Research), Industry	20000	World
86	Exhibitions	EPIA	Information desk – booth at EU PVSEC/European PV Solar Energy Conference and Exhibition. Discussing and exchanging on request about SOPHIA project/objectives/activities and TNA calls.	01/09/2013	Paris, France (28th EU PVSEC)	Scientific Community (higher education, Research), Industry	20000	World
87	Exhibitions	EPIA	Information desk – booth at EU PVSEC/European PV Solar Energy Conference and Exhibition. Discussing and exchanging on request about SOPHIA project/objectives/activities and TNA calls.	01/09/2014	Amsterdam, The Netherlands (29th EU PVSEC)	Scientific Community (higher education, Research), Industry	20000	World
88	Posters	ISE-IWES	PV roof integrated systems vs. Best- and Worst-Cases: Novel measurement for long-term outdoor measurement of PV roof integrated systems (electrical, thermal and mechanical	01/09/2013	Paris, France (28th EU PVSEC)	Scientific Community (higher education, Research), Industry	20000	World

			behaviors)					
89	Exhibitions	EPIA	Information desk – booth at Intersolar Europe. Discussing and exchanging on request about SOPHIA project/objectives/activities and TNA calls.	01/06/2011	Munich, Germany	Scientific Community (higher education, Research), Industry	30000	World
90	Exhibitions	EPIA	Information desk – booth at Intersolar Europe. Discussing and exchanging on request about SOPHIA project/objectives/activities and TNA calls.	01/06/2012	Munich, Germany	Scientific Community (higher education, Research), Industry	30000	World
91	Oral presentation to a scientific event	ECN	Climate chamber testing beyond current standards	03/06/2014	Sophia reliability workshop, Freiburg, germany	Scientific Community (higher education, Research), Industry, Policy makers	80	World
92	Oral presentation to a scientific event	ECN	Results of module testing Sophia	22/09/2014	EUPVSEC, Amsterdam, The Netherlands	Scientific Community (higher education, Research), Industry	1500	World
93	Oral presentation to a scientific event	ECN	“Thermal modeling of BIPV elements and solutions for heat reduction and shade optimization”	15/09/2014	Sophia BIPV workshop, Chambery, France	Scientific Community (higher education, Research), Industry	600	European countries
94	Posters	ECN	Strategic vison on PV research infrastructure	22/09/2014	EUPVSEC, Amsterdam, The Netherlands	Scientific Community (higher education, Research), Industry	1500	World
95	Oral presentation to a scientific	Tecnalia	Analytical model for optical calculation of BIPV multiple glazing systems	30/08/2013	Sophia BIPV workshop, Chambery, France	Scientific Community (higher education, Research), Industry	100	European countries

	event							
96	Oral presentation to a scientific event	Tecnalia	BFIRST Project: building-integrated fibre-reinforced solar technology	15/09/2014	Sophia BIPV workshop, Chambery, France	Scientific Community (higher education, Research), Industry	100	European countries
97	Oral presentation to a scientific event	ISE-IWES	SOPHIA CPV Module Round Robin: Power Rating at CSOC	24/09/2014	EUPVSEC, Amsterdam, The Netherlands	Scientific Community (higher education, Research), Industry	1500	World
98	Organisation of Workshops	UPM	Discussion and progress on Performance Testing Standard Concentrator Photovoltaic (CPV) Performance Testing	19/04/2012	Annual meeting of the IEC TC82 WG7, Toledo, Spain	Scientific Community (higher education, Research), Industry	100	World
99	Organisation of Workshops	UPM	Discussion and progress on Performance Testing Standard Concentrator Photovoltaic (CPV) Performance Testing	18/04/2013	Annual meeting of the IEC TC82 WG7, Miyazaki, Japan	Scientific Community (higher education, Research), Industry	100	World
100	Organisation of Workshops	UPM	Discussion and progress on Performance Testing Standard Concentrator Photovoltaic (CPV) Performance Testing	05/09/2012	Annual meeting of the IEC TC82 WG7, Denver, USA	Scientific Community (higher education, Research), Industry	100	World
101	Organisation of Workshops	UPM	Discussion and progress on Performance Testing Standard Concentrator Photovoltaic (CPV) Performance Testing	01/09/2011	Annual meeting of the IEC TC82 WG7, Cologne, Germany	Scientific Community (higher education, Research), Industry	100	World
102	Organisation of Workshops	UPM	Discussion and progress on Performance Testing Standard Concentrator Photovoltaic (CPV) Performance Testing	08/09/2012	Annual meeting of the IEC TC82 WG7, Las Vegas, USA	Scientific Community (higher education, Research), Industry	100	World

103	Organisation of Workshops	UPM	Discussion and progress on Performance Testing Standard Concentrator Photovoltaic (CPV) Performance Testing	25/09/2013	Annual meeting of the IEC TC82 WG7, San Jose, USA	Scientific Community (higher education, Research), Industry	100	World
104	Organisation of Workshops	UPM	Discussion and progress on Performance Testing Standard Concentrator Photovoltaic (CPV) Performance Testing	10/04/2014	Annual meeting of the IEC TC82 WG7, Albuquerque, USA	Scientific Community (higher education, Research), Industry	100	World
105	Organisation of Workshops	RSE	1th International Spectroradiometer and Broadband Intercomparison	23/05/2011	Portici, Italy	Scientific Community (higher education, Research), Industry	20	Europe
106	Organisation of Workshops	RSE	2th International Spectroradiometer and Broadband Intercomparison	18/06/2012	Catania, Italy	Scientific Community (higher education, Research), Industry	25	Europe & Japan
107	Organisation of Workshops	RSE	3th International Spectroradiometer and Broadband Intercomparison	20/05/2013	Puertollano, spain	Scientific Community (higher education, Research), Industry	35	Europe & Japan
108	Organisation of Workshops	Jülich	Zno as a transparent conductor: Stability and Annealing effects	13/11/2014	Juelich, Germany	Scientific Community (higher education, Research), Industry	23	Europe
109	Organisation of Workshops	Jülich	Development of a roadmap for the inclusion of degradation into the modelling of OPV	09/08/2014	Juelich, Germany	Scientific Community (higher education, Research), Industry	12	Europe
110	Oral presentation to a scientific event	Jülich	Exchange of researcher from ENEA to Juelich - Expert knowledge exchange, materials modelling, Multiscale , molecular modelling, research collaboration, and simulation of a-Si material	25/06/2014	Juelich, Germany	Scientific Community (higher education, Research)	5	European countries

111	Oral presentation to a scientific event	Jülich	Invited Expert from PARC, USA - Teaching and training - materials modelling	08/09/2014	Juelich, Germany	Scientific Community (higher education, Research), Industry	50	Europe / USA
112	Oral presentation to a scientific event	Jülich	'The Sophia project', with a focus on the JRA4 simulation chain	17/09/2013	Monschau, Germany	Scientific Community (higher education, Research)	17	European countries, including non-member states
113	Oral presentation to a scientific event	Jülich	Invited Oral presentation to a scientific event from CREST - thin film characterisation	24/11/2014	Juelich, Germany	Scientific Community (higher education, Research)	15	European countries
114	Oral presentation to a scientific event	Jülich	Exchange of 2 researchers from Juelich to CREST - thin film and characterisation	27/11/2014	Loughborough, UK	Scientific Community (higher education, Research)	20	European countries
115	Oral presentation to a scientific event	Jülich	'The Sophia project modelling chain', with a focus on the inclusion of degradation.	08/09/2014	Juelich, Germany	Scientific Community (higher education, Research), Industry	12	Europe / USA
116	Oral presentation to a scientific event	Jülich	Stability and annealing effects of ZnO - Literature debates and experimental insights'	13/11/2014	Juelich, Germany	Scientific Community (higher education, Research)	23	Europe
117	Oral presentation to a scientific event	CREST	Exchange of researcher from AIT to CREST - Expert knowledge exchange, thermal and outdoor measurements and simulations	24/07/2014	Loughborough, UK	Scientific Community (higher education, Research)	2	European countries
118	Oral presentation	CEA-INES	Thermal and electrical analysis of	22/09/2014	München, Germany, 29th	Scientific Community (higher education,	200	Europe

	to a scientific event		BIPV systems in the Sophia Project		European Photovoltaic Solar Energy Conference and Exhibition	Research)		
119	Organisation of Workshops	EPIA	Strategic Vision for PV Research Infrastructure - Keystone for the reinforcement of the PV industry, Europe's growth and competitiveness	23/09/2014	EUPVSEC, Amsterdam, The Netherlands	Industry, Scientific Community (higher education, Research), policy makers	80	World
120	Web sites/Applications	EPIA	News to promote the sophia final workshop at EU PVSEC (mailings + EPIA SOLARIS newsletter)	01/07/2014	http://www.epia.org/home/	Scientific Community (higher education, Research), Industry	15000	World
121	Web sites/Applications	EPIA	News to promote the sophia final workshop at EU PVSEC (mailings + EPIA SOLARIS newsletter)	01/09/2014	http://www.epia.org/home/	Scientific Community (higher education, Research), Industry	15000	World
122	Web sites/Applications	EPIA	News to promote the sophia final workshop at EU PVSEC (mailings + EPIA SOLARIS newsletter)	02/11/2014	http://www.epia.org/home/	Scientific Community (higher education, Research), Industry	15000	World
123	Web sites/Applications	EPIA	News to promote the sophia final workshop at EU PVSEC (mailings + EPIA SOLARIS newsletter)	01/12/2014	http://www.epia.org/home/	Scientific Community (higher education, Research), Industry	15000	World
124	Web sites/Applications	EPIA	News to promote the sophia final workshop at EU PVSEC (mailings + EPIA SOLARIS newsletter)	02/01/2015	http://www.epia.org/home/	Scientific Community (higher education, Research), Industry	15000	World
125	Press releases	EPIA	Presse Conference during the Symposium	21/01/2015	http://www.pv-tech.org/news/solar_rd_needs_systemic_shock_to_avert_death_of_eu	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers,	5000	World

					ropean_pv	Medias		
126	Oral presentation to a scientific event	IMEC	Oral presentation to PV specialisation EUREC Masters students	24/04/2013	Newcastle, UK	Scientific Community (higher education, Research)	50	United Kingdom
127	Oral presentation to a scientific event	JRC	Uncertainty considerations of Temperature coefficients measurements	04/02/2014	Ispra, Italy	Scientific Community (higher education, Research)	20	Europe
128	Oral presentation to a scientific event	AIT	Multifunctional integration of vertical BIPV	16/09/2014	Sophia BIPV workshop, Chambery, France	Scientific Community (higher education, Research), Industry	100	European countries
129	Oral presentation to a scientific event	AIT	MULTIFUNCTIONAL ASPECTS OF VERTICAL INTEGRATED PV - Marcus Rennhofer at the ENERGY FORUM, Conference on Advanced Building Skins, session of the FP7-SOPHIA project	28/10/2014	Bressanone, Italy	Scientific Community (higher education, Research), Industry	100	European countries
130	Web sites/Applications	ENEA	ENEA Newsletter . "ENEA informa" news on "Fotovoltaico innovativo: a disposizione della comunità scientifica internazionale la piattaforma web SOPhi@webinar realizzata dall'ENEA nell'ambito del progetto FP7-SOPHIA"	01/03/2015	on line	Scientific Community (higher education, Research), Industry	5000	Italy
131	Web sites/Aplications	CEA-INES	Free access to 48 Photovoltaic Research Infrastructures	01/01/2012	Chambery, France	Scientific Community (higher education, Research)	500	European countries

132	Organisation of Workshops	UPM	Discussion and progress on Performance Testing Standard Concentrator Photovoltaic (CPV) Performance Testing	29/09/2015	Albuquerque, USA, Annual meeting of the IEC TC82 WG7	Scientific Community (higher education, Research), Industry	100	World
133	Organisation of Workshops	UPM	Discussion and agreement on power rating procedures	03/11/2015	Instituto de Energía Solar, Madrid, Spain	Scientific Community (higher education, Research)	6	Europe and USA

* A drop down list allows choosing the dissemination activity: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, other.

** A drop down list allows choosing the type of public: Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias ('multiple choices' is possible.

2.2 Section B: Use (Public)

2.2.1 List of applications for patents, trademarks, registered design… (B1) - Public

No patents, nor trademarks nor registered design were generated during the lifetime of the SOPHIA project. The main aim of the SOPHIA project was not to create and develop new technologies that can be protected with patents for example. The SOPHIA project had the ambition to join forces within European PV research to provide a better service for researchers and to avoid duplication and unnecessary investment. SOPHIA had an impact on the establishment and definition of standards in the PV field.

2.2.2 List of exploitable foreground (B2) - Public

Template B2: List of exploitable foreground										
No	**WP**	**Type of Exploitable Foreground***	**Description of exploitable foreground**	**Confidential (Yes/No)**	**Foreseen embargo date DD/MM/YYYY**	**Exploitable product(s) or measure(s)**	**Sectors of appli-cation****	**Timetable, commercial or any other use**	**Patents or other IPR exploitation (licences)**	**Owner & Other Beneficiarys involved**
1	10	Exploitation of R&D results via standards	Standard procedures for rating of CPV modules	No	31/03/15	IEC standard for the power rating of PCV modules	Concentrating PV	NA	NA	NA
2	11	General advancement of knowledge	Creation of pre-normative standards for lifetime determination, intercomparison and prediction for OPV devices.	No	31/01/15	O-diagram	Organic photovoltaics Based on the consensus of EERA and SOPHIA members.	NA	NA	NA
3		General advancement of knowledge	Collection of results for different approaches to measure perfor-mance	No	31/01/15	Know-how on how to measure carrier lifetime	Institutes and characterization in industry	NA	NA	NA

			gains by bifaciallity as input to standardization committee							
4		Exploitation of R&D results via standards	Data collection and clarification of industrial strategies for solar grade silicon	No	31/01/15	Silicon specifications	Institutes and industry	NA	NA	NA
5		General advancement of knowledge	Figure of Merit for TCO	No	31/01/15	Thin film PV	Research and Industry	NA	No	NA
6		Exploitation of R&D results via standards	RR of pretreatment for tf modules	No	31/01/15	Thin film PV	Research and Industry	Currently used for research but no plans for commercial use	No	NA
7	12	General advancement of knowledge	Interface program which provides a standard data format (standard inputs and outputs) for use in solar cell, module, and system simulation tools. Program provides: Interpolation for required temperature and illumination ranges. (Spectral ranges to be added.) Fitting for one- and two-diode model parameters	No	01/01/17	Universal library' simulation tool Interface program	J58.2.9 - Other software publishing (PV simulation program)	NA	open source publishing of software	B. Pieters (Jülich), B. Kubicek (AIT)
8	12	Exploitation of R&D results via standards	Standard data and data types required at each interface (material-cell, cell-module, module-	No	01/01/17	Standardised interface data and protocols	J58.1.9 - Other publishing activities (standards)	NA	Development of standards, publication, know how,	B. Pieters (Jülich), W.Sprenger (ISE), R. Varache (CEA-INES),

			system, system-annual energy yield) for passing data along the value chain.						presentation to conferences	G. Janssen (ECN), I.R. Cole (CREST) F. Friedrich (HZB), J. Hüpkes (Jülich)
9	2	Exploitation of R&D results via standards	Outcome of workshop on how to include degradation into the modelling of OPV. Three main focus points for future research.	No	01/01/17	Results from OPV workshop on inclusion of degradation into the modelling of OPV	J58.1.9 - Other publishing activities (Roadmap)	N/A	In clusion in OPV roadmap	B. Street (PARC), T. Kirchartz (Jülich), B.Pieters (Jülich), Y.Augarten (Jülich), S. Gevorgyan (DTU), H. Hoppe (TU Ilmenau), E. Voroshazi (IMEC), G. Bardizza (JRC), T. Mueller (Heliatek)
10		General advancement of knowledge	Simulation program SourceField/ModuleSim: A new 2D model for the electrical potential in a cell stripe in thin-film solar modules including local defects	No	01/01/17	Quasi-Analytical model for cell stripes in a thin-film module including local defects	J58.2.9 - Other software publishing (PV simulation program)	Already published open source	Journal publication, open source publishing of software, presentation to conferences	B. Pieters (Jülich)

* A drop down list allows choosing the type of foreground: General advancement of knowledge, Commercial exploitation of R&D results, Exploitation of R&D results via standards, exploitation of results through EU policies, exploitation of results through (social) innovation.
** A drop down list allows choosing the type sector (NACE nomenclature) : http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

Additional Template B2: Overview table with exploitable foreground		
No	**Description of Exploitable Foreground**	**Explain of the Exploitable Foreground**
1	Standard procedures for rating of CPV modules	**Purpose:** Rating of CPV modules **How the foreground might be exploited, when and by whom:** Labs and manufactures **IPR exploitable measures taken or intended:** No **Further research necessary, if any:** Yes New high efficiency cells approaching CPV which will involve new characterization procedures and instruments for cells, optics, modules and systems

		Potential/expected impact (quantify where possible): Lower uncertainty in power rating, needed for higher confidence in CPV technology
2	Creation of a special methodology/diagram (o-diagram) as a pre-normative standard (based on the consensus of EERA and SOPHIA member partners) for lifetime determination, intercomparison and prediction for OPV devices	**Purpose:** To predict, define and intercompare lifetime of OPV devices **How the foreground might be exploited, when and by whom:** By researchers and industry in the field of organic photovoltaics starting from today **IPR exploitable measures taken or intended:** NA **Further research necessary, if any:** Continuous collection of data for upgrading and improving the methodology **Potential/expected impact (quantify where possible):** Acceleration of lifetime improvement of OPV devices via rapid tests and prediction.
3	Collection of results for different approaches to measure performance gains by bifaciallity as input to standardization	**Purpose:** Define and standardize measures for bifaciallity gain by collecting results for different approaches to measure performance gains by bifaciallity from international intercomparison; **How the foreground might be exploited, when and by whom:** Transfer after final evaluation at ISE to standardization committee in May 2015. To be transferred to standardization committees formed following bifPV workshop 2014. **IPR exploitable measures taken or intended:** NA **Further research necessary, if any:** Yes **Potential/expected impact (quantify where possible):** Bifacial gain opens new option for economic production in mid-sized industry in Europe; LCOE below 5 ct/kWh in Spain reachable.
4	Data collection and clarification of industrial strategies for solar grade silicon	**Purpose:** Collection of data base for silicon material for solar use; transparent exchange and clarification of industrial views on the future roadmap for solar grade silicon in discussions with industry at workshop in Rome 2013. Develop roadmap/strategic direction for solar silicon material **How the foreground might be exploited, when and by whom:** General increase of transparency already achieved by publication in "Solar Energy Materials & Solar Cells" 130 (2014) 629 **IPR exploitable measures taken or intended: NA** **Further research necessary, if any:** Yes **Potential/expected impact (quantify where possible):** Better transparent route for silicon material provides guideline for industrial developments and for strategy optimisation of the participating research institutes.
5	Define the TCO quality for specific thin film technologies by quantifying transmission and conductivity	**Purpose:** Make TCO quality comparable **How the foreground might be exploited, when and by whom:** Module manufacturers **IPR exploitable measures taken or intended:** None **Further research necessary, if any:** Yes **Potential/expected impact (quantify where possible): /**
6	Define pretreatments for thin film modules to make efficiency measurements more reliable	**Purpose:** More reliable efficiency measurements **How the foreground might be exploited, when and by whom:** **IPR exploitable measures taken or intended: N**one **Further research necessary, if any:** Yes

		Potential/expected impact (quantify where possible): /
7	Interface program which provides a standard data format (standard inputs and outputs) for use in solar cell, module, and system simulation tools. Program provides: Interpolation for required temperature and illumination ranges. (Spectral ranges to be added.) Fitting for one- and two- diode parameters	**Purpose:** Improve the ease with which data can be exchanged between I-V based PV simulation programs, facilitating collaborations between simulation tools along all levels of the PV value chain. **How the foreground might be exploited, when and by whom: B**y the PV simulation community. **IPR exploitable measures taken or intended:** Publication of open source code in a number of known, well-used simulation websites **Further research necessary, if any:** Improvement to the fitting algorithms, improvement to the calculation of temperature dependent IV curves, definition of minimum necessary original input data sets (Temp. and irradiation range). **Potential/expected impact (quantify where possible): /**
8	Standard data and data types required at each interface (material-cell, cell-module, module-system, system-annual energy yield) for passing data along the value chain.	**Purpose:** Standardise some aspects of data input and output in I-V based simulation programs, to improve the ease with which data can be exchanged between them. **How the foreground might be exploited, when and by whom:** By the PV simulation community. **IPR exploitable measures taken or intended:** Development of standards for input and output data and data types for (I-V based) simulation programs. **Further research necessary, if any:** **Potential/expected impact (quantify where possible):** Easier, more efficient collaboration between researchers using different simulation tools.
9	Outcome of workshop on how to include degradation into the modelling of OPV. Three main focus points for future research.	**Purpose:** Owing to the large number of different chemical combinations, generalised simulations of OPV coming from a physical basis are difficult.Three main points for investigation, which have the potential to form the basis of a generalised physical description of the OPV interface, were identified. **How the foreground might be exploited, when and by whom:** OPV modelling community, in the next roadmap for OPV. **IPR exploitable measures taken or intended:** To be sent to the OE-A, who are responsible for publishing the organic electronics roadmap **Further research necessary, if any:** Finalisation of official document. **Potential/expected impact (quantify where possible):** Overview and direction of focus points for development of OPV simulation tools; particular focus on the direction necessary for inclusion of degradation into OPV simulations, along the value chain.
10	Simulation program SourceField/ModuleSim: A new 2D model for the electrical potential in a cell stripe in thin-film solar modules including local defects	**Purpose: F**ast 2D simulation of thin film cells with local defects or shunts. Can be used to quantify these defects and their effect on the module. As the model is quasi-analytical it is also a good reference point to estimate accuracy of other, fully numerical, models. **How the foreground might be exploited, when and by whom:** Thin film PV research community and industry; identification and classification of local defects and their effect on local and global module properties **IPR exploitable measures taken or intended:** None **Further research necessary, if any:** Yes **Potential/expected impact (quantify where possible):/**

3 Report on societal implications

A General Information *(completed automatically when **Grant Agreement number** is entered.*

Grant Agreement Number:	262533
Title of Project:	SOPHIA : PhotoVoltaic European Research Infrastructure
Name and Title of Coordinator:	Philippe Malbranche

B Ethics

1. Did your project undergo an Ethics Review (and/or Screening)? • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	No
2. Please indicate whether your project involved any of the following issues (tick box) :	
RESEARCH ON HUMANS	
• Did the project involve children?	No
• Did the project involve patients?	No
• Did the project involve persons not able to give consent?	No
• Did the project involve adult healthy volunteers?	No
• Did the project involve Human genetic material?	No
• Did the project involve Human biological samples?	No
• Did the project involve Human data collection?	No
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	No
• Did the project involve Human Foetal Tissue / Cells?	No
• Did the project involve Human Embryonic Stem Cells (hESCs)?	No
• Did the project on human Embryonic Stem Cells involve cells in culture?	No
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	No
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	No
• Did the project involve tracking the location or observation of people?	No
RESEARCH ON ANIMALS	

• Did the project involve research on animals?	No
• Were those animals transgenic small laboratory animals?	No
• Were those animals transgenic farm animals?	No
• Were those animals cloned farm animals?	No
• Were those animals non-human primates?	No
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Did the project involve the use of local resources (genetic, animal, plant etc.)?	No
• Was the project of benefit to local community (capacity building, access to healthcare, education etc.)?	No
DUAL USE	
• Research having direct military use	No
• Research having the potential for terrorist abuse	No

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator	0	1
Work package leaders	0	11
Experienced researchers (i.e. PhD holders)	41	94
PhD Students	11	23
Other	24	56

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	**14**
Of which, indicate the number of men:	12

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project? ○ No

6. Which of the following actions did you carry out and how effective were they?

	Not at all effective				Very effective
❑ Design and implement an equal opportunity policy	○	○	○	○	○
❑ Set targets to achieve a gender balance in the workforce	○	○	○	○	○
❑ Organise conferences and workshops on gender	○	○	○	○	○
❑ Actions to improve work-life balance	○	○	○	○	○

○ Other:

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

○ No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

○ Yes- please specify: Lectures at universities, open day events, webinars, summer schools, lab tours

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

○ Yes- please specify: SOPHIA@webinar site, recorded videos of the lectures, guidelines…

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

○ Main discipline[1]: 2.3

○ Associated discipline[1]: 1.2 ○ Associated discipline[1]: 1.3

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)* ○ No

[1] Insert number from list below (Frascati Manual).

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

- ○ No
- ○ Yes- in determining what research should be performed
- ○ Yes - in implementing the research
- ○ Yes, in communicating /disseminating / using the results of the project

11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	○	No

12. Did you engage with government / public bodies or policy makers (including international organisations)

- ○ No
- ○ Yes- in framing the research agenda
- ○ Yes - in implementing the research agenda
- X Yes, in communicating /disseminating / using the results of the project

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

- X Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
- ○ Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
- ○ No

13b If Yes, in which fields?

Agriculture		**Energy**		Human rights	
Audiovisual and Media		Enlargement		**Information Society**	
Budget		Enterprise		Institutional affairs	
Competition		**Environment**		Internal Market	
Consumers		External Relations		Justice, freedom and security	
Culture		External Trade		Public Health	
Customs		Fisheries and Maritime Affairs		**Regional Policy**	
Development Economic and Monetary Affairs		Food Safety		**Research and Innovation**	
		Foreign and Security Policy		Space	
Education, Training, Youth		Fraud		Taxation	
Employment and Social Affairs		Humanitarian aid		Transport	

13c If Yes, at which level?

- ○ Local / regional levels
- ○ National level
- X European level
- ○ International level

H Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?	**41**
To how many of these is open access[2] provided?	**2**
How many of these are published in open access journals?	
How many of these are published in open repositories?	
To how many of these is open access not provided?	**39**
Please check all applicable reasons for not providing open access:	
X publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other[3]: ……	

15. How many new patent applications ('priority filings') have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*		**0**
16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	**0**
	Registered design	**0**
	Other	**0**
17. How many spin-off companies were created / are planned as a direct result of the project?		**0**
Indicate the approximate number of additional jobs in these companies:		**0**

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

❑ Increase in employment, or	❑ In small & medium-sized enterprises
❑ Safeguard employment, or	❑ In large companies
❑ Decrease in employment,	❑ None of the above / not relevant to the project
X Difficult to estimate / not possible to quantify	

[2] Open Access is defined as free of charge access for anyone via Internet.
[3] For instance: classification for security project.

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:	*Indicate figure:* *5*
Difficult to estimate / not possible to quantify	X

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

X Yes ○ No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

○ Yes X No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

X	Press Release	X	Coverage in specialist press
X	Media briefing	X	Coverage in general (non-specialist) press
❑	TV coverage / report	❑	Coverage in national press
❑	Radio coverage / report	❑	Coverage in international press
X	Brochures /posters / flyers	X	Website for the general public / internet
❑	DVD /Film /Multimedia	X	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

❑	Language of the coordinator	X	English
X	Other language(s)		

***Question F-10*:** Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES

1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]

1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)

1.3 Chemical sciences (chemistry, other allied subjects)

1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)

1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY

2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)

2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]

2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES

3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)

3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)

3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES

4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)

4.2 Veterinary medicine

5. SOCIAL SCIENCES

5.1 Psychology

5.2 Economics

5.3 Educational sciences (education and training and other allied subjects)

5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)

6.2 Languages and literature (ancient and modern)

6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]