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Workplan 2018-2021

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PEARL PV

COST Action CA16235 - PEARL PV

Performance and Reliability of Photovoltaic Systems: Evaluations of Large-Scale Monitoring Data

Workplan 2018-2021

Version 2: 18 November 2018

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EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

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0. Introduction to Pearl PV's Workplan

Chair: Angèle Reinders, University of Twente and TU/e, The Netherlands

Vice Chair: David Moser, Eurac Research, Italy

This document presents COST Action PEARL PV's workplan for the period of 2018 until the end of the Action in 2021. It is the result of a collaborative effort of all PV experts that volunteer in the PEARL PV network and will be fully implemented in the forthcoming years. This workplan will also be available as a living document that will be periodically revised by the website of PEARL PV at https://www.pearlpv-cost.eu/.

COST Action PEARL-PV aims are:
i) to improve the energy performance and reliability of photovoltaic (PV) solar energy systems in Europe leading to lower costs of electricity produced by PV systems by a higher energy yield,
ii) a longer life time eventually beyond the guaranteed 20 years as specified by manufacturers, and
iii) a reduction in the perceived risk in investments in PV projects.

These objectives will be achieved by a solid collaboration between five Working Groups (WGs), see Figure 1, which will be using a shared data bank and joint simulation tools to analyze big data of the actual monitored long-term performance, defects and failures in PV systems installed all over Europe. The 5 Working Groups are focused on (WG1) PV monitoring, (WG2) Reliability and durability of PV, (WG3) PV simulation, (WG4) PV in the built environment and (WG5) PV in grids.

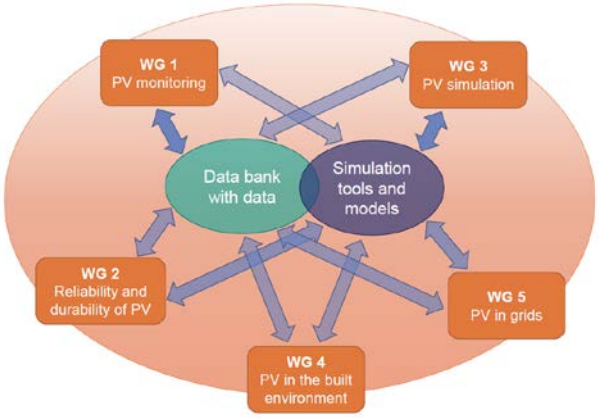

Figure 1: The 5 Working Groups of COST Action PEARL-PV in relation to a shared data bank and simulation tools.

By data analyses and simulations it will be possible to quantitatively determine the absolute influences of components rated performance, key design of systems, installation, operation, maintenance practice, geographic location and weather factors on the performance, performance degradation over time and failure modes of installed PV systems.

In this document the workplans of the five Working Groups are presented in the context of the wider Action. The background for workplan is the MoU of the Action which provides information about the objectives, the research field of PV performance analyses and the expected research program at the start of the Action in October 2017. However because of interactions between researchers in combination with new insights resulting from ongoing research in the field, these objectives and related research programs can change. Therefore this Action's workplan for the period of 2018 to 2021 has developed as a dynamic document with the aim to review the Action's progress on the basis of this document and where necessary annually update it in relation to the internal progress made in this Action and the external developments in the fields of PV performance, durability and reliability research.

To give the reader an insight in the wider scope and activities of this Action, Table 1 shows the global planning of PEARL PV from 2018 to 2021 including all scheduled MC meetings, research milestones regarding the set up and use of the envisioned data bank, and many networking events such as Seminars, Workshops, Training Schools and Valorization Panel Meetings as well as expected reporting for the COST Association, the Action's participants and external parties.

After the workplans of the five Working Groups (WGs) have been presented in Chapter 1 to 5, in Chapter 6 already scheduled meetings and events will be presented with a summary of the core activities in this Action. Finally in Chapter 7 the publication policy of PEARL PV and in Chapter 8 the participant lists (as known by Fall 2018) of this Action will be presented.

At present, 1st of October 2018, Cost Action PEARL PV consist of 31 member countries: that is to say 29 European COST Member countries (including Israel), 1 International Partner Country (IPC), namely the USA, and 1 Near Neightbour Country (NNC) which is Armenia. The map below, Figure 2, shows all the with PEARL PV affiliated countries except the USA.

Figure 2: Countries involved in COST Action PEARL-PV by September 2018 in orange.

Since its start at 5 October 2017, COST Action PEARL PV has acquired 165 members among which 50 MC members, 37 MC Substitutes and 77 regular members. Since it is required that in this COST Action all members actively contribute to the execution of the workplan, new members will be kindly invited to accept a role in this Action, ranging from being a member of a Working Group to having a managerial role to being part of the Core Group. In Chapter 8 therefore all roles will be shown with names of those involved by 1 October 2018.

Table 1: Planning of COST Action PEARL PV for the period of 2018 until 2021

Year	2018										2019											
Month	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Grant Periods	GP1		GP2												GP3							
Reports & Newsletter		N						M12 - PR1	Work Plan 18-21	N				N						M24 – PR2	N	
Meetings			CG			CG		Seminar Training School		CG		MC3 Work shops			CG					Seminar Training School		CG
Data bank	Requirements				Realization data bank						First data analyses / round robin test completed				Second round analyses / round robin test							
Working Groups	Realization of individual WGs work plans				Combining all WGs work plans in a joint work plan for whole Action				Sharing of work plan and approval by MC3 meeting			Implementation of work plan									Review work plan for each WG	
Training Schools	Preparation			Advertising			Execution TS 1		Quality survey		Preparation				Advertising				Execution TS 2		Survey	

Year	2020										2021											
Month	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O
Grant Periods	GP3				GP4												GP5					
Reports & Newsletter				N						M36 – PEARL Book	N					N						M48 - PR3 Newsletter
Meetings		MC4 Work shops			CG					Seminar Training School		CG		MC5 Work shops			CG					Conference Training School
Data bank	Second round analyses / round robin test completed						Third round analyses / round robin test completed										Fourth round analyses / round robin completed					
Working Groups	Revise & approve MC4		Implementation of revised work plan								Review work plan for WGs	Revise & approve MC5		Implementation of revised work plan								
Training Schools		Preparation			Advertising		Execution TS 3				Survey		Preparation				Advertising			Execution TS 4		

1. Workplan of WG1: PV Monitoring

WG1 Chair: Wilfried van Sark, Utrecht University, the Netherlands

WG1 Vice Chair: Christian Braun, Fraunhofer ISE

'PV Monitoring' is focused on the identification of relevant data to be collected to properly assess PV performance of installed PV systems in the field and on rooftops. Activities cover both defining guidelines for collection and analysis, as well as designing a data bank with appropriate access options. A strong connection to all other Working Groups in the PEARL-PV project is envisioned as data requirements will differ per Working Group.

The overall objective of WG1 is to **investigate long-term PV performance.** This will be achieved by analyzing data of the actual monitored long-term performance, defects and failures in PV systems installed all over Europe to quantitatively determine the absolute influences of components rated performance, key design of systems including BIPV, residential, field-based and floating systems, installation, operation, maintenance practice, geographic location and weather factors on the performance, performance degradation over time and failure modes of these PV systems.

In order to reach this overall objective, the following detailed objectives are defined as:

1. To develop generally accepted approaches and guidelines for the collection of data on performance of PV modules and PV systems
2. To set-up a data bank for data collection and sharing
3. To develop generally accepted approaches and guidelines for the use and/or analysis of data
4. To define a strategy for data bank access

WG1 Description of Tasks

WG1 has four major tasks, as described below.

Task 1.1: Development of generally accepted approaches and guidelines for the collection of data.

In this task a study of published approaches and existing guidelines on data collection will be performed first, and will be discussed in a WG1 workshop. Existing IEC standards and IEA-PVPS-Task13 reports will be used a basis, while a distinction will be made between need-to-have and nice-to-have data taking into account that data availability can be flexible. Obviously, power and energy data from systems are essential as well as irradiation data. The combined outcomes will be used to design a questionnaire on data needs and requirements, that will be used for consultation of all PEARL-PV participants in all working groups. The results of the questionnaire will be then be discussed at a WG1 seminar, which will finally will form the basis for the data structure of the data bank (T1.2).

This task will be completed by the end of Grant Period 2, while updates may be made if new data is available. This task contributes to Objective 1.

Task leader: Anne Gerd Imenes, Norway

Subtasks:
T1.1.1: Preparation of data requirement questionnaire

T1.1.2: Distribution of questionnaire

T1.1.3: Analysis of questionnaire responses and summary of results

Task 1.2: Compilation of a data bank on a server.

Based on required data, statistical (meta)data and dynamical data, data types and time resolutions, a system for data collection and sharing will be identified. Options using SQL and non-SQL, HDFS, and others will be investigated. A decision will be made in Grant Period 2, after consultation with PEARL-PV data experts during a WG1 seminar. A first version of the data bank will be set-up, which will also prescribe the (standardized) formats for data. In order to make the data structure future proof, a data bank will be selected that allows for inclusion of different data and formats in the future.

Though originally it was assumed that the data bank would be fully available by the end of 2018, due to the complexity of implementation, it is more realistic to assume that this task will be completed by the end of Grant Period 2, while updates may be made if new data is available. This task contributes to Objective 2.

Task leader: Dijana Capeska Bogatinoska, fYR Macedonia

Subtasks:
T1.2.1: Investigation of data bank structure options

T1.2.2: Selection of data bank structure

T1.2.3: First realization of data bank structure

T1.2.4: Assess necessity for updates of data bank structure

Task 1.3: Development of guidelines for use and analysis of data.

This task will target the development of generally accepted approaches and guidelines for the use, analysis and/or interpretation of meteorological data and data about the performance of PV modules and systems. This will use existing scientific documentation, guidelines and standards, as well as meetings with PV monitoring experts. A link with Working Group 3 will ensure harmonization of data and procedures regarding simulation algorithms and software. Also, PEARL-PV data experts will co-develop scripts to access the data bank, if deemed necessary. The guidelines will contain advantages and disadvantages, relevance, accuracy and complexity of application as well as data requirements. Finally, using the guidelines on collected data will provide information on the performance of PV systems.

This task contributes to Objective 3.

Task leader: Giorgio Belluardo, Italy

Subtasks:
T1.3.1: Collect state-of-the-art data use and analysis guidelines

T1.3.2: Discuss state-of-the-art guidelines among PV experts

T1.3.3: Compile updated guidelines

T1.3.4: Perform analyses on collected data

Task 1.4: Development of a strategy for data bank access

In this task an access strategy to data stored on a server will be developed in the form of a data management plan, which will include non-disclosure agreements for participants that supply data that may contain privacy sensitive information. The EU General Data Protection Regulation will be guiding in this. Also, a policy for use of these data taking into consideration costs, publishing and IP for COST Action participants and external parties will be developed.

This task contributes to Objective 4.

Task leader: Wilfried van Sark, the Netherlands

Subtasks:
T1.4.1: Draft a data management plan

T1.4.2: Prepare a Non-Disclosure Agreement

T1.4.3: Develop data bank access strategy and policy for use

WG1 Deliverables Plan

Within the project specification, three main deliverables were identified for WG1 (D1 to D10 detailed below). This deliverables plan links the main deliverables to their respective Tasks and identifies the path to those deliverables, according to the current workplan.

D1. Publications of findings originating from WG1 in high-impact scientific journals, conference proceedings and via the COST Action's website

D2. Reports of the WG 1 activities (month 12, 24, 36, 48), including the organization of one workshop per year and one seminar per year on PV monitoring.

D3. A data bank to be realized on one of the MC members' server.

D4. Publication of findings originating from WG3 in high impact journals, conference proceedings and a book.

Pathway to D1: All tasks will contribute to the preparation of reports, specifically Task 1.1 and Task 1.3. These will be assessed in terms of their suitability for the preparation of journal or conference papers, with a specific target of the specialist journals and conferences relating to the PV community. Since the first reports are due to be prepared in the third quarter of GP2, the initial plan is to target abstract submission for the PV conferences taking place from April to September 2019 (such as IEEE PVSC and EU PVSEC). WG1 will also contribute to papers submitted in relation to the overall PEARL PV project, as appropriate. Specifically, subtask 1.3.4, in which actual PV system data analysis will be performed based on the data collected will lead to several publications in high-impact journal. It is expected that the work of WG3 will allow a contribution of several specialist chapters to the projected book arising from the COST Action.

D2. Annual reports of the WG 1 activities (month 12, 24, 36, 48), including the organization of one workshop per year and one seminar per year on PV monitoring.

Pathway to D9: Annual reports will be produced as required. The first annual report, in autumn 2018, will report on Tasks 1.1 and 1.2, both of which will be well advanced at that time, and on Tasks 1.3 and 1.4 that just will have started. WG1 is organizing a seminar in October 2018 on "Matching PV data and PV performance research questions" as part of Task 1.1. WG1 is also contributing to the training workshop to be held in October 2018 on "Monitoring and simulation of the performance and reliability of photovoltaics in the built environment". WG1 will contribute to other workshops, always focusing on PV system performance aspects.

D3. A data bank to be realized on one of the MC members' server.

Pathway to D3: The activities of Tasks 1.1 will provide input to Task 1.2, which is about setting up the data bank itself. It is planned that a first version of the data bank is available in December 2018, and data access (Task 1.4) is defined at that time as well. Collection of data as well as the use and analysis of data (Task 1.3) will be evaluated which may lead to a change in data bank structure. This means that the data bank structure will be made flexible.

WG1 Timetable of Actions

Task	Subtask	2017	2018			2019			2020			2021	
		10-12	1-4	5-8	9-12	1-4	5-8	9-12	1-4	5-8	9-12	1-4	5-10
1.1	1.1.1												
	1.1.2												
	1.1.3												
1.2	1.2.1												
	1.2.2												
	1.2.3												
	1.2.4												
1.3	1.3.1												
	1.3.2												
	1.3.3												
	1.3.4												
1.4	1.4.1												
	1.4.2												
	1.4.3												

	Grant Period 1
	Grant Period 2
	Grant Period 3
	Grant Period 4
	Grant Period 5

Deliverables by the end of Grant Period 1 (30 April 2018):

- Workshop on data needs (Brussel, 22 January 2018)
- Questionnaire on data needs and PV monitoring guidelines defined and send out to all PEARL-PV participants (completed 26.04.2018)

Deliverables by the end of Grant Period 2 (30 April 2019)

- Report “Results from questionnaire on data needs and PV monitoring guidelines” (November 2018) (Task 1.1.1)

- Report D1.1 First annual report of WG1 activities (November 2018)
- Seminar S1.1 Matching PV data and PV performance research questions (Nicosia, Cyprus, 22 October 2018)
- Contribution to training school "Monitoring and Simulation of the Performance and Reliability of PV in the Built Environment" (Nicosia, Cyprus, 23-26 October 2018)
- Contribution to joint conference paper for 35th EU PVSEC (September 2018)
- Realization of first data bank at MC member server (Task 1.2.1, 1.2.2, 1.2.3)
- Report on state-of-the-art in data use and analysis guidelines (Task 1.3.1), potentially in the form of a paper
- Report on data access (Q2-2019)

Deliverables by the end of Grant Period 3 (30 April 2020)

- Contribution to training school "Evaluation of the performance degradation of PV-systems – influence factors, failure modes and their detectability and affect on economic viability" (Q3-2019)
- Realization of updated data bank at MC member server (Task 1.2.4)
- Contribution to (joint) conference paper for 36th EU PVSEC (September 2019)
- Report D1.2 Second annual report of WG1 activities (November 2019)
- Report on updated state-of-the-art in data use and analysis guidelines (Task 1.3.2, 1.3.3), potentially in the form of a paper
- First paper on analysis of data on PV system performance using data collected (Task 1.3.4)

Deliverables by the end of Grant Period 4 (30 April 2021)

- Realization of updated data bank at MC member server (Task 1.2.4)
- Scientific paper on overall performance of PV systems in Europe, focus on energy yields (Q2-2020, Task 1.3.4)
- Contribution to (joint) conference paper for 37th EU PVSEC (September 2020)
- Report D1.3 Third annual report of WG1 activities (November 2020)
- Contribution to training school "Simulation tools and models for the forecast of system efficiencies of PV plants – with focus on environmental and integration aspects (Q3-2020)

Deliverables by the end of Grant Period 5 (31 October 2021)

- Contribution to (joint) conference paper for 38th EU PVSEC (September 2021)
- Scientific paper on detailed analysis of performance of PV systems in Europe, identifying causes for malfunction (Q3-2021, Task 1.3.4)
- Contribution to (joint) conference paper for 38th EU PVSEC (September 2021)
- Contribution to training school "Potential of monitoring tools and advanced operation and maintenance practice for security and predictability of PV performance (Q3-2021)
- Report D1.3 Fourth annual report of WG1 activities (31 October 2021)

2. Workplan of WG2: Reliability and Durability of PV

WG2 Chair: Gernot Oreski, Polymer Competence Center Leoben GmbH, Austria

WG2 Vice Chair: Hristina Spasevska, SS Cyril and Methodius University Skopje, Macedonia

The main objectives of WG 2 are defined as follows:

1. Definition of reliability and durability metrics for PV modules, components and systems
2. Identification of relevant data to be collected to measure reliability and durability
3. Sharing knowledge via workshops, seminars and joint publications originating from WG2 with a wider community of PV experts solar electricity and other experts working for insurers, investors and banks.

WG2 Description of Tasks

The work in WG2 is divided in two Tasks. The Deliverables and Task Leaders are summarized in Table 2.

Task 2.1: Development of a common description of reliability and durability of PV modules and PV systems by meetings and communications with PV researchers and other experts leading to a shared document to be published on this COST Action's website.

Task 2.2: Identification of required data and appropriate simulation models to be used in the framework of understanding reliability and durability given the challenges of (i) the often long elapsed duration before occurrence of both defects and degradation of PV modules in the field (ii) the climate dependency of these effects and (iii) relationships between the manufactured quality of PV module and observed reliability and durability in practice.

Table 2: Overview on Tasks, Task leaders and deliverables for WG2

TASK 2.1: Development of a common description of reliability and durability of PV modules and PV systems LEADER: Gernot Oreski Task 2.2: Identification of required data to be used in the framework of understanding reliability and durability LEADER: Ana Rosa Lagunas
DELIVERABLES AT THE END OF THE 1ST GRANT PERIOD (30.04.2018)
Work Plan (done)
Deliverables at month 12 (01.11.2018)
WG2 report #1
Deliverables at month 24 (01.11.2019)
WG2 report #2 Workshop #1: Reliability metrics for PV
Deliverables at month 36 (01.11.2020)
WG2 report #3 Workshop #2 Deliverable 5: White paper on definition of reliability and durability of different PV technologies
Deliverables at month 48 (01.11.2021)
WG2 report #4 Deliverable 7: Report on possible ways for modelling durability and reliability aspects of PV

Task 2.1: Development of a common description of reliability and durability of PV modules and PV systems

The main objective of Task 2.1 is the definition of reliability and durability metrics for PV modules, components and systems. One the one hand properties describing reliability & durability from different views of PV stakeholders (Consumers, investors, manufacturers, researchers, utilities) are defined. One the other hand also different metrics for different PV technologies (c-Si, thin film, organic….) are considered. Also metrics dependent on different applications like PV for consumer products, utility-scale power production, mobility, building integration etc. will be evaluated. Finally also discrepancies between high durability and easy end-of-life management will be addressed.

The main outcome of Task 2.1 is Deliverable 5 mentioned in the MoU: White paper on definition of reliability and durability of different PV technologies, which is planned to be published mid 2020. The tentative paper structure has been discussed with the work group members via email, a conference call in July 2018, bilateral talks and a personal meeting at the PVSEC 2018 in Brussels. The main contributing authors (as of October 2018) will be: Gernot Oreski (AUT); Gabriele Eder (AUT); Alessandro Virtuani (CH); Eleonora Annigoni (CH); Caroline Tjengdrawira (BE); Krzysztof Pielichowski (PL); Mihaela Girtan (F); Killian Lobato (PT); Shahzada Ahmad (E); Samrana Kazim (E); Jeff Kettle (UK). The next steps will be the distribution of an online document as well as to attract additional WG members to take over missing contributions. The tentative paper structure is shown in Table 3.

Table 1: Paper structure based on WG2 members feedback

1	Definition of reliability and end-of-life considering different views of PV stakeholders and different technologies ▪ Differentiation of the terms reliability and durability ▪ Standard conditions for reliability – climate conditions ▪ End-of-Life & Reliability: Consideration of different applications like PV for consumer products, utility-scale power production, mobility, building integration etc. ▪ Discussion of PV Modules, PV systems and BOS components ▪ Different approach of reliability for different technologies: i. Silicon PV ii. CIGS iii. CDTE iv. Organic PV and Dye Sensitized Cells v. Perowskites vi. Other ▪ Discussion and disclosure of discrepancies between high durability and easy end-of-life management ▪ Aspects of Eco-Design and recyclability?
2	Reliability testing of PV modules ▪ How to test reliability? ▪ Possibilities of acceleration ▪ Overview on comparison of lab results with field results
3	Modelling of PV module and PV system reliability and/or lifetime ▪ Can reliability, lifetime or end-of-life be modelled from short term testing? ▪ Known approaches for life time estimation and modelling i. Modelling of material degradation effects (polymers, metal…) ii. Modelling of failure modes → IEA Task 13 iii. Modelling of PV systems
4	Outlook: Can available models for single effects or single materials be combined to a comprehensive PV module lifetime assessment method? ▪ Which approaches? ▪ Which data is needed? ▪ Proof of concept?

Task 2.2: "Identification of required data to be used in the framework of understanding reliability and durability"

The work plan of Task 2.2 had to be adapted in order to avoid overlaps and duplications with parallel running activities. For example, simulation models for certain PV module degradation modes are already summarized in IEA Task 13 report on "Assessment of PV module failures in the field" (published 2017). Also, there are strong overlaps between original Task 2.2 description and recent IEA PVPS Task 13 work program (2018-2021), which runs in parallel to Pearl PV. Moreover, several proposals of WG2 members are already covered within Task 13, such as description of reliability and failure modes of new module technologies and new system designs. Therefore the new objectives for Task 2.2 are as follows.

Main objectives: Identification of relevant data to be collected to measure reliability and durability. This includes the description of mass PV data analysis methods - output power over time and multi-faceted analysis to gauge output decrease, the identification of issue causing decrease in power output (e.g. shading, physical degradation…) and a correlation of failure modes with climatic conditions

The planned output of Task 2.2 is Deliverable 7 ("An open source model for durability and reliability aspects of PV modules"). However, the WG members are not sure if this deliverable can be provided at the end of the COST action. Nevertheless, chapters 3 and 4 of the Task 2.1 Paper are dealing with this question and at least will provide a current state of the art as well as an outlook on what has to be done in order to provide such a model.

WG2 Deliverables Plan

Within the project specification, three main deliverables were identified for WG2 (D5 to D7 detailed below). This deliverables plan links the main deliverables to their respective Tasks and identifies the path to those deliverables, according to the current workplan.

D5. Publications of findings originating from WG2 in high-impact journals, conference proceedings and a special issue of an international peer reviewed journal..

Pathway to D5: to be amended in the next version of the workplan

D6. Reports of the WG2 activities (month 12, 24, 36, 48), including the organisation of one workshop per year on reliability and durability of PV modules, components and systems.

Pathway to D6: to be amended in the next version of the workplan

D7. An open source model for durability and reliability aspects of PV modules

Pathway to D7: to be amended in the next version of the workplan

3. Workplan of WG3: PV Simulation

WG3 Chair: Nicola Pearsall, Northumbria University, UK

WG3 Vice Chair: João Serra, Universidade de Lisboa, Portugal

'PV Simulation' considers the use of modelling tools to simulate the performance of photovoltaic devices and systems. This covers both the prediction and the assessment of performance and complements the activities of the other Working Groups in the PEARL PV project, especially those considering specific PV applications. The objectives of WG3 are:

1. Classification of PV simulation models by content ranging from (i) fundamental solar cell research, (ii) PV irradiance modelling including forecasting and cloud formation, (iii) PV systems (grid-connected, stand alone and hybrid), (iv) PV in the built environment and (v) PV grid interactions. Distinction will be determined between simulation models that can predict performance on short and long timescales as well as different approaches to prediction of the durability of PV modules and systems.
2. Identification of PV simulation tools and models by category.
3. Provision of access to information about PV solar electricity simulation models.
4. Comparison of various PV solar electricity simulation models.
5. Sharing knowledge originating from WG3 with a wider community of PV and other renewable energy experts by internet, workshops, seminars and joint publications about the topic of PV simulation.

WG3 Description of Tasks

WG3 has three major tasks, as described below.

Task 3.1: Development of a common description of PV simulation

The description of simulation will be expressed in terms of the categories outlined in Objective 1 and developed by meetings and consultation with PV researchers and other experts, both within and outside the COST Action. This will lead to a shared document to be published on the PEARL PV website, together with contributions to the journal, conference and workshop publications from PEARL PV. The initial work involves the initial identification of software, the categorization of that software and the specification of the information requirements for the inventory (ST 3.1.1). This feeds into the development of the questionnaire in Task 3.2 (see below), the results of which will feed back into ST 3.1.2 where the scope of the current modelling will be determined. Finally, the recommendations arising from ST 3.1.3 will feed into the definition and realization of the testing programme in Task 3.3 (see below).

The three subtasks will be completed by the end of Grant Period 2 and will then be repeated as necessary to support the recurring testing programme in Task 3.3.

This task contributes mainly to Objectives 1, 2, 3 and 5.

Task Leader: Tihomir Betti, Croatia

Subtasks:

ST 3.1.1	Identification of the simulation categories and inventory requirements
ST 3.1.2	Determination of the scope of modelling currently undertaken
ST 3.1.3	Recommendations for testing of models and development of new models

Task 3.2: Identification of PV simulation tools and models

This task will identify the PV simulation tools and models that are currently used and/or available to the PV community, together with information on scope and ease of use. This will be achieved via consultation with the COST Action participants and other members of the community, together with internet and publication searches. The first two subtasks relate to the development and distribution of a questionnaire that investigates the current usage of software by the COST Action participants and others, determines some of the reasons for that usage and seeks to identify any gaps in provision. ST 3.2.3 summarizes the results of the questionnaire and feeds into ST 3.1.2 and 3.1.3 of Task 3.1.

The initial distribution and analysis of the questionnaire will be completed by the middle of Grant Period 2, with subsequent investigations (using the same or a modified questionnaire) will be carried out as necessary through the COST Action.

This task contributes mainly to Objectives 2, 3 and 5.

Task Leader: Jesús Robledo Bueno, Germany

Subtasks:

ST 3.2.1 Preparation of simulation questionnaire (including delivery method)

ST 3.2.2 Distribution of questionnaire

ST 3.2.3 Analysis of questionnaire responses and summary of inventory results

Task 3.3: Testing of simulation models

A selection of models, identified and classified in the first two tasks, will be tested in a round-robin format by participants in the COST Action. The testing will investigate the suitability of the models for meeting the requirements of the community, with specific interaction with the PEARL PV Working Groups in relevant areas. Testing will be repeated at intervals during the COST Action so as to account for developments in both the models and the simulation needs. ST 3.3.1 will use information from Tasks 3.1 and 3.2 to aid in the definition of which software should be tested and the applications to be considered. The second and third subtask relate to the organization of the testing, linking with one or more of the other Working Groups in the COST Action, and the assessment of the results from the testing.

The choice of software to be tested, the system scenarios to be considered and the execution of the tests will be carried out in consultation with the other Working Groups, depending on the focus of the test. Relevant data from the database developed by WG1 will be used in the testing, where possible. For each testing round, liaison members will be identified for all relevant Working Groups to ensure close cooperation. The coordination of the testing will take account of the expertise of members in the relevant Working Groups and the methodology will be adapted to suit the topic (e.g. BIPV systems, durability of modules) and the chosen software.

The first round of testing is planned to be completed by the third quarter of Grant Period 3, with two further rounds of testing in GP3/4 and GP 4/5.

This task contributes mainly to Objectives 3, 4 and 5.

Task Leader: Nicholas Riedel, Denmark

Subtasks:

ST 3.3.1 Definition of software to be tested, together with the test regimes

ST 3.3.2 Organisation and completion of the round robin testing programme

ST 3.3.3 Assessment of test results and recommendations for future tests

WG3 Deliverables Plan

Within the project specification, three main deliverables were identified for WG3 (D8 to D10 detailed below). This deliverables plan links the main deliverables to their respective Tasks and identifies the path to those deliverables, according to the current workplan.

D8. Publication of findings originating from WG3 in high impact journals, conference proceedings and a book.

Pathway to D8: All three tasks will result in the preparation of reports, specifically as an output of STs 3.1.2, 3.1.3, 3.2.3 and 3.3.3. These will be assessed in terms of their suitability for the preparation of journal or conference papers, with a specific target of the specialist journals and conferences relating to the PV community. Since the first reports are due to be prepared in the third quarter of GP2, the initial plan is to target abstract submission for the PV conferences taking place from April to September 2019. WG3 will also contribute to papers submitted in relation to the overall PEARL PV project, as appropriate. It is expected that the work of WG3 will allow a contribution of one or two specialist chapters to the projected book arising from the COST Action.

D9. Annual reports of the WG3 activities, together with the organization of two workshops and two seminars on PV simulation.

Pathway to D9: Annual reports will be produced as required. The first annual report, in autumn 2018, will report on Tasks 3.1 and 3.2, both of which will be well advanced at that time. WG3 is also contributing to the training workshop to be held in October 2018, with a specific set of sessions on the simulation of BIPV systems. It is planned that the third PEARL PV training workshop, to be held in GP4, will focus on simulation and modelling, whilst WG3 also expects to contribute to the fourth workshop in GP5. The detail of the seminar programme is still to be determined.

D10. Open source software for the simulation of PV modules and systems.

Pathway to D10: The activities of Tasks 3.1 and 3.2 will identify the current open source software available for PV modules and systems and provide advice on how to access this software. Task 3.3 is likely to include the testing of some open source software in the round robin programme. WG3 will identify the current software and make recommendations for future development. If appropriate, some software development may be instigated or projects identified for that development.

WG3 Timetable of Actions

Task	Subtask	2017	2018			2019			2020			2021	
		10-12	1-4	5-8	9-12	1-4	5-8	9-12	1-4	5-8	9-12	1-4	5-10
3.1	3.1.1												
	3.1.2												
	3.1.3												
3.2	3.2.1												
	3.2.2												
	3.2.3												
3.3	3.3.1												
	3.3.2												
	3.3.3												

Tasks 3.1 and 3.2 repeated as necessary

	Grant Period 1
	Grant Period 2
	Grant Period 3
	Grant Period 4
	Grant Period 5

Deliverables by the end of Grant Period 1 (30 April 2018):

- Definition of the questionnaire - delayed to 23 May 2018 (completed)
- Distribution of the questionnaire – delayed to 01 June 2018 (completed)

Deliverables by the end of Grant Period 2 (30 April 2019)

- Report (ST 3.1.2) on the scope of the modelling tools at the current stage
- Report (ST 3.2.3) summarizing the questionnaire/inventory results
- Report (ST 3.1.3) on the recommendations for testing of models
- Definition of software to be tested (Round 1) (ST 3.3.1)
- Review/benchmark paper on PV simulation
- Workshop 1 with session on PV simulation of BIPV systems
- First annual report for WG3 (month 12)

Deliverables by the end of Grant Period 3 (30 April 2020)

- Report on the first round of simulation testing (Task 3.3.3)
- Definition of the software to be tested (Round 2) (Task 3.3.1)

- Report on the organisation of the first seminar on PV simulation
- Paper on simulation testing results
- Second annual report for WG3 (month 24)

Deliverables by the end of Grant Period 4 (30 April 2020)

- Report on the organization of the training workshop on PV simulation
- Report on the second round of simulation testing (Task 3.3.3)
- Definition of the software to be tested (Round 3) (Task 3.3.1)
- Third annual report for WG3 (month 36)

Deliverables by the end of Grant Period 5 (31 October 2021)

- Report on the organization of the second seminar on PV simulation
- Report on the third round of simulation testing (Task 3.3.3)
- Paper on open source software availability and development needs
- Fourth annual report for WG3 (month 48)

4. Workplan of WG4: PV in the Built Environment

WG4 Chair: Alessandra Scognamiglio, ENEA, Italy

WG4 Vice Chair: Francesco Frontini, SUPSI, Zwitserland

For many years PV has been used with the unique objective to produce renewable energy from the sun thanks to the installation of modules on open area field and on large industrial or commercial flat roofs. Since the drastically cost reduction of photovoltaic technologies and the definition of net Zero Energy Buildings as target for new buildings by 2020, the idea to integrate PV modules in Built environment (mainly as façade or roof element) become more feasible and important for designers. This has been defined as Building Integrated Photovoltaic (BIPV) meaning that PV modules will serve not only as renewable energy producers but also as element of the building with further functions such as weather protection or shading device.

If integrated in the Built Environment PV modules have to withstand more complex and often variables outdoor condition leading to more complex situation difficult to be predicted with SoA simulation model and existing standards that are normally produce to represent “conventional” condition. For these reasons the main goal of WG4 are:

1. Collect information about the applications of PV solar electricity in the built environment using both information from other WGs and by communications with PV experts, architects, installers, construction and building services engineers and city/urban planners.

2. Identify monitored data and the appropriate simulation models to be used in the framework of PV in the built environment.

3. Sharing knowledge originating from WG4 with a wider community of PV experts and other experts in the building sector by internet, workshops, seminars and joint publications.

WG4 Description of Tasks

WG4 has two major tasks, as described below.

Task 4.1: Collection of information in the data server

The aim of this task is the collection of information in a data server of this Cost Action about PV in the built environment. In particular it is foreseen to collect, thanks to the interviews of different WG partners and other stakeholders all relevant and useful information from realized projects (such as exemplary public founded research or Pilot and Demonstration projects), scientific publications and information retrieved from internet.

Moreover since the objective is to enlarge the scope of the task and increase the echo of the action PV experts related to cost partners, architects that already experienced PV installation in their building project, installers, construction and building services engineers and city/urban planners will be interviewed thanks to a specific survey that will be developed.

The data collected will be stored in a data server and available also for other WGs.

Task 4.2: Identification of required data and appropriate simulation models to be used in the framework of PV systems in the built environment

The aim of the task that is fully complementary of task 3.1 is to identify useful relevant data from real case studies to assess and simulate the performances and the behaviors of PV system in the built environment (BIPV). This collection will be done thank to first the definition of BIPV and PV in built environment archetypes (thanks to the description of used and existing product and system), afterward the physical, technological and architectural parameters related to integration into building (e.g. shading, temperature, non-optimal cabling, …) will be described in order to in the last stage to identify the specific and appropriate simulation models that better fit to the planning needs and designer requirements.

Within this task the building and planning codes (such as international regulation and norms) that apply and are required for BIPV will be also reviewed and presented in order to give a general overview of the international (with focus on European region) situation.

There is a strong overlaps between Task 4.2 description and recent IEA PVPS Task 15 work program that maybe extended after 2019.

Subtasks:

ST 4.2.1 Definition of BIPV and PV in built environment archetypes (product and system)

ST 4.2.2 Identification of issue and parameter related to integration into building (e.g. shading, temperature, non-optimal cabling, …)

ST 4.2.3 Identification of specific and appropriate simulation models

ST 4.2.4 Identification of building and planning codes/regulation/norms that apply and are required for BIPV.

WG4 Deliverables Plan

Within the project specification, three main deliverables were identified for WG3 (D8 to D10 detailed below). This deliverables plan links the main deliverables to their respective Tasks and identifies the path to those deliverables, according to the current workplan.

D11. Publications of findings originating from WG4 in high-impact journals, conference proceedings and a special issue of an international peer reviewed journal.

Pathway to D11: All tow tasks will result in the preparation of reports, specifically as an output of different subtasks activities as described before. These will be assessed in terms of their suitability for the preparation of journal or conference papers, with a specific target of the specialist journals and conferences relating to the BiPV community (photovoltaic expert and construction domain). In particular for the firs years we have foreseen two publication regarding the Trends in integration of photovoltaic facilities into the built environment and the identification of international experiences on the use of photovoltaics in the built environment.

For the second half of the project a report and a scientific publication is foreseen on the actual situation of PV in built environment in practice: photovoltaic products, building technologies and morphologies. Worldwide overview.

D12. Reports of the WG 4 activities (month 12, 24, 36, 48), including the organization of two workshops and two seminars about PV in the built environment.

Pathway to D12: Annual reports will be produced as required. The first annual report, end of 2018, will report on Tasks 4.1, both of which will be well advanced at that time. WG4 is also contributing to the training workshop to be held in October 2018 in Cyprus, with a specific set of sessions on the simulation of BIPV systems and state of the art of BIPV in Europe. The detail of the following seminar programs is still to be determined.

D13. Open source data and software for PV in the built environment

Pathway to D13: Collection of information in the data server of this Action about PV in the built environment, from realized projects, publications and information retrieved from internet, together with PV experts, architects, installer, construction and building services engineers and city/urban planners. Design of the data server still have to be completed.

WG4 deliverables at the end of 1st GP

Under D11 the following publications were published:

Paper for Places and Technologies conference 2018 (published in the proceedings)
Title: Trends in integration of photovoltaic facilities into the built environment
Authors: Aleksandra Krstić-Furundžić, Alessandra Scognamiglio, Mirjana Devetaković, Francesco Frontini, Budimir Sudimac

Paper for ESCC Energy Sustainablity and Climate Change 2018 (abstract in publishing process in the conference proceedings)
Title: International experiences ongoing on the use of photovoltaics in the built environment. Starting points for new research development
Authors: Alessandra Scognamiglio, Francesco Frontini (abstract to be published in the book of proceedings).

Paper for EUPVSEC (presented as a visual presentation)
Title: The Use of Photovoltaic Technologies in the Built Environment: Open Issues and Research Perspectives
Authors: A. Scognamiglio, F. Frontini, A. Krstić-Furundžić, M. Devetaković, B. Sudimac

5. Workplan of WG5: PV in grids

WG5 Chair: Jonathan Leloux, Polytechnic University of Madrid, Spain

WG5 Vice Chair: Marios Theristis, University of Cyprus, Cyprus

The WG5 aims to contribute towards PV systems that are better integrated into the grid, that perform better, and whose operation under real-world conditions is better understood. This WG will use information from WG1, WG2 WG3 and WG4 on PV monitoring, reliability and durability and PV simulation respectively and information from communications with PV experts, electrical engineers, utilities, smart grid experts and meteorologists. These objectives will be achieved by exploring different complementary pathways, such as the dentification of required data and appropriate simulation models, to be used in the framework of PV in grids, and the development of several data analysis and simulation tools, for PV integration into the grid, PV power forecasting, power quality evaluation, and fault detection.

WG5 Description of Tasks

WG5 has five major tasks, as described below.

Task 5.1: PV power forecasting and self-consumption

This task is concerned with the short-term and long-term accurate forecasting of solar PV power generation and cloud formation to help utilities to better balance their distribution grids. There is a need for accurate forecasting of solar power and cloud formation by utilities to be able to balance distribution grids. Matching electricity demand with supply in (smart) energy homes is a promising path for the future. Smart solar charging of electric vehicles and other storage solutions will be contemplated, as well as self-consumption and domestic uses of PV such as smart appliances. A tool will be developed to provide a short-term and also a long-term forecasting of irradiance and PV power generation for utilities. It will also study the relationship between PV power fluctuations, solar irradiation, local and energy consumption.

Peer-to-peer prosumer cooperation, e.g. using blockchain technology are increasingly appearing as a viable option for the future development of PV generation. Therefore, a tool will be developed to allow for these considerations, and it will contain a spatio-temporal forecasting using data from distributed PV systems.

Task Leader: Carolina Senabre, Miguel Hernandez University of Elche, Spain

Task 5.2: PV power fluctuations for grid operators

An analysis of the interface between PV systems and low voltage distributed grids will be carried out. The possibility for feeding distributed solar power into grids under variable irradiance conditions will be explored. A tool will be developed to provide a short-term and also a long-term forecasting of irradiance and PV power generation for utilities.

A tool will allow the assessment of the PV power mitigation potential from the geographic dispersion of PV systems.

A tool will be developed for the assessment of PV power fluctuations at one PV system, as well as for PV system fleets, including the study of the correlation between the fluctuations in PV power between neighboring installations. This will be done through several complementary approaches, including parametric and non-parametric models, peer to peer (P2P) approaches, Artificial Neural Networks (ANNs), the use of geostatistics...

Task Leader: Emilio Gómez, University of Castilla-La-Mancha, Spain

Task 5.3: PV power quality in the grid

The evaluation of the Power Quality indicators at the connection of PV systems to the grid is going to become increasingly important along with the increasing PV penetration into the grid, and a tool will therefore be developed to analyze these aspects.

Task Leader: Sonia Pinto, University of Lisboa, Portugal

Task 5.4: PV energy storage and management

Better energy management and storage control at the interface between PV systems and low voltage distributed grids are needed and they will be investigated. There will be a link with the smart solar charging of electric vehicles, and domestic uses of PV such as smart appliances. This includes the study of the relationship between the PV production and the local consumption, the possible use of batteries, the economic viability of alternative options...

Task Leader: Luis Fialho, University of Évora, Portugal

Task 5.5: PV performance and fault detection

Better procedures for cheap and effective Operation and Maintenance (O&M) of PV systems will be searched for, including soiling and cleaning strategies.

A fault detection toolbox will be developed to improve the energy yield of grid-connected PV systems and reduce their power instability. This will be done through several complementary approaches, including parametric and non-parametric models, peer to peer (P2P) approaches, Artificial Neural Networks (ANN), stochastic modelling...

Task Leader: Emilio Muñoz, University of Jaén, Spain

WG5 Deliverables Plan

Within the project specification, three main deliverables were identified for WG5 (D14, D15 and D16 detailed below).

D14. Publications of findings originating from WG5 in high-impact journals, conference proceedings and a special issue of an international peer reviewed journal.

Pathway to D14: Several journal publications will be produced. Their exact nature will depend on the advances that will be achieved in each one of the five tasks.

D15. Reports of the WG5 activities (month 12, 24, 36, 48), including the organization of two workshops and two seminars about PV in grids.

Pathway to D15: Workshops and seminars will be held during the course of the project and they will allow to present the main findings obtain as the results of the work done in WG5.

D16. Open source data and software for PV in grids.

Pathway to D16: Several tools will be developed in WG5, and part of their code will be made open source, to be decided as a function of the interest of the parties and the soundness of the use of open source for these tools.

6. Schedule of Future Meetings and Results

Event	Dates	Location - LO	Targeted audience	Comments
Seminar WG1	22 – 10 - 2018	Cyprus – Nicosia - University of Cyprus	WG 1 members and all other interested Action participants	Confirmed
Training School 1 *	23 – 10 – 2018 until 26 – 20 -2018	Cyprus – Nicosia - University of Cyprus	Trainees: PhD students, colleagues from academia, industry partners	Confirmed
MC3 meeting	25 – 02 - 2019	Portugal - Lisbon – University of Lisbon	MC members only	Confirmed
Workshops	26 – 02 – 2019 until 01 – 03 -2019	Portugal - Lisbon – University of Lisbon	All participants of the Action	Confirmed
Seminar	14 – 10 - 2019	Malta – MCAST	All participants of the Action	Confirmed
Training School 2 *	15 – 10 – 2019 until 18 – 10 - 2019	Malta - MCAST	Trainees: PhD students, colleagues from academia, industry partners	Confirmed
MC4 meeting	February 2020	Netherlands – Utrecht - UU	MC members only	Dates not confirmed
Workshops	February 2020	Netherlands – Utrecht - UU	All participants of the Action	Dates not confirmed
Seminar	15 – 10 - 2020	Romania – University of Brasov	All participants of the Action	Confirmed
Training School 3 *	16 – 10 – 2020 until 20 – 10 - 2020	Romania – University of Brasov	Trainees: PhD students, colleagues from academia, industry partners	Confirmed
MC5 meeting	February 2021	TBDL	MC members only	Local organizer to be selected Dates not confirmed

Workshops	February 2021	TBDL	All participants of the Action	Local organizer to be selected Dates not confirmed
Conference	October 2021	Netherlands – Enschede - UT	All participants of the Action	Dates not confirmed
Training School 4 *	October 2021	Netherlands – Enschede - UT	Trainees: PhD students, colleagues from academia, industry partners	Dates not confirmed
Valorization Panel Meeting	2019	TBDL	External parties from industry, governmental bodies, consumer organizations and financial institutions	VPMs will be scheduled in coherence with major conferences, therefore location and exact dates tbdl
Valorization Panel Meeting	2020	TBDL	Idem	Idem
Valorization Panel Meeting	2021	TBDL	Idem	Idem

*) *Training School 1:* Monitoring and Simulation of the Performance and Reliability of PV in the Built Environment.
Training School 2: Evaluation of the performance degradation of PV-systems – influence factors, failure modes and their detectability and effects on economic viability.
Training School 3: Simulation tools and models for the forecast of system efficiencies of PV plants – with focus on environmental and integration aspects.
Training School 4: Potential of monitoring tools and advanced operation and maintenance practice for security and predictability of PV performance.

7. Publication Policy of PEARL PV

Authors of papers are allowed to acknowledge PEARL PV only if at least 2 PEARL PV countries are represented. Please make sure that you circulate the author list and an abstract of the manuscript to the relevant WG leader(s), chair and vice chair:

- 2 weeks before submission in case of submission to a peer-reviewed journal, and
- 1 week before submission in case of submission to a conference.

Once published please send a communication to the Action's Science Communication Manager for further dissemination of the publication through the PEARL PV publication list at the website of PEARL PV: https://www.pearlpv-cost.eu/dissemination/publications/

Please follow the dissemination guidelines and COST corporate identity which can be found here http://www.cost.eu/media/dissemination-corporate-identity

Please include the following standard COST acknowledgment in any publication, poster, book, etc.: " This article/publication is based upon work from COST Action CA16235 PEARL PV supported by COST (European Cooperation in Science and Technology)" as well as further texts shown on page 55 of this workplan. Please also include the COST website as well as the PEARL PV, COST logo and EU logo in any publication. If space is limited then only the COST logo should be shown.

8. Participant Lists of COST Action PEARL PV

Core Group and Special Roles

Core Group Members

Role	Name	Country
Action Chair	Prof.dr. Angèle Reinders	Netherlands
Action Vice Chair	Dr. David Moser	Italy
Grant Holder	Mr. Peter Jansen	Netherlands
Working Group 1 Leader	Prof.dr. Wilfried van Sark	Netherlands
Working Group 2 Leader	Dr. Gernot Oreski	Austria
Working Group 3 Leader	Prof.dr. Nicola Pearsall	United Kingdom
Working Group 4 Leaders	Dr. Alessandra Scognamiglio Dr. Francesco Frontini	Italy Switzerland
Working Group 5 Leader	Mr. Jonathan Leloux	Spain
STSM Manager	Dr. Markus Schubert	Germany
Science Communication Manager	Mrs. Eliza Loucaidou	Cyprus

Special Roles

Role	Name	Country
Training School Manager	Dr. Gabriele Eder	Austria
Training School Manager	Prof.dr. Aleksandra Krstic-Furundzic	Serbia
Newsletter Editor	Dr. Sarah McCormack	Ireland
COST Policy Monitoring Manager	Mr Jonathan Leloux	Spain
Industry Liaison Manager	Mrs. Laura Azpilicueta	Spain
Science Communication Support	Mr. Vasileios Tompros	Greece
Web Manager	Mr. Fjodor van Slooten	Netherlands

MC Members and MC Substitutes

MC Members

Country	MC Member
Austria	Dr Gernot ORESKI
Austria	Mr Karl BERGER
Belgium	Mr Gaëtan MASSON
Belgium	Mr Guillaume DECLÈVE
Bosnia and Herzegovina	Mr Jovan TODOROVIC
Bulgaria	Prof Penka GEORGIEVA
Croatia	Dr Tihomir BETTI
Cyprus	Prof George Elias GEORGHIOU
Cyprus	Ms Eliza LOUCAIDOU
Denmark	Dr Dezso SERA
Denmark	Mr Nicholas RIEDEL
France	Mr David TREBOSC
France	Mr Adrien DESPORTES
fYR Macedonia	Prof Hristina SPASEVSKA
fYR Macedonia	Prof Vladimir DIMCHEV
Germany	Dr Markus B. SCHUBERT
Germany	Mr Dirk STELLBOGEN
Greece	Dr Ioannis GIALELIS
Greece	Dr George MOUSDIS
Ireland	Prof Brian NORTON
Ireland	Dr Sarah MCCORMACK
Israel	Dr Abraham YOSIPOF
Israel	Dr Tareq ABU HAMED
Italy	Dr David MOSER

Italy	Dr Alessandra SCOGNAMIGLIO
Latvia	Dr Mikelis DZIKEVICS
Lithuania	Prof Vaidotas KAZUKAUSKAS
Malta	Ms Renata MIKALAUSKIENE
Malta	Dr John LICARI
Netherlands	Dr Wilfried VAN SARK
Norway	Prof Anne Gerd IMENES
Norway	Dr Sean Erik FOSS
Poland	Prof Krzysztof PIELICHOWSKI
Poland	Mr Daniel PIASECKI
Portugal	Mr Luis FIALHO
Portugal	Prof João SERRA
Romania	Prof Marius PAULESCU
Romania	Prof Bogdan-Gabriel BURDUHOS
Serbia	Prof Aleksandra KRSTIC-FURUNDZIC
Slovenia	Prof Marko TOPIC
Slovenia	Dr Mitja MORI
Spain	Mr Jonathan LELOUX
Spain	Ms Laura AZPILICUETA
Switzerland	Ms Gabi FRIESEN
Switzerland	Dr Alessandro VIRTUANI
Turkey	Dr Abdulkerim GOK
	Dr Alastair BUCKLEY
	Prof Nicola PEARSALL

MC Substitute Members

Country	MC Substitute
Austria	Dr Bettina OTTERSBÖCK
Austria	Dr Marcus RENNHOFER
Belgium	Ms Caroline TJENGDRAWIRA
Belgium	Mr Patrick HENDRICK
Croatia	Dr Ivan MARASOVIC
Cyprus	Dr Marios THERISTIS
Cyprus	Dr Nestor FYLAKTOS
Denmark	Mr Peter BEHRENSDORFF POULSEN
France	Prof Mihaela GIRTAN
France	Mr Simon BODDAERT
fYR Macedonia	Prof Vlatko STOILKOV
fYR Macedonia	Dr Dijana CAPESKA BOGATINOSKA
fYR Macedonia	Prof Margarita GINOVSKA
Germany	Mr Christian BRAUN
Germany	Dr Carolin ULBRICH
Greece	Dr Stathis TSELEPIS
Greece	Mr Vasileios TOMPROS
Ireland	Ms Aydaa ESFANDYARI
Lithuania	Dr Mindaugas PRANAITIS
Malta	Dr Cedric CARUANA
Malta	Dr Brian AZZOPARDI
Malta	Mr Ryan BUGEJA
Netherlands	Dr Atse LOUWEN
Norway	Dr Espen OLSEN
Norway	Prof Marisa Di SABATINO
Poland	Mr Jakub NIEDZWIEDZ

Portugal	Dr Hugo SILVA
Portugal	Prof Sónia PINTO
Romania	Dr Petru Adrian COTFAS
Romania	Prof Ion VISA
Serbia	Prof Budimir SUDIMAC
Slovenia	Dr Kristijan BRECL
Spain	Dr Ana LAGUNAS
Spain	Dr Emilio MUNOZ CERON
Spain	Prof Emilio GOMEZ
Switzerland	Dr Francesco FRONTINI

Participant Lists of WG1

Members of WG1*: to be amended in the next version of the workplan*

Task	Role	Name	Country

Participant Lists of WG2

Members of WG2*: to be amended in the next version of the workplan*

Task	Role	Name	Country

Participant List of WG3

Members of WG3

Task	Role	Name	Country
	Chair	Nicola Pearsall	United Kingdom
	Vice Chair	Joao Serra	Portugal
3.1	Task Leader	Tihomir Betti	Croatia
3.2	Task Leader	Jesus Robledo Bueno	Germany
3.3	Task Leader	Nicholas Riedel	Denmark
	Participant	Ian Cole	Cyprus
	Participant	Imre Horvath	Belgium
	Participant	Philip Ingenhoven	Italy
	Participant	Sanya Lazarova-Molnar	Denmark
	Participant	Steve Ransome	UK
	Participant	Budomir Sudimac	Serbia

Participant List of WG4

Members of WG4

Task	Role	Name	Country
4.1; 4.1a	(Vice) Chair; Task Leader	Alessandra Scognamiglio	Italy
4.2; 4.1d	(Vice) Chair; Task Leader	Francesco Frontini	Switzerland
4.1c	Task Leader	Georgia Apostolou	The Netherlands
	Participant	Csaba Benedek	Hungary
	Participant	Simon Boddaert	France
	Participant	Christine Coonik	United Kingdom
	Participant	Bodgan Gabriel Burduhos	Romania
4.1b	Task Leader	Mirjana Devetakovic	Serbia
	Participant	Gabriele Eder	Austria
	Participant	Gabi Friesen	Switzerland
4.1c; 4.1d	Task Leader	Margarita Ginovska	Republic of Macedonia
	Participant	Patrick Hendrick	Belgium
4.1a	Task Leader	Aleksandra Krstic-Furundzic	Serbia
	Participant	Gabriele Lobaccaro	Norway
	Participant	Georgios Martinopolous	Greece
	Participant	Laura Maturi	Italy
	Participant	Marta Panao	Portugal
	Participant	Geralt Siebert	Germany
	Participant	Ion Visa	Romania
4.1b	Task Leader	Maider Machado Garcia	Spain

Participant List of WG5

Members of WG5

Task	Role	Name	Country
5.5	Chair, Participant	Jonathan Leloux	Spain
5.5	Vice Chair, Participant	Marios Theristis	Cyprus
	Participant	Mihaela Albu	Romania
5.5	Participant	Florencia Almonacid	Spain
5.1	Participant	Grazia Barchi	Italy
5.1	Participant	Miguel Brito	Portugal
5.3	Participant	Cedric Caruana	Malta
5.5	Participant	Adrien Desportes	France
5.5	Participant	Eduardo Fernandez	France
5.4	Task leader	Luis Fialho	Portugal
	Participant	Penka Georgieva	Bulgaria
5.1	Participant	Cihan Gercek	Netherlands
5.5	Task leader	Emilio Gomez	Spain
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5.2	Participant	John Licari	Malta
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