This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nº 691768

Quality Management Plan

Project report

Tecnalia

September 2016

Document summary

This document describes the project organization and procedures, tasks, timings, efforts and roles within the PVSITES project. It includes an updated, detailed project management plan, Gantt chart and work breakdown structure. It displays at least a schedule per task, responsible partner, related subtasks, related deliverables and dependencies to other tasks.

Acknowledgements

The work described in this publication has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nº 691768.

The present report was prepared by PVSITES Project coordinator Tecnalia. The report was originally submitted to the European Commission as Project Deliverable D10.1 in April 2016.

Disclaimer

About the PVSITES project

PVSITES is an international collaboration co-funded by the European Union under the Horizon 2020 Research and Innovation program. It originated from the realisation that although building-integrated photovoltaics (BIPV) should have a major role to play in the ongoing transition towards nearly zero energy buildings (nZEBs) in Europe, large-scale deployment of the technology in new constructions has not yet happened. The cause of this limited deployment can be summarised as a mismatch between the BIPV products on offer and prevailing market demands and regulations.

The main objective of the PVSITES project is therefore to drive BIPV technology to a large market deployment by demonstrating an ambitious portfolio of building integrated solar technologies and systems, giving a forceful, reliable answer to the market requirements identified by the industrial members of the consortium in their day-to-day activity.

Coordinated by project partner Tecnalia, the PVSITES consortium started work in January 2016 and will be active for 3.5 years, until June 2019. This document is part of a series of public reports summarising the consortium's activities and findings, available for download on the project's website at www.pvsites.eu.

The PVSITES consortium:

Tecnalia Research & Innovation	CTCV	FormatD2
Onyx Solar	Flisom	Vilogia
BEAR-iD	Cricursa	R2M Solution Research to Market
Nobatek	CEA	CADCAMation
Film Optics	Acciona Infraestructuras	WIP - Renewable Energies

Contents

Tables

Figures

1 EXECUTIVE SUMMARY

1.1 Description of the deliverable content and purpose

This document describes the project management organization, roles, members and execution procedures of PVSITES project for progress and control monitoring, meetings, progress reporting, quality assurance, information sharing, dissemination and internal communication. It also includes an updated, detailed project management plan, Gantt chart and work breakdown structure. It displays at least a schedule per task, responsible partner, related subtasks, related deliverables and dependencies to other tasks.

The governance structure, communication flow and methods and work implementation plan aim to serve as a Project Handbook for the consortium. Revisions of the project quality management plan will be made on month 15 (D10.2) and month 27 (D10.3). These governance structure, communication flow and methods complete and extend PVSITES Consortium Agreement (CA). However, in case of discrepancy, CA text will prevail.

1.2 Reference material

– Grant Agreement 691768

– Consortium Agreement PVSITES

1.3 Abbreviation list

AB	Advisory Board
AFM	Administrative & Financial Manager
BEMS	Building Energy Management System
BIPV	Building-integrated photovoltaics
BOS	Balance Of System
CA	Consortium Agreement
CO	Confidential, only for members of the consortium
CON	Confidential, exclusively for members of the consortium
EC	European Commission
EDT	Exploitation & Dissemination Team
ESCO	Energy Service Companies
FR	Final Report
GA	General Assembly
IPR	Intellectual Property Rights
IR	Internal Report
KoM	Kick-off Meeting
LARGE	Large company
LCA	Life Cycle Assessment
LCIA	Life Cycle Impact Assessment
PC	Project Coordinator
PDM	Project Dissemination Manager
PEM	Project Exploitation Manager
PM	Project Manager
PO	Project Officer
POF	Project Office
PP	Restricted to other programme participants

PR	Partner Representative
PR	Periodic Report
PTC	Project Technical Committee
PTM	Project Technical Manager
PU	Public
QA	Quality Assurance
RE	Restricted to a group specified by the consortium
ROI	Return Of Investment
RTDG	RTD Grouping
RTO	Research and Technology Organization
RV	Scientific and technical ReView
SME	Small Medium Enterprise
ST	Subtask
T	Task
TL	Task Leader

TECNALIA	FUNDACION TECNALIA RESEARCH & INNOVATION
ONYX	ONYX SOLAR ENERGY S.L
BEAR	BEAR HOLDING BV
NOBATEK	NOBATEK
FOPTICS	FILM OPTICS Ltd
CTCV	CENTRO TECNOLOGICO DA CERAMICA E DO VIDRO PCUP
FLISOM	FLISOM AG
CRICURSA	CRISTALES CURVADOS SA
CEA	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES
ACCIONA	ACCIONA INFRAESTRUCTURAS S.A.
FD2	BUREAU D'ARCHITECTES FORMAT D2 SPRL
VILOGIA	VILOGIA SA
R2M	R2M SOLUTION SRL
CADCAM	CADCAMATION KMR SA
WIP	WIRTSCHAFT UND INFRASTRUKTUR GMBH & CO PLANUNGS KG

2 PROJECT MANAGEMENT ORGANISATION

2.1 Project Management Structure

Project Management deals with the governance structure, the role and responsibilities of the various actors and the contract with the EC. It includes the overall management, communication and coordination between the different partners, as well as the monitoring of the scientific and technical progress of the entire project, by means of the supervision of the achieved milestones, the management of the risks and establishment of contingency plans, gender equity, and other non-technical aspects. It also provides outputs for knowledge management and other RTD innovation related activities, such as Intellectual Property Rights (IPR) and dissemination. Besides, it promotes networking with other related projects and initiatives. A specific Project Management work package (WP10) is included in the work plan.

PVSITES Project Management will be performed by TECNALIA Research & Innovation, which has a large experience in the co-ordination of numerous national and international co-operation projects (377 projects in FP7, of which 81 were coordinated). By December 2015, TECNALIA is participating in 87 H2020 projects, coordinating 17 of them. The practical managerial framework, organizational structure and decision-making mechanisms, have been tailored to the size and complexity of the project. The general structure of the project management is shown in the following figure:

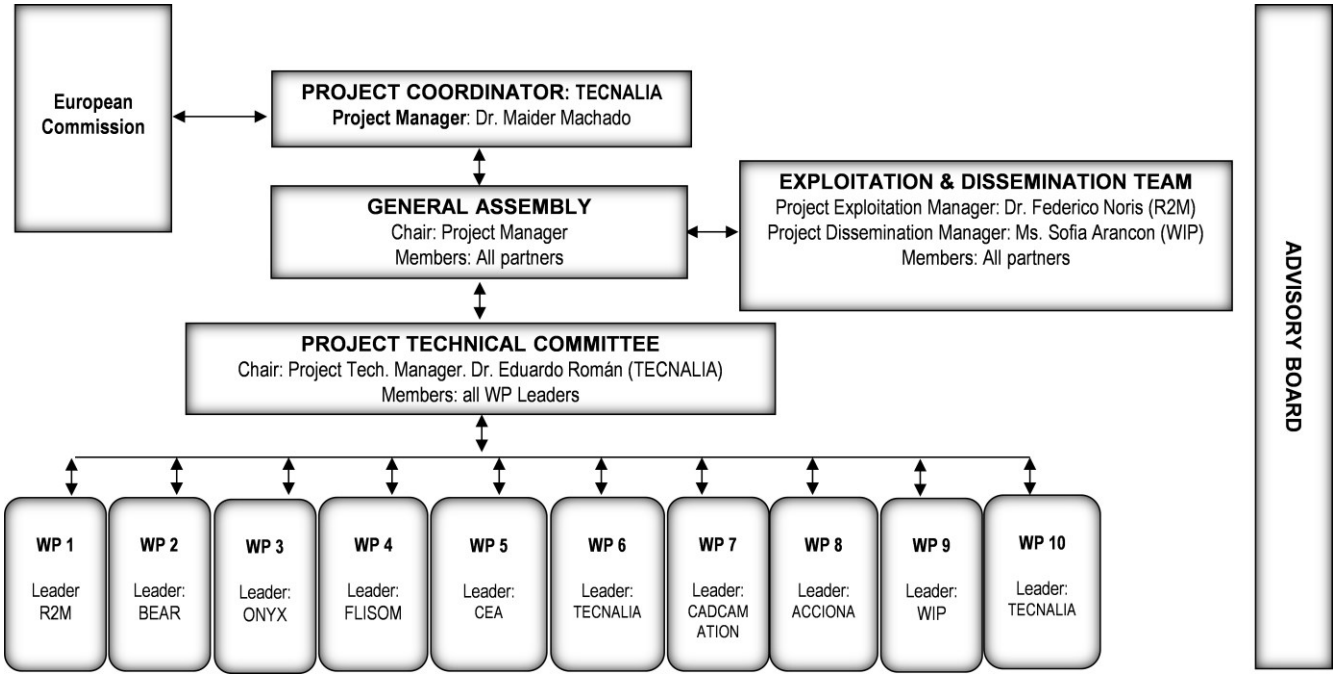

Figure 2.1 Project Management Structure

2.1.1 Project Coordinator (PC)

The main responsibility of the PC is to ensure the timely and effective overall progress of the project according to the Contract. The **Project Manager (PM)** is appointed by the Project Coordinator. The PM chairs the General Assembly, and has primarily the following roles:

- Ensure the timely and effective overall progress of the project
- Interface between the consortium and the EC, dealing also with contractual, administrative and financial matters in addition to overall responsibility for project progress reporting.

Circulation of respective information and communications. The PM will communicate with the European Commission on behalf of the consortium.

- Organisation of General Assembly meetings, project reviews and co-ordination of dissemination and exploitation events (in association with the Project Technical Manager).
- Manage all the aspects connected with payment of financial contributions.

2.1.2 Project Manager

The Project Manager of PVSITES Project will be Dr. Maider Machado. She has been the scientific coordinator of European RTD projects in the fields of BIPV and PV cell technology, and has also coordinated several research projects funded by the Spanish Government. The PM will be supported by TECNALIA Programmes Office, which has a large experience in the co-ordination of international co-operation projects.

2.1.3 General Assembly (GA)

General Assembly (GA). The role of the GA is to make decisions concerning any important top-level management issues arising. This function will include the PM and senior project representatives from each partner (PR), together with the PTM and PEM.

2.1.4 Project Technical Committee (PTC)

The role of the PTC is to make decisions concerning any important technical issues arising. This function is chaired by the Project Technical Manager (PTM) and will include all work package leaders (WPL). The main responsibility of the PTC is to manage all the technical activities outlined in the project's work plan and is responsible for the day-to-day liaison between consortium partners to consolidate inputs into project planning, progress monitoring and technical milestone reporting (via PTM reported to the GA). The PTM will be Dr. Eduardo Román, from TECNALIA. Dr. Román has coordinated several EU RTD projects like BFIRST and PURE.

2.1.5 Exploitation & Dissemination Team (EDT).

The Project Exploitation Manager (PEM) coordinates all exploitation activities and the Project Dissemination Manager (PDM) coordinates the dissemination and training activities. The EDT is responsible for the exploitation plan and follows up on this plan, coordinating exploitation activities across partners, as well as dissemination plan, communication, the project web sites, cooperation platforms (wiki, project repository, mailing lists), and other communication mechanisms. The PEM and the PDM report to the PM. The PEM will be Dr Federico Noris (R2M) and PDM will be Ms. Sofía Arancón (WIP).

A definition of potentially exploitable project results is provided in section 2.2 of the Grant Agreement, as well as the foreseen exploitation routes. These products include innovative BIPV solutions at module, BOS and building integration levels, new software and advanced consulting services. At project development stage, an early market and stakeholder analysis is foreseen (task 1.1), which will provide a clear identification of the target groups and their needs, setting as well the basis for dissemination activities. Tailored business models and exploitation routes (IPR, business description and competitors analysis, marketing and operating plans, etc.) will be developed for each project result (task 1.4, 1.5, 1.6), under the leadership of Exploitation Manager. In close collaboration with the Exploitation Manager, the Dissemination Manager will work on the most effective Dissemination and Communication activities to lead the project results towards PVSITES main objective: a significant market uptake of BIPV technology.

2.1.6 Advisory Board (AB)

An Advisory Board has been created with 6 respected members of the BIPV community, in order to receive advice during the project lifetime (see Milestone 8 for more information).

2.1.7 Partner Representative (PR).

In order to limit any duplication of information and to facilitate an efficient communication process by both real and virtual channels, the distribution of all relevant project information will be channelled through the PM to one key person for each partner (Partner Representative). The PR will be member of the GA (in case of unavailability a deputy or assistant could be appointed) and will act as a switchboard thus ensuring that the concerned persons within the Partner organisation are reached as required.

2.1.8 Workpackage Leader (WPL)

This position is covered by the partner indicated in the relevant tables as responsible for the work package and involves co-ordinating and ensuring suitable progress of the corresponding technical activities. Responsibilities include coordination of WP and task meetings and activities, planning and control. Work package and task meetings will be organised in line with the needs of the specific technical activities. Progress will be reported in periodical meetings co-ordinated by the PTM, who will also ensure communication with the GA.

WPLs are shown in Table 2.1.

WP No	Work Package Title	Lead Participant		PM	Start Month	End Month
		No.	Short name			
1	Business case definition	13	R2M	93	1	42
2	From market and legal requirements to system specifications	3	BEAR	70,5	1	42
3	BIPV modules based on crystalline silicon technology	2	ONYX	139,5	1	36
4	BIPV modules based on CIGS thin film technology	7	FLISOM	94	1	36
5	Advanced grid interface for the BIPV systems	9	CEA	54	4	18
6	Building Energy Management System for different building uses	1	TECNALIA	44	4	18
7	BIPV software tool	14	CADCAM	52	1	42
8	Large scale demonstration and assessment of BIPV systems in real buildings	10	ACCIONA	225	10	42
9	Dissemination and communication	15	WIP	80	1	42
10	Management	1	TECNALIA	25	1	42

Table 2.1 Work package list, leaders and allocated effort.

2.1.9 Task Leaders (TL)

The Task Leader is responsible for the achievement of the task objectives within each Work Package within the specified timescale. The Task Leader is responsible for reporting technical progress to the WPL, whereupon a review between the two parties will take place. The outcome is then reported to the project coordinator.

2.1.10 Consortium members

PVSITES consortium is composed by 15 partners from 8 different countries (Spain, France, Belgium, Germany, the Netherlands, Switzerland, Italy and UK). Each partner has been selected due to its excellence in its specific industrial or research field. Managers and owners of demonstration buildings have been chosen attending to market replication potential, associated with their industrial activity or the type of building entrusted to the project. The geographical distribution of these end users in the consortium is not casual, as an effort has been done to cover not only different building types and uses, but also different climatic conditions.

PVSITES industrial partners (11 out of 15) cover the main part of the BIPV industrial value chain, including: designers (BEAR Holding), PV manufacturers (Flisom) and BIPV manufacturers (Flisom, Onyx), construction industry (Acciona), optical elements (Film Optics), ESCO (ACCIONA), and end-users: FormatD2 (architects and owners of demo site in Belgium), Cricursa (architectural glazing manufacturer and owner of demo site in Spain), Vilogia (constructor and manager of demo site in France), Tecnalia (RTO, owner of demo building in San Sebastian, owner of several offices buildings across Spain). Research to Market (R2M) is specialized in exploitation management of innovative projects, with a large expertise in solar energy. Finally, WIP is an expert in dissemination and communications activities to support market activities. There are also 4 research organisations involved in PVSITES: Tecnalia (coordinator), CEA, CTCV and Nobatek. They constitute a core support for technical activities.

Partner	Type	Expertise	Main role in the project
TECNALIA	RTO	Photovoltaics and building-integrated PV	Project coordinator. WP6 leader, development of BEMS. Relevant role in c-Si modules design (WP3) and testing. Relevant role in software tool development WP7. Owner of Spanish demo in San Sebastian, Spain.
ONYX	SME	BIPV systems manufacturer.	Relevant participation in WP2. WP3 leader, progress on a range of BIPV c-Si glass-glass solutions. System manufacturer for demonstration activities.
BEAR	SME	Architect studio, expert in BIPV.	WP2 leader, definition of specifications, and architectural design processes. Involvement in WP7 for software tool.
NOBATEK	RTO	Energy efficiency in buildings.	In charge of monitoring process (WP8) and building energy performance simulation throughout the project.
FILM OPTICS	SME	Fresnel lens manufacturer.	Support to lens design and manufacturing for demonstration (WP3).
CTCV	RTO	Technological centre for ceramics & glass.	Testing on glazing systems (WP3, WP4). In charge of Life Cycle Analysis activities (WP8).
FLISOM	SME	PV and BIPV manufacturer.	Relevant participation in WP2. WP4 leader, progress on a range of CIGS based BIPV solutions. System manufacturer for demonstration.
CRICURSA	SME	Architectural glazing company.	Owner of Spanish demo site in Barcelona, industrial building.
CEA	RTO	Public body, PV systems labs.	WP5 leader for advanced grid interface for BIPV systems. In charge of INCAS platform for outdoor module testing (WP3, WP4).
ACCIONA	LARGE	Construction company. ESCO.	Leader of WP8, demonstration installations. Relevant role in WP6 (BEMS) and WP3 (outdoor testing platform).
FORMATD2	SME	Architect studio.	Owner of Belgium demo site, single-detached residential dwelling.
VILOGIA	LARGE	Construction company, social	Owner of France demo site, multifamiliar residential dwelling, social housing.
RESEARCH TO MARKET	SME	Innovation company.	Exploitation Manager and leader of WP1. Participation in WP6 for BEMS and WP8 for monitoring.
CADCAMATION	SME	Software developer	Development of an integrated BIPV software tool (leader of WP7). Implementation of BIPV products portfolio, WP9.
WIP	SME	Renewable energies, policies, technology, events	Leader of WP9 for dissemination and communication activities.

Table 2.2 Main expertise and role of PVSITES partners

2.1.11 Consortium Agreement

A Consortium Agreement (CA) has been signed on month 1 of project development. Organisational, financial and exploitation-related issues have been detailed in the CA, including decision-making rules, agreements and conditions in relation with (background and foreground) Intellectual Property Rights (IPR).

2.2 Decision making and conflict resolution

Every General Assembly member will have one vote. Each party with voting power can authorise any other party to vote in his place, however, the Coordinator has to be informed of this in advance in writing. The General Assembly shall not deliberate and decide validly unless a quorum two-thirds (2/3) of the Voting Parties are present or represented. Normal decisions will be taken with the majority of votes (in case of equal voting the PM will have the casting vote) with some exceptions such as the expansion of the consortium (a new partner should be accepted by all partners).

The Consortium recognises that the resolution of problems and conflicts must be handled systematically. Establishing a good working relationship between the project team members will be a prerequisite for the quick resolution of problems and issues. In the event that consortium partners have been unable to amicably resolve any dispute arising out of the work on the project (disagreements, strategic divergence and conflicts of interest,..), it shall be finally settled at a conflict resolution meeting organised by the PM. Attempts at arbitration will be performed in increasing order of authority: within the WP task, the WP team, the PTC and finally the GA, with the possibility of including the EC Project Officer. Nevertheless, the existence of collaborative ties among the partners and the cohesiveness of the Consortium do not pose the threats of major conflict. The rules of making decisions & conflict resolution processes are further defined in the Consortium Agreement.

2.3 Risk Management Process

One of the actions in order to generate the accurate general framework conditioning the achievement of the expected project impacts, is the implementation of a **Risk assessment and mitigation plan** that will monitor and control the project risks in a continuous manner (T1.8), to avoid undermining the full exploitation potential of the developments.

As in all innovation and new endeavours there are several risks. However, PVSITES project will take all the necessary steps to:

- Identify the risks (technical, financial, legislative, social and environmental). At the proposal preparation stage, the consortium has identified the main risks that the project will face.
- Define preventive and mitigation measures with different ambitions and scopes depending on the severity of the expected damage. Risk mitigation actions will reduce the chance that a risk will be realised and besides will reduce the seriousness of a risk that may be realised. Some of the actions will be a-priori (e.g., to prevent the risk from happening), while other actions will be triggered only after a certain event occurred and will be seen as true mitigation.

Risk analysis will be periodically reviewed to adapt to the fast changing nature of the topics involved. Besides, a deliverable and two updates (D1.21, D1.22 and D1.23) are foreseen for M24, 36 and 42 respectively.

Dr. Federico Noris from Research to Market (R2M), as leader of WP1 and T1.8 (Global risk analysis and mitigation), will be in charge of this continuous follow-up, and there will be a point dedicated to risk management in each PTC meeting.

2.4 Structure of the technical work

1. WP1 is aimed to an early business case definition, clear understanding of market barriers and needs, regulatory framework and potential risks. The final objective is to guide the project towards highly deployable results, fulfilling the needs of the target market. WP1 also sets the framework for high impact dissemination actions to promote and support future market uptake. WP1 starts in month 1 and will be ongoing throughout the whole project.

In parallel, WP2 translates the general framework established in WP1 into a coherent set of specifications for the BIPV systems that will be demonstrated within the project. These specifications must be in accordance with every business model defined in WP1. WP2 sets the basis of a portfolio tool gathering all technical information generated on each product during the project. The portfolio physical implementation is done under WP9.

2. At this stage of the project, progress is made on the technology solutions at module, grid interface and energy management system levels, setting them ready for demonstration activities. WP3 and WP4 work from month 1 in the optimization of proposed BIPV solutions at module level with two PV cell technologies. Both WPs end with the demonstration of a part of the proposed portfolio in test benches and experimental buildings, thus achieving (TRL 6). The rest of solutions are taken to demonstration in real buildings (WP8). WP5 works from month 3 to 18 on the definition, progress and validation of interface of the BIPV generators with the grid. WP6 deals in parallel with validation of smart building energy management systems. Starting from month 1, this stage includes the development of a software tool to provide a joint platform for integrated PV and building energy performance simulations. The tool will support the characterisation of products performance (WP3 and WP4) and the design of demo installations (WP8). On the other hand, the accuracy of the tool will be validated from results coming from monitoring in WP8. The specific timing needed to perform this cross-checking has been taken into account in the schedule.

3. The last step towards TRL 7 is taken in WP8, with the execution and assessment of the products installed and monitored in 6 demonstration installations across Europe. The results of this WP will directly feed into the definition of business cases in WP1, dissemination activities WP9, optimisation processes (WP7) and further optimization of technical solutions (post-project) to pave the way towards market uptake.

WP9 runs throughout the whole project, feeding from the results of previous work packages, and providing support to exploitation of project results through highly focused communication and dissemination activities. WP10 ensures an effective project management all along the execution of the work plan.

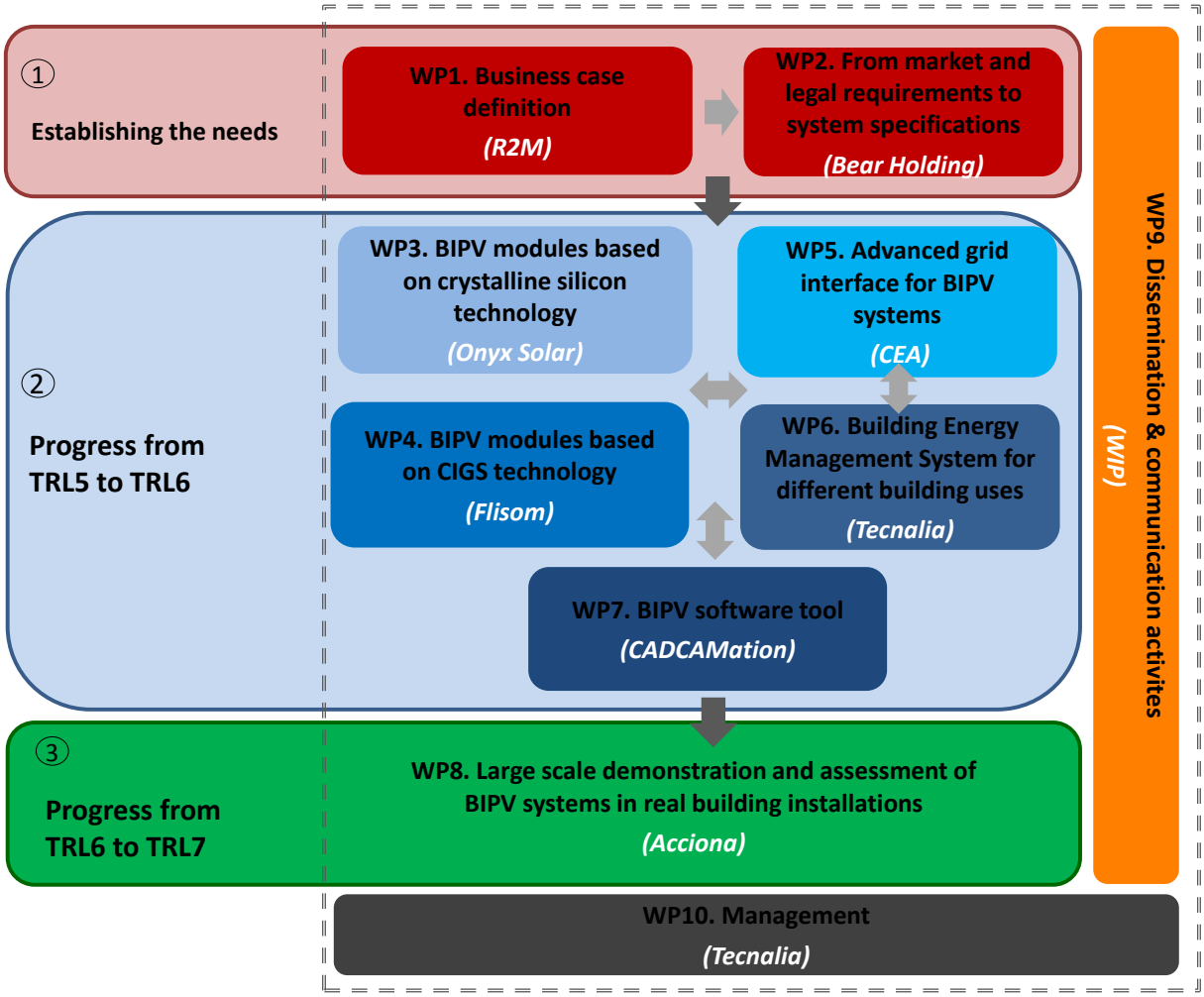

Figure 2.2 General structure of the project work plan

3 PROJECT EXECUTION PROCEDURES

3.1 Procedures and levels for the project progress and control monitoring

The Project progress control and monitoring will comprise:

- **Meetings:** There will be a project Kick-off Meeting, monthly virtual WP meetings, quarterly Project Technical Committee meetings and General Assembly twice a year.
- **Internal monitoring:** this monitoring is facilitated by the organisation and management structure of the project. The PM will monitor overall project progress with the help of the WP leaders. WP participants will report periodically their progress report to their respective WP leader. Then, six-monthly the WP leaders will prepare a WP report including information on technical progress, results obtained and compliance with the work program, resources spent and possible risks and corrective actions. This report will be sent to the PC and presented in the GA meetings;
- **External monitoring:** Monitoring carried out by the European Commission, this external monitoring will be based on the review of the reports and deliverables of the project by the reviewers selected by the Commission.

3.1.1 EC level

At this level, several reports will be sent by the coordinator to the EC Project Officer (PO), all of them constituting the contractual obligations acquired by PVSITES consortium upon signature of the GA.

- Project Deliverables (D) and Milestones (MS),
- Interim Report in M12 and M24,
- Periodic Reports (PR) for the Reporting Period RP1 (M15) and RP2 (M27),
- Final Report (FR) for the Reporting Period RP3 in M42.

Besides, scientific and technical reviews will take place after periodic and final reports: RV1(M17), RV2(M29) and RV3(M42).

3.1.2 Project level

At project level, the following items are envisaged:

- Kick-off Meeting (KoM): to review and confirm the workplan and timing and to launch the project administration and financial matters.
- Project Technical Committee meetings are held each 3 months. The meetings are open to all the consortium members; however, the presence of WPLs (WP leaders) involved in WPs being developed by the time of the meeting or to be started shortly after the meeting is essential for the correct assessment of the technical progress of the project.
- General Assembly meetings are held approximately each 6 months. One representation per partner is necessary.
- Interim Cost Statements each 6 months (within 15 days after the project meetings) can be submitted to the Project Manager for financial monitoring; although it is not a contractual obligation, it is recommended, especially for partners with less management experience in European projects. The Project Manager will review and include them in the Periodic Reports to the EC. A Cost Statement template will be provided to the partners.

- WP work progress each 6 months. Participants will report periodically their progress report to their respective WP leader. Then, six-monthly the WP leaders will prepare a WP report including information on technical progress, results obtained and compliance with the work program, resources spent and possible risks and corrective actions. This report will be sent to the PC and presented in the General Assembly meetings;

- Monthly work package meetings minutes will be sent to PM. The PM could also attend the work package meetings if necessary.

3.2 Meeting procedures

Meetings will be an integral part of the management and communication strategy inside the Consortium. Efforts will be made to reduce travel costs (choosing cost-effective locations, etc.) without compromising the integrity of the communication strategy. In order to reduce travel costs, phone conferences and net meetings will be called if and when useful. There will be a project Kick-off Meeting and three kinds of regularly scheduled meetings:

Meeting	When	Who	What
Project KoM	Project start-up (face-to-face)	All project partners	To discuss the work plan, the structure of the project organisation, the flows of information and to promote co-operation.
General meeting	Six-monthly (face-to-face)	All project partners	To discuss the technical and financial progress of the project, to put in common detailed information of the WPs to all partners in the project.
Workpackage Meetings	Monthly (virtually) Six-monthly (face-to-face) in conjunction with general meeting	WPL and WP participants	To focus the work within a WP; a status report is generated for WPL and distributed to all participants
Project Technical Committee	quarterly (virtually) Six-monthly (face-to-face) in conjunction with general meeting	PTC members + additional staff as appropriate	To co-ordinate and monitor the work of different WPs: discuss the project work progress and co-ordination, outstanding actions and ad hoc issues. Minutes will be recorded by the PM and distributed to all participants

Table 3.1 PVSITES project meetings plan

The planned face-to-face project meetings are the following:

Meeting description	Time	Place
Kick-off meeting	M1	Tecnalia (Bilbao-Spain)

6 months meeting	M6	CEA-INES (Le Bourget du Lac - France).
12 months meeting. 1st Interim report	M12	To be determined
1st Review meeting	M17 o M18	To be determined
24 months meeting. 2nd Interim report	M24	To be determined
2nd Review meeting	M29 or M30	To be determined
36 months meeting	M36	To be determined
Final meeting and 3rd Review meeting	M42	To be determined

Table 3.2 PVSITES project meetings schedule

3.3 Change request procedures

"Change Requests" are due whenever the content of the project or the way it is executed changes, regardless the reason or the kind of change. Change Requests are subject to approval of the PTC when ruling strategic issues; they may require the update of the GA and CA.

Change Request will be brought to the closest PTC meeting or if necessary and possible to an Extraordinary meeting. A partner can initiate a Change Request by informing the PM about the situation and consulting him about the procedure to be followed. Upon the instructions of the PM, the requesting partner prepares a written Change Request, and she/he submits this to the PM. The PM adds her/his written comments and recommendations and brings it to the PTC at the earliest occasion (if it is an urgent matter, the PM will call for an Extraordinary Meeting). The Change Request shall be considered as approved if, within 2 weeks from receipt, none of the PTC members has objected in writing to the PM. Subsequently, the PM sends it to the PO for approval from the EC, if required. Finally she/he takes care that the workplan and/or Annex I is updated. A change becomes effective after approval has been received from PO.

⚠ **ATTENTION:** Partners shall never send Change Requests directly to the PO.

3.4 Progress report procedures

PVSITES project reporting comprises internal (within the Consortium) and external (to EC) monitoring. The internal monitoring consists mainly in periodic technical reports of the different WPs, prepared by the WPL with the collaboration of TL and WP partners and gathered by the PM. The external monitoring will be based on the reports and technical deliverables produced by the consortium and approved by the PM. In total 2 periodic reports, 1 final report, 108 deliverables and 8 milestones will be submitted to the EC according to the predefined dynamics and procedures.

3.4.1 Deliverables

During the course of PVSITES project, we should submit:

- The deliverables identified in Annex I according to their timetable (by electronic means via SYGMA)
- The Coordinator has to design a template (common title page with the title of the deliverable, the name and contact detail of the author, an index for the version, an introduction, a conclusion, a table of contents).Templates have been presented in D9.5, Guidelines for project`s visual identity, and are available in the private area of PVSITES web page.
- The work package leaders should prepare the deliverables and send them on time to the Coordinator (2 weeks before the deadline set in DOW). PM could ask before for the index or a draft version previously.
- The Coordinator double-checks the quality of the deliverables and uploads them in SYGMA.

3.4.2 Internal WP progress reports (IR)

The WP progress report is a technical document prepared every six months (approximately, on a basis as requested by the PM) by the WPL summarizing current status of the led WP. It shall include progress made since last report, description of significant results, comparison between progress made and ideal progress to reach the goals, reasons for deviations, potential red flags and recommendations for corrective actions (where necessary), a statement on the use of resources and new plans for next six-month period. These reports will allow monitoring the progress, gathering the information periodically and will be the base of the Periodic and Final Reports.

A template for this report will be provided by coordinator.

3.4.3 Periodic Report

Two periodic reports (PR) and one final report will be prepared at months 15, 27 and 42 in an aggregated form at the end of each period, as an overview of the technical activities and the claimed costs of all partners.

The periodic report comprises:

- An explanation of the work carried out by the beneficiaries
- An overview of the progress towards the objectives of the action
  - ✓ Work expected and work carried out
  - ✓ Exploitation and dissemination of the results
  - ✓ Plan for the exploitation and dissemination of the results
  - ✓ A summary for publication by the Agency
- Answers to the "**questionnaire**", about issues related to the action implementation and the economic and societal impact
- A **periodic financial report**
  - ✓ Financial Statements (Form C) and Summary Financial Report
  - ✓ An explanation of the use of the resources
    - Explanation of personnel costs, subcontracting and costs incurred by each beneficiary, linking them to work packages
    - Details have now to be provided by each beneficiary within the Forms at the Participant Portal.

The Consortium shall transmit the reports through the Coordinator to the Commission by electronic means via SYGMA.

3.4.4 Final Report

A final report has to be submitted, within 60 days after the end of the project, which shall comprise a publishable final activity report, a report covering and overview of the results and their exploitation and dissemination, the conclusions on the action and the socio-economic impact of the action, a Final summary financial statement and the request for payment of the balance.

The final report comprises:

- Publishable final activity report (within 60 days after the end of the project) covering results, conclusions and socio-economic impact of the project
- A report covering :
  - ✓ an overview of the results and their exploitation and dissemination
  - ✓ the conclusions on the action, and
  - ✓ the socio-economic impact of the action
- A Final **Summary financial statement** and the **request for payment of the balance**
- Certificate **on the Financial Statement** for each beneficiary, if it requests a total contribution of at least EUR 325.000 of direct costs.

The Consortium shall transmit the reports through the Coordinator to the Commission by electronic means via SYGMA.

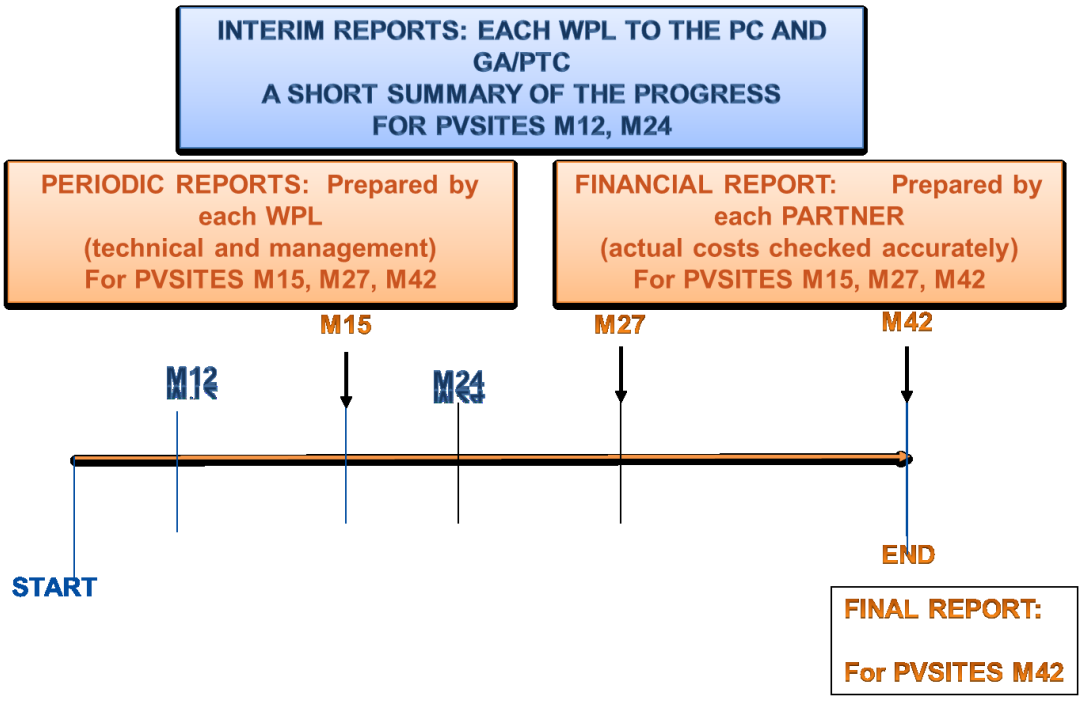

Figure 3.1 Interim Reports vs Periodic Reports & Final Report

3.5 Quality Assurance Measures

Quality assurance (QA) measures are only applied to paper documents produced within the project. The following QA measures apply in the project:

- Project documents (reports, project deliverables, etc.) have to go through at least two QA iterations:
  - To achieve “draft” or “first release” status they should be internally reviewed by the author(s) of the document.
  - To achieve “reviewed” status the document needs to be reviewed and approved by project members other than the author(s) of the document, for example WPL Reviewers shall identify if something is missing, if there is any inconsistency between sentences, if something is superfluous (not useful or not appropriate in the deliverable) or if something is wrong.Then the reporting partner will be asked to make the improvements and where necessary an extension to the deadline for the deliverable will be requested from the Project Officer.
  - To receive “approved” status, formal approval from the PTC or the PM is needed.
  - Future iterations of the document will generate new versions that will follow the same iteration process; the changes description will be recorded in the first page. An optional annex could also be included for further explanation of the changes.
- Reports to the PO or EC need approval of the Project Technical Manager or the Project Manager.
- Publications of joint project results, e.g. as conference papers, brochures, public documents, etc., need approval of the involved partners. Prior notice of any planned publication shall be given to the other Parties at least 45 calendar days before the publication, providing a copy of the planned publication. Any objection to the planned publication shall be made in accordance with the Grant Agreement in writing to the Coordinator and to the Party or Parties proposing the dissemination within 30 calendar days after receipt of the notice. If no objection is made within the time limit stated above, the publication is permitted (see Consortium Agreement for further guidance).
- Where it is not possible to submit the Deliverable due to failure from the reporting partner to deliver a report of acceptable standard:

  a) An extraordinary meeting of the Project Technical Committee will be called to discuss the potential consequences and determine an approach which will not impact on other project deliverables.

  b) A vote will be taken on whether formal action should be taken against the reporting partner.

  c) A decision to submit the report as it stands or not submit it at all will be taken.

Note: Failure of Deliverable-submission by a responsible partner will result with fellow Deliverable partners being ineligible to claim for any work undertaken on that Deliverable.

3.6 Information sharing and communication procedures

All relevant papers (documents, minutes, action lists, etc.) derived from the project are stored in the project “central archive”. As the main rule, the archive only accepts the most commonly used web document formats, i.e. pdf, html and Microsoft Office (.doc, .ppt, .xls…) formats.

The archive is made available by deploying a project web server where project documents and electronic material are stored. The description of PVSITES web server (www.PVSITES.eu), as well as other online tools made available for the project is included in deliverable D9.5 already submitted.

The project web server has both public and private parts. Sensitive project documents will be archived and shared among the partners using the private area, while all the information oriented to give the project visibility will be publicly available at the open section. The logical structure of the archive follows the project structure. Accordingly, documents stored in the file server may have different security/dissemination levels:

PU = Public (inc. distribution to third parties)

PP = Restricted to other programme participants *

RE = Restricted to a group specified by the consortium *

CO = Confidential, only for members of the consortium *

CON = Confidential, exclusively for members of the consortium

* Including the Commission Services

The security/dissemination levels should be marked at the first page in order to make them clearly visible. The information stored in this file server is accessible for all Partners.

3.6.1 Centralised Registered Documents

The term “Centralised Registered Document” stands for all documents which are archived in the project file server. These include:

- Deliverables;
- Internal documents:
    - Meeting minutes and presentations from the project meetings
    - Minutes of the WP conference calls
    - WP progress reports
    - Contacts and roles lists
    - Others considered useful by the PM or the WPLs
- Templates to be used when preparing
    - Cost statements
    - Presentations
    - WP Progress reports
    - Invitation to meeting & Meeting Agenda
    - Deliverables
- Major documents and reports as
    - Periodic Reports
    - Final Report
    - Other documents requested by the PO or the EC
    - Other documents suggested and/or approved by WPLs
    - Other documents requested/or approved by the PTC
    - Other

3.6.2 Document and file naming

All files stored on the project archive or website should adhere to the following naming conventions:

PVSITES-WPn-Tnx-Dnz/<Type>_MYY-PARTNER-yyyymmdd-vxx.doc

Where:

- WPn Work Package identifier, as for example: “WP1”,”WP2”, if applicable.
- Tnz- Task number as “T71” for Task 7.1, if applicable
- Dnx Deliverable number, as “D72” for Dev. 7.2, or Task number, as “T71” for Task 7.1, if applicable.
- <Type/Description> Document type (see below)
- MYY Submission month
- Partner Alias of the partner author of the document
- yyyymmdd Date in “yearmonthdate” format
- <Version> Two digits version identifier, as ‘v00’, ‘v09’
- <Ext> Extension of the file name, usually associated to the edition tool, like Word, Excel, ppt etc.

⚠ ATTENTION: lowercase and uppercase characters are allowed, and separate the words with (‘-’) or (‘_’). Don’t use spaces (‘ ‘) or slash (‘/’). For example: PVSITES-WP8-D82_PU-M3-TECNALIA-20160308-v0.pdf

When one of the concepts does not apply it is not included in the naming. If the document is not a deliverable, instead to put Dnz, the “type” should be indicated. The type is assigned by at least two capital letters identifying the contents of the document. New type names will be generated under WP10 when necessary. The following table shows the different type existing so far:

CS	Cost Statement
Dnz	Deliverable.
Mnz	Milestone
FR	Final Report
INV	Invitation & agenda of meeting
MIN	Minutes of meeting
PR	Periodic Report
PRE	Presentation
WPR	Work Package report

Table 3.3 Document type abbreviations

3.6.3 Reference documents, templates and guides

D9.5 Guidelines for project`s visual identity contains the templates of key documents types and they are also available in the private area of the PVSITES web page. New templates will be generated within WP10 when necessary for the project.

3.7 Dissemination and communication activities

Dissemination and communication activities are detailed in the deliverable D9.1 Dissemination and communication plan, which sets the most appropriate strategies for dissemination and communication, in line with the strategies for exploitation of results. D9.1 will be updated in months 12, 24, 36.

PVSITES dissemination and publication policy is described in detail in Article 8.3 of the CA.

⚠ **ATTENTION:** All publications or any other dissemination relating to foreground shall include the EU emblem and the following statement to indicate that said foreground was generated with the assistance of financial support

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nº 691768.

This publication reflects only the author's view and the Commission is not responsible for any use that may be made of the information it contains.

3.8 Internal and external project communication

3.8.1 General

All official communication with the PO or the EC Services related to PVSITES project will be channeled through the Project Manager (PM).

3.8.2 Internal

Communication within PVSITES project is achieved across a number of platforms: project website, video conferencing, email, teleconferencing and face-to-face meetings.

In order to avoid unnecessary mailing messages, senders will carefully select the recipients to the narrowest audience possible. Coordinator will stablish a contact list per WP.

⚠ **ATTENTION:** in order to facilitate filtering and anti-spam measures, the subject line should indicate the term "PVSITES:" followed by a short explanation sentence or few keywords about the message.

3.8.3 Communication flow

Coordinator (TECNALIA) will address Work Package Leaders (WPL) to give or request information related to the workpackage. In the same way, WPLs will address Task Leaders (TL) as responsible of the tasks. TL will address the partners involved in their task.

If a partner does not reply to a Task Leader request within a specified time, the TL escalates the issue to the Work Package Leader. If the same partner fails to respond to the WPL, the WPL escalates it to the Coordinator.

The Coordinator (when involved) will communicate with the partner(s) directly, including WPLs and TLs in subsequent communications.

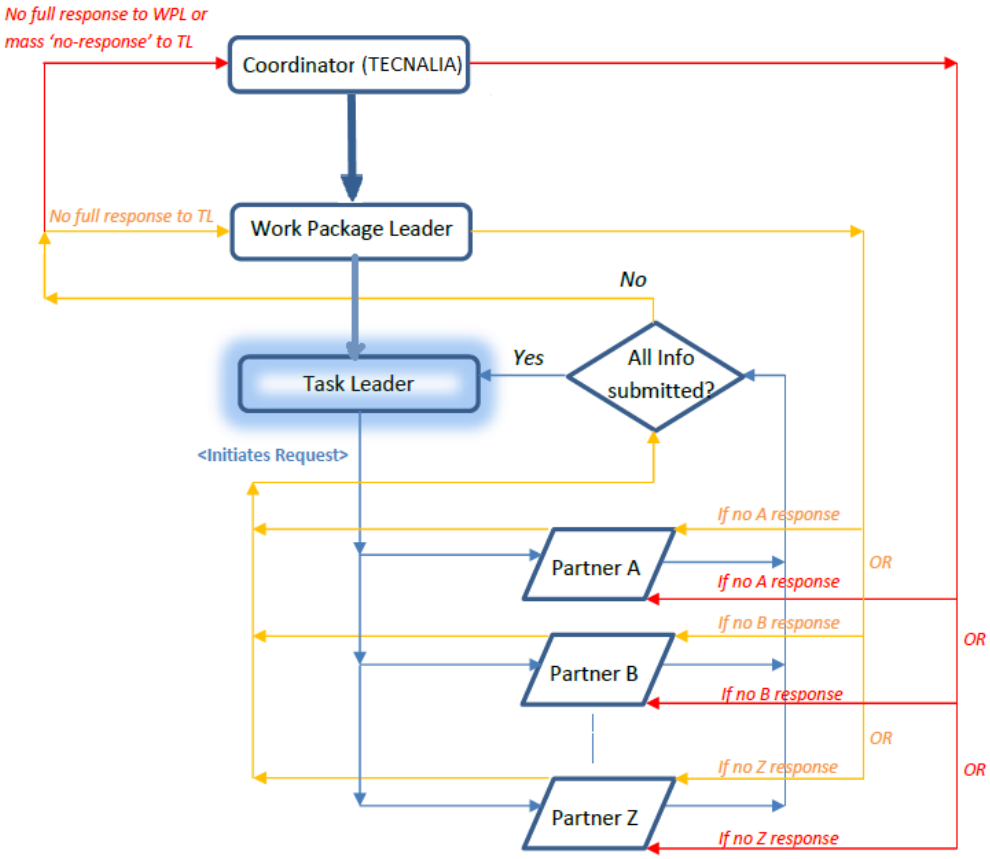

Figure 3.2 Communication flow

3.8.4 Partner Contact Details

Typically, there is more than one contact per beneficiary, however; Table 5.1 provides the main for contact for each Party:

Nº	Partner	Country	Name	e-mail
1	**TECNALIA**	Spain	Maider Machado	maider.machado@tecnalia.com
2	**ONYX**	Spain	Elena Rico	erico@onyxsolar.com
3	**BEAR**	Netherlands	Tjerk Reijenga	tjerk@bear-id.com
4	**NOBATEK**	France	Pascale Brassier	pbrassier@nobatek.com
5	**FOPTICS**	United Kingdom	Lawrence Chan	l.chan@film-optics.co.uk
6	**CTCV**	Portugal	Victor Francisco	victor.francisco@ctcv.pt
7	**FLISOM**	Switzerland	Ulfert Ruehle	ulfert.ruehle@flisom.ch
8	**CRICURSA**	Spain	Ferrán Figuerola	ferranf@cricursa.com
9	**CEA**	France	Françoise Burgun	Francoise.BURGUN@cea.fr
10	**ACCIONA**	Spain	José Carlos Esteban	josecarlos.esteban.matias@acciona.com

11	**FD2**	Belgium	Dominique Deramaix	info@formatd2.be
12	**VILOGIA**	France	Agnieszka Bogucka	Agnieszka.Bogucka@vilogia.fr
13	**R2M**	Italy	Federico Noris	federico.noris@r2msolution.com
14	**CADCAM**	Switzerland	Nguyen Van Khai	vknguyen@cadcamation.ch
15	**WIP**	Germany	Ingrid Weiss	Ingrid.Weiss@wip-munich.de

Table 3.4 PVSITES main contacts

4 WORK IMPLEMENTATION PLAN

This chapter includes a detailed work implementation plan.

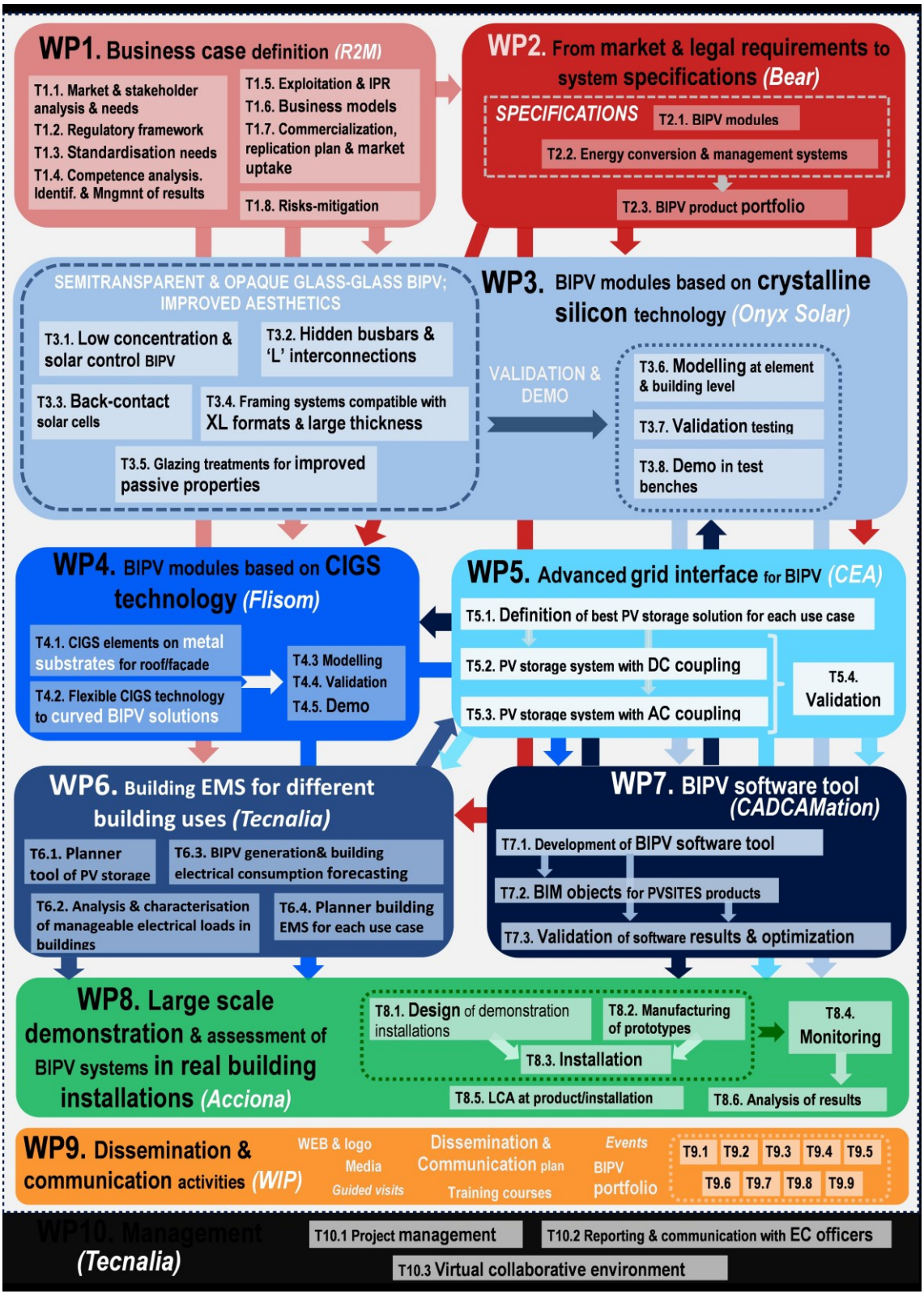

Figure 4.1 Graphical presentation of the components and inter-relations

Participant nº/ Short Name		WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	WP10	Total Person Months
1	TECNALIA	6	10	27	12	24	**24**	12	18	6	**14**	**153**
2	ONYX	8	9	**48**	10	0	0	0	9	3	1	**88**
3	BEAR	4	**12**	3	3	0	0	4	12	3	1	**42**
4	NOBATEK	4	10	15	12	0	0	6	29	3	0,5	**79.5**
5	FOPTICS	3	6	7	0	0	0	0	6	3	0,5	**25.5**
6	CTCV	7	0	8,5	10	0	0	0	10	3	0,5	**39**
7	FLISOM	3	9	0	**36**	0	0	0	18	3	1	**70**
8	CRICURSA	3	0	0	0	0	0	0	15	6	0,5	**24.5**
9	CEA	6	6	14	11	**30**	0	0	6	2	1	**76**
10	ACCIONA	9	6	17	0	0	11	0	**50**	4	1	**98**
11	FD2	3	0	0	0	0	0	0	16	6	0,5	**25.5**
12	VILOGIA	3	0	0	0	0	0	0	21	7	0,5	**31.5**
13	R2M	**29**	1,5	0	0	0	9	0	8	3	1	**51.5**
14	CADCAM	2	1	0	0	0	0	**30**	7	7	1	**48**
15	WIP	3	0	0	0	0	0	0	0	**21**	1	**25**
TOTAL		**93**	**70,5**	**140**	**94**	**54**	**44**	**52**	**225**	**80**	**25**	**877**

Table 4.1 Summary of project effort in person month (PM)

The following table includes an overview of efforts per task for each partner.

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
ID	Description	Leader	TEC	ONYX	BEAR	NOB	FO	CTCV	FLIS	CRIC	CEA	ACCI	FD2	VILO	R2MS	CADC	WIP	TOTAL
WP1	BUSINESS CASE DEFINITION (PM planned)	R2MS	6	8	4	4	3	7	3	3	6	9	3	3	29	2	3	93
T1.1	Market and stakeholder analysis and needs	R2MS	0	1,5	1,5				1			1			6			11
T1.2	Regulatory framework	ACCIONA	0			2					0,5	4						6,5
T1.3	Standardisation needs	CEA	2					3			4,25							9,25
T1.4	Competence analysis, identification and management of exploitation	R2MS	1	2	0,5	0,5	0,5	1,5	0,5	0,5	0,25	1	0,5	0,5	3	0,5	1	13,75
T1.5	Exploitation, IPR protection and agreements	R2MS	1	1	0,5	0,5	0,5	0,5	0,5	0,5	0,25	1	0,5	0,5	3	0,5	0,5	11,25
T1.6	Business models	R2MS	0									1			6			7
T1.7	Commercialization, replication plan and market uptake	R2MS	1	2	1	0,5	1	1	0,5	1	0,25	0,5	1	1	5	0,5	1	17,25
T1.8	Global risk analysis and mitigation	R2MS	1	1,5	0,5	0,5	1	1	0,5	1	0,5	0,5	1	1	6	0,5	0,5	17
WP2	FROM MARKET AND LEGAL REQUIREMENTS TO SYSTEM	BEAR	10	9	12	10	6	0	9	0	6	6	0	0	1,5	1	0	70,5
T2.1	Specifications for BIPV modules	BEAR		2	6	3	6		3		0,5	3				0,5		24
T2.2	Specifications for energy conversion and management systems	TECNALIA	3								5	3			1,5			12,5
T2.3	BIPV products portfolio	BEAR	7	7	6	7			6		0,5					0,5		34
WP3	BIPV MODULES BASED ON CRYSTALLINE SILICON TECHNOLOGY(PM	ONYX	27	48	3	15	7	8,5	0	0	14	17	0	0	0	0	0	139,5
T3.1	Semitransparent low concentration and solar control BIPV solutions	TECNALIA	14	3	3	5	2											27
T3.2	Hidden busbars and L-interconnections for opaque BIPV solutions	ONYX	0	11														11
T3.3	Back-contact solar cells implemented as see-thru glass/glass BIPV	ONYX	0	11														11
T3.4	Framing systems compatible with XL formats and large thickness	ONYX	0	3														3
T3.5	Glazing treatments for improved passive properties	ONYX	0	11														11
T3.6	Modelling at element and building level	NOBATEK	5			10												15
T3.7	Performance validation testing	TECNALIA	5	2			3	8,5			4							22,5
T3.8	Technology demonstration in test benches	ACCIONA	3	7			2				10	17						39
WP4	BIPV MODULES BASED ON CIGS THIN FILM TECHNOLOGY (PM	FLISOM	12	10	3	12	0	10	36	0	11	0	0	0	0	0	0	94
T4.1	CIGS elements on metal substrates for opaque roofs and façades	FLISOM	0		3				16									19
T4.2	Flexible CIGS module technology to curved BIPV solutions	ONYX	3	6					6									15
T4.3	Modelling at element and building level	NOBATEK	9			12			2									23
T4.4	Performance validation testing	FLISOM	0	4				10	6		4							24
T4.5	Technology demonstration in test benches and experimental building	FLISOM	0						6		7							13
WP5	ADVANCED GRID INTERFACE FOR BIPV SYSTEMS(PM planned)	CEA	24	0	0	0	0	0	0	0	30	0	0	0	0	0	0	54
T5.1	Definition of best PV storage solution for each use case	CEA	6								6							12
T5.2	Integrated grid interface using storage system with DC coupling	TECNALIA	12															12
T5.3	SiC based inverter technology for cost reduction and flexibility in	CEA	0								12							12
T5.4	Characterisation and validation of the novel solutions	TECNALIA	6								12							18
WP6	BUILDING ENERGY MANAGEMENT SYSTEM FOR DIFFERENT	TECNALIA	24	0	0	0	0	0	0	0	0	11	0	0	9	0	0	44
T6.1	Planner tool of PV storage system for each use case	TECNALIA	6									5						11
T6.2	Analysis and characterisation of manageable electrical loads in	R2MS	2												6,0			8
T6.3	Refinement of BIPV generation and building electrical consumption	TECNALIA	6															6
T6.4	Building Energy Management System for each use case	TECNALIA	10									6			3,0			19
WP7	BIPV SOFTWARE TOOL (PM planned)	CADCAM	12	0	4	6	0	0	0	0	0	0	0	0	0	30	0	52
T7.1	Development of BIPV software tool	CADCAM	8		2	4										10		24
T7.2	BIM objects for PVSITES products	CADCAM	0													15		15
T7.3	Validation of software results and software optimization	TECNALIA	4		2	2										5		13
WP8	LARGE SCALE DEMONSTRATION AND ASSESSMENT OF BIPV	ACCIONA	18	9	12	29	6	10	18	15	6	50	16	21	8	7	0	225
T8.1	Design of demonstration installations	ACCIONA	5	1,0	9	7			3	6		12	6	9		4		62
T8.2	Manufacturing of prototypes	ACCIONA	3	6,5			5		6		3	6						29,5
T8.3	Installation and commissioning of installations	ACCIONA	3						6	6		15	4	9				43
T8.4	Monitoring of installations	NOBATEK	3			19			1	2		12	3	2	6			48
T8.5	Life cycle assessment at product and installation level	CTCV						9										9
T8.6	Analysis of results	ACCIONA	4	1,5	3	3	1	1	2	1	3	5	3	1	2	3		33,5
WP9	DISSEMINATION AND COMMUNICATION (PM planned)	WIP	6	3	3	3	3	3	3	6	2	4	6	7	3	7	21	80
T9.1	Dissemination and communication plan	WIP	0,1	0,5	0,1	1,1	2	1	0,25	1	0,25	1	1	0,8	0,5	1,5	3,0	14,1
T9.2	Project logo and visual identity	WIP	0,1	0,1	0,1	0,1	0	0,1	0,25	0,1	0	0,5	0,1	0,1	0,1		2,0	3,65
T9.3	Project website	WIP	0,1	0,1	0,1	0,1	0,25	0,2	0,1	0,2	0,25	0,5	0,2	0,1	0,2		4,0	6,4
T9.4	Media campaign	WIP	0,1	0,3	0,1	0,2	0,5	0,2	0,4	0,2	0,5	1	0,2	2	0,6		4,0	10,3
T9.5	Events	WIP	1	1	0,5	1	0,25	1,5	0,5	1	0,5	0,5	2	1,5	0,6	2	3,0	16,85
T9.6	Training courses for installers	TECNALIA	1,5	1	0,1	0,5			0,5			0,5			1	0,5	0,5	6,1
T9.7	Guided visits to demo sites	WIP	0,8						0,5	1			2	1,5			1,5	7,3
T9.8	Implementation of BIPV product portfolio	CADCAM	1,5		1,5				0,5					1		2,0	1	7,5
T9.9	Training courses on BIPV software tool	CADCAM	0,8		0,5											1,0	2	4,3
WP10	MANAGEMENT (PM planned)	TECNALIA	14	1	1	0,5	0,5	0,5	1	0,5	1	1	0,5	0,5	1	1	1	25
T10.1	Project management	TECNALIA	8	0,5	0,2	0,25	0,25	0,25	0,25	0,25	0,5	0,5	0,25	0,25	0,4	0,25	0,25	12,35
T10.2	Reporting and communication with EC officers	TECNALIA	5	0,4	0,4	0,25	0,25	0,25	0,75	0,25	0,25	0,25	0,25	0,25	0,3	0,75	0,5	10,1
T10.3	Monitoring and management of external relationships	TECNALIA	1	0,1	0,4						0,25	0,25			0,3		0,25	2,55
			153	88	42	79,5	25,5	39	70	24,5	76	98	25,5	31,5	51,5	48	25	877

WP leader
WP partner
Task leader
Task partners

Table 4.2 PVSITES participants roles and contributions in PM

The following table includes a Gantt chart of project tasks, deliverables and milestones:

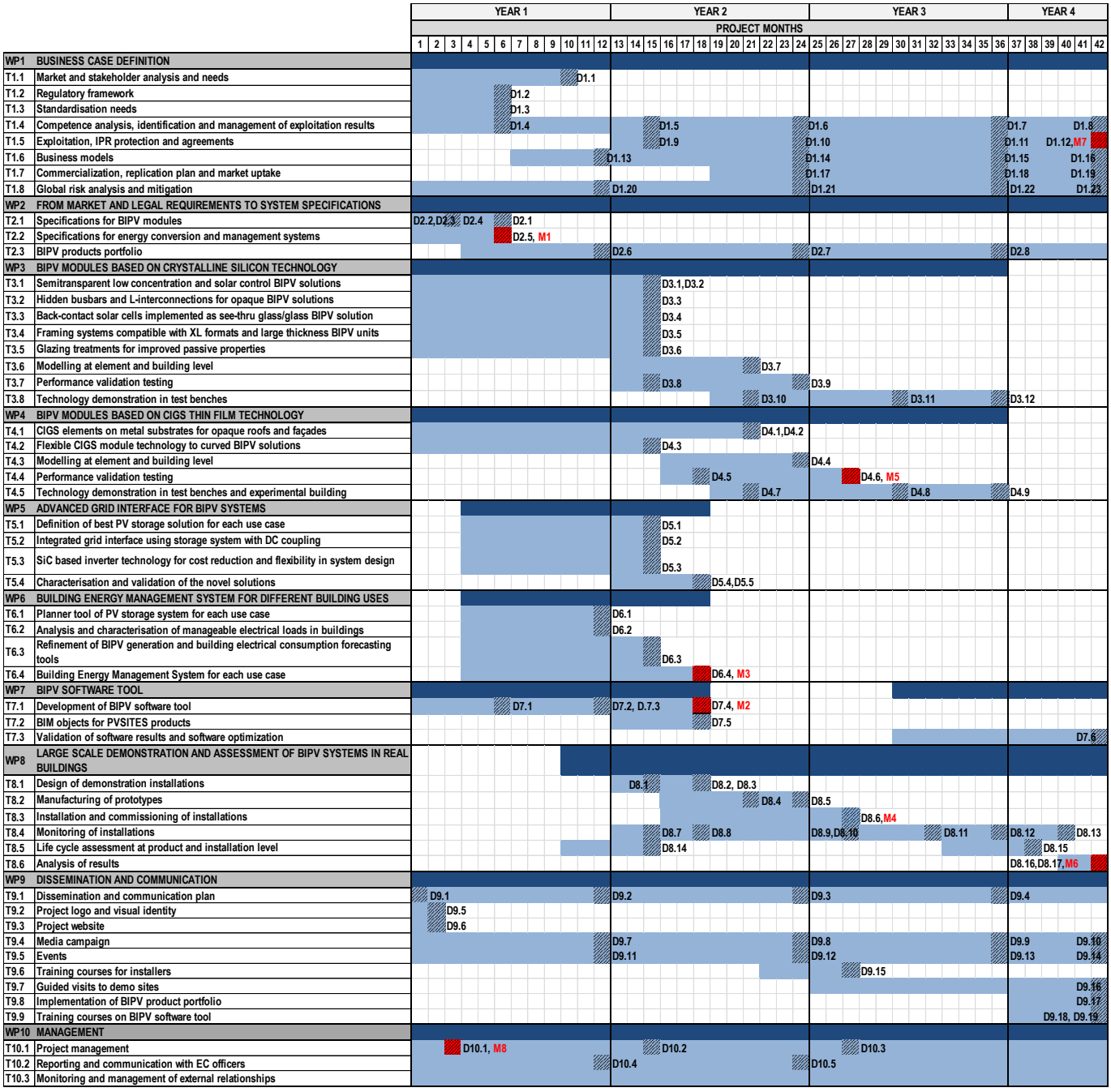

Table 4.3 Gannt Chart

The following sections include a detailed schedule per work package, including tasks, subtasks, related deliverables and dependencies to other tasks.

4.1 WP1 BUSINESS CASE DEFINITION

WP number	1					Start Date		M1			End Date		M42		
WP title	Business case definition.														
Participant nº	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Participant short name	TECNALIA	ONYX	BEAR	NOBATEK	FOPTICS	CTCV	FLISOM	CRICURSA	CEA	ACCIONA	FD2	VILOGIA	R2M	CADCAM	WIP
Person/months	6	8	4	4	3	7	3	3	6	9	3	3	29	2	3

Table 4.4 WP1 general information

4.1.1 WP1 Purpose and Objectives

WP1 will set the foundation for effective development and exploitation of results into the market. It will support the developments by providing a clear picture of needs and legislative framework affecting BIPV products. It will provide the basis and support for ensuring great market impacts of the results developed and demonstrated in the following WPs. It has the following specific objectives:

- Characterise the markets, the stakeholders and their needs.
- Clearly understand the complex regulatory framework and standardization needs.
- Assess the outstanding features of our exploitable results.
- Manage, protect and find agreements on the results.
- Identify appropriate business models for each exploitable results and set forward a plan for commercialization and market uptake.
- Characterize the different risks and identify solutions to mitigate them.

4.1.2 WP1 Problem definition and timing of different tasks

The main objective of this WP is to support the commercialization and market entry of the solutions (e.g., products, tools) developed and demonstrated within the project. The achievement of these several activities must be performed ranging from preliminary actions such as market and stakeholder assessment (T1.1), depicting regulatory (T1.2) and standardization framework (T1.3) to others focused clearly on exploitation such as competence analysis and management of results (T1.4), exploitation and IPR protection (T1.5), business model definition (T1.6), replication plan (T1.7) and risk analysis and mitigation (T1.8). The preliminary tasks are concentrated in the first few months because their outputs will be needed for the development of the technical solutions. On the other hand, the exploitation and commercialization tasks will start later and be critical toward the end of the project when the solutions will be ready to enter the market.

Ref	Task title	Responsible	Estimated indicative person-months	Start month	End month
WP1	**BUSINESS CASE DEFINITION**	**R2M**	**93**	**1**	**42**
T1.1	Market and stakeholder analysis and needs	R2M	11	1	10
T1.2	Regulatory framework	ACCIONA	6,5	1	6
T1.3	Standardisation needs	CEA	9,25	1	6
T1.4	Competence analysis, identification and management of exploitation results	R2M	13,75	1	42
T1.5	Exploitation, IPR protection and agreements	R2M	11,25	13	42
T1.6	Business models	R2M	7	19	42
T1.7	Commercialization, replication plan and market uptake	R2M	17,25	7	42
T1.8	Global risk analysis and mitigation	R2M	17	1	42

Table 4.5 WP1 tasks

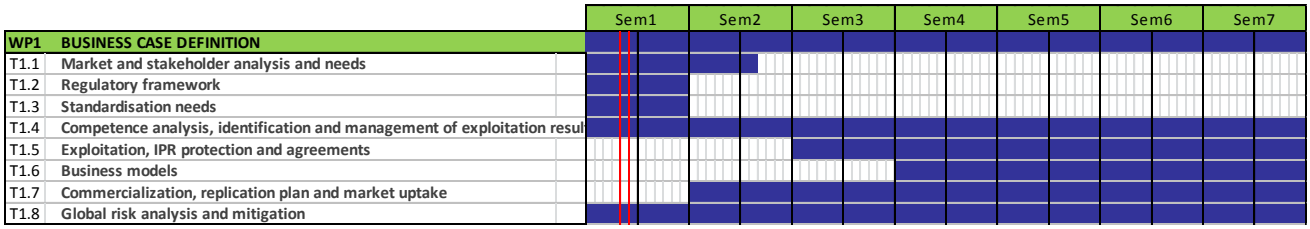

Table 4.6 Timing of WP1 tasks

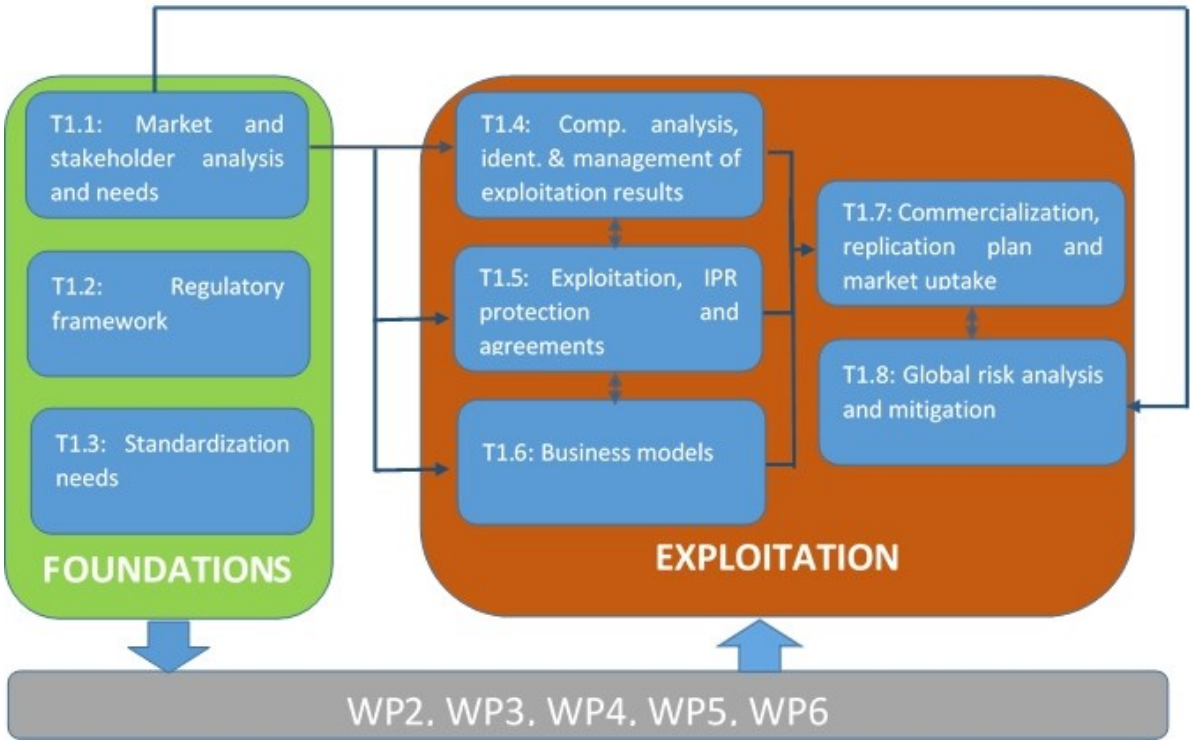

Figure 4.2 Relationship between WP1 tasks

4.1.3 WP1 Tasks Description

T1.1 Market and stakeholder analysis and needs [R2M] (ONYX, BEAR, FLISOM, ACCIONA)

The task will perform a market and stakeholder analysis and needs relevant to BIPV. The size and share of the market for different classifications and products will be defined. This will be used during the development phase but also for exploitation (task 1.4) since a clear picture of the needs and target users will be established. The stakeholder analysis/need will focus on: i) Investors, ii) Designers, iii) Managers, iv) Maintenance manager v) Occupants vi) Grid operators. For the different stakeholders, we will depict their responsibilities/activity, expectations/desired benefits, and problems they would like to fix. Detailed breakdown of applications, climatic conditions and contexts will be performed and will support the understanding of which specific market and elements attention should be the focus. Specific technological drivers (e.g. added values regarding performances due to synergies among technologies – natural lighting opening/channels covered with BIPV) will be mapped. The specific challenges that have limited/could limit the diffusion of BIPV will be discerned especially regarding: concerns regarding durability, effects (structural, thermal and aesthetic) on supporting structure, flexibility of integration, ROI, system performance, integration on the building and with the surrounding grids.

Specific responsibilities are:

- R2M will be responsible for the management & coordination of the task, and characterization of stakeholder analysis/needs.
- Onyx and Flisom will characterize the PV market potential analysis, challenges, trends and installer/maintenance expectations.
- Bear will characterize the needs of designers, maintenance and final user needs and BIPV challenges.
- Acciona will characterize the construction and grid demands/needs and understand the potential market application breakdown.

No	Action/ subtask name	Start	Deadline	Responsible	Output/ Comments
T1.1	**Market and stakeholder analysis and needs**	**M1**	**M10**	**[R2M] (ONYX, BEAR, FLISOM, ACCIONA)**	**D1.1**
1	Definition of topics and structure of D1.1 with responsibilities	M1	Beginning M2	R2M Onyx, Flisom, Bear, Acciona	Table of Contents
2	Identification and sharing of relevant reports, studies, etc	M3	Mid M2	R2M, Onyx, Flisom, BEAR, ACC + ALL	Literature database
3	PV market potential analysis, challenges, trends, applications, installer expectations	M5	Mid M3	Onyx, Flisom	PV industry perspective
4	Draft Market Assessment by county, technology and applications	M3	End M3	R2M + Onyx, Flisom	Draft of Market Assessment chapter
5	Characterization of needs of investors, developers and construction industry	M3	Mid M4	Onyx, Flisom	Explain key players' point of view, needs, issues
6	Characterization of needs of designers, maintenance and final user needs with BIPV challenges	M6		BEAR	
7	Characterization of construction and grid demands/needs and understand the potential market application breakdown	M1		ACC	

8	Draft Stakeholder Assessment by type	-	End M4	R2M + Onyx, Flisom, BEAR, ACC	Draft of Stakeholder Assessment chapter

Table 4.7 Timing of T1.1 planned activities

T1.2 Regulatory framework [ACCIONA] (CEA, NOBATEK)

A detailed analysis of the latest and under development regulatory legislation potentially affecting the project expected impacts will be performed as the main objective. Building energy performance and structural integrating aspects of BIPV, and grid & smart grid related legislation will be identified and studied as possible drivers/barriers for the main project objectives. In this regards, it will be useful to know the different initiatives launched by European Governments to promote BIPV and to have a clear view of the current situation of construction products standardization.

The work carried out in this task will include the following subtasks:

- Analysis of feed-in tariffs and other support schemes and initiatives launched by European Governments to promote building integrated photovoltaics.
- Analysis of self-consumption business models, emerged thanks to the achieving of the grid-parity in several countries in the last few years; and assessment of the status of legislation in this regard, currently not fully developed or with difficulty in doing.
- Assessment of the current procedures for the standardization of construction products and possible barriers to integrate photovoltaics in buildings: CE marking, building codes, etc. which could affect the pre-industrial stages of project results will be established.
- Analysis of the most appropriate business models considering the regulatory framework defined in the above tasks.

Responsibilities of partners involved:

- ACCIONA and CEA will work on regulations focused on photovoltaic generation and energy management.
- NOBATEK will perform the building-related regulations (construction products, energy efficiency and architectural integration issues).

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T1.2	**Regulatory framework**	**M1**	**M6**	**[ACCIONA] (CEA, NOBATEK)**	**D1.2**
1	Analysis of Feed-in tariffs and other support schemes and initiatives.	M1	M4	ACCIONA and CEA	Analysed list for the demo-sites' countries
2	Analysis of self-consumption business models and assessment of the status of legislation.	M1	M4	ACCIONA and CEA	Analysed list of existing different self-consumption models
3	Assessment of the current procedures for the standardization of construction products and possible barriers.	M4	M4	NOBATEK	Explanation of procedures, and needs & barriers of standardization
4	Analysis of the most appropriate business models.	M4	M5	ACCIONA and CEA	Proposal of the most appropriated business models
5	Delivery	-	M6	ACCIONA	Deliverable D1.2

Table 4.8 Timing of T1.2 planned activities

T1.3 Standardisation needs [CEA] (TECNALIA, CTCV)

This task will consist in the definition of standard tests needed for the eight BIPV products to be developed in the framework of the project prior to their market introduction.

A listing and a comprehensive analysis of standards concerning BIPV products will be realized. All standards addressing BIPV systems will be included from existing standards related to construction world and photovoltaic world to new BIPV standard prEN50583 final content (Photovoltaics in building). The in-depth analysis will be achieved focusing on synergies and deviations between existing and new standards. Also, the suitability of standards tests application to BIPV products based on crystalline silicon (task 3.7) and thin-film (task 4.4) modules as well as to inverters (task 5.4) will be taken into account in order to identify and propose when necessary new complementary kind of tests.

Based on this analysis, a specific testing plan to be applied to each BIPV product will be proposed after identifying modifications planned to increase its TRL level. The testing plan will provide a sequence of standards tests to be performed in order to comply with existing construction and photovoltaic standards tests and new prEN50583 standard tests. Requirements of each test will be evaluated aiming BIPV products long term reliability and performance.

Specific responsibilities are:

- CEA will be responsible for the management and coordination of this task and for the analysis of standards related to photovoltaic world and inverters.
- TECNALIA will analyze new prEN50583 standard tests and inverters standard tests and will identify the BIPV products modifications planned during the project.
- CTCV will analyze standard tests related to building and will compile all analysis results in order to propose a testing plan for each product.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T1.3	**Standardization needs**	**M1**	**M6**	**[CEA] (TECNALIA, CTCV)**	**D1.3**
1	Definition of structure and content of deliverable D1.3 with responsibilities	M1	Mid M2	CEA, TECNALIA, CTCV	Table of content: done
2	Sharing of relevant reports, documents and standard texts	M1	Beginning M3	CEA, TECNALIA, CTCV+ All	Literature base, standards
3	Draft of in-depth analysis of existing standards (construction, PV and prEN50583 final content)	M2	Beginning M4	CEA, TECNALIA, CTCV	Draft of D1.3 chapter 2 (Qualitative analysis of standards)
4	Identification of product modifications planned (based on task15 IEA) See manufacturers for data (Onyx, Flisom)	M2	Mid M3	TECNALIA, CEA, CTCV,	Draft of D1.3 chapter 3(Testing plan)
5	Incorporation to project and evaluation of requirements of prEN50583 standard tests needed (long term reliability, performance)	M2	End M4	TECNALIA, CEA, CTCV,	Draft of D1.3 second chapter 3 (Testing plan)
6	Testing plan definition, specific for each product (8 products)	M3	End M5	CTCV	Assessment of results in task 3.7
7	Complete D1.3: Standardization needs	M1	Mid M6	CEA, TECNALIA, CTCV	D1.3

Table 4.9 Timing of T1.3 planned activities

T1.4 Competence analysis, identification and management of exploitation results [R2M] (all)

In this task, the project exploitable results will be identified and the ongoing developments will be critically evaluated in order to understand their potentials and promising applications. A SWOT analysis will be performed to identify the strengths, opportunities, weaknesses and threads of the foregrounds; A 'Value Map' must meet the customer/market needs for the results to become successful. Therefore, for each innovative development the distinguishing features setting them apart from competitors and a preliminary list of steps for market uptake will be identified. Subsequently, the 'Fit' between the 'Costumer/Market needs' defined in task 1.1 and the 'Value Map' will be assessed and improved, if needed. An exploitation manager will be assigned to each development, supported by the project exploitation manager, and will periodically report on the exploitation progress and actions needs to maximize exploitation (e.g., prototyping, demonstration, partner agreements, standardisation). A summary table will be created. The action needed for exploitation will refer to the specific business model(s) identified in Task 1.5.

R2M will coordinate the task, lead the SWOT analysis and matching of needs/benefit. All other participants will provide inputs regarding their exploitable products and act as manager.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T1.4	**Competence analysis, identification and management of exploitation results**	**M1**	**M42**	**R2M, All**	**D1.4, D1.5, d1.6, D1.7. D1.8**
1	Fill out table template distributed by R2M to identify preliminary exploitable results	M1	M2	All	Preliminary result table
2	Assign manager to each result	M1	M3	R2M + All	Table with responsible persons
3	SWOT analysis of results	M2	M3	R2M	Assessment of results
4	Define actions to secure (risk assessment and mitigation measures) and maximize exploitation. These range from legal, legislative, technical and economic evaluation and actions	M3	M4	Each result responsible + R2M	Action list for each result
5	Competence analysis (Value Proposition and Fit)	M3	M4	R2M	Value Proposition & Fit
6	Execution of actions defined above (tbd)	M4	M5	all	Tbd
7	Complete draft of D1.4: Identification and Assessment of Exploitable Results	M6	M6	R2M + others	D1.4 with updates at M15, M24, M36 and M42

Table 4.10 Timing of T1.4 planned activities

T1.5 Exploitation, IPR protection and agreements [R2M] (all)

Building on the table developed under T1.4 as starting point, for each innovation we will define an exploitation plan to reach the desired TRL and market uptake along with steps regarding IPR protection and agreements among partners. After performing a patent search to identify existing patents, the best IP protection and contractual agreements will be defined and set in place for each result. Dissemination of results will occur after IP has been strongly protected. All relevant partners involved with a specific innovation will receive assistance and invited to work cooperatively to identify the best multi-lateral agreement. This will include 3rd party licensing, royalty rates, adjustment of terms and conditions over time and legal dispute considerations. These agreements will support the business models set in place and strengthen the replication plan for post-project activities.

R2M will coordinate the task, provide support regarding IPR protection and agreements. All other participants will identify the suitable exploitation plan, IPR protection and agreements needed for their results.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T1.5	**Exploitation, IPR protection and agreements**	**M13**	**M42**	**R2M +all**	**Exploitation plans, IPR protected and agreements. D1.9, D1.10, D1.11, D1.12**
1	Drafting of a preliminary plan for exploitation	M13	M42	R2M + all	Draft deliverable (M15) with updates at M24, M36 and M42
2	Existing IP and design search	M13	M18	R2M	Identification of existing IP
3	Definition for each result of best IP and agreements	M18	M24	R2M + all	Proposal for protection and agreement
4	Discussion among partners to reach agreements	M24	M30	R2M + all	Achievement of agreement
5	Protection of IP	M24	M36	R2M + all	IP protected

Table 4.11 Timing of T1.5 planned activities

T1.6 Business models [R2M] (ACCIONA)

In this task, we will develop ad-hoc business models for the results developed within the project. Based mainly on the activities of T1.4 and T1.5, we will identify the appropriate strategies, organizational structure, infrastructures, policies, sourcing for each result. The defined business models will leverage the existing channels of cooperation with local actors (designers, dealers, developers) that the partners already have established and adapt the existing business models to the new products and services being offered. We will breakdown the exploitation potential of each result understanding the financial flows (e.g., expenditure, gain), legislative implications (e.g., standard modifications), partnerships or agreements with subjects external to the consortium.

Some of the business models considered include:

i) Development of multifunctional elements with integration of BIPV. Its costs (ideally a low, controlled overcost) will be absorbed by the foreseen standard construction cost; there will be synergies among elements/technologies to exploit reducing the additional cost (less than the sum of the individual cost).

ii) Addition /substitution of BIPV in coordination with other maintenance work in expected (e.g., roof/façade upgrade) therefore reducing the installation cost and defining structural elements with the needs and integrated with the BIPV

iii) PV storage with BEMS SW optimizing electricity flow. Could be based on leasing the battery and tool and charging a little for each cycle used or Wh stored or revenues based on the savings generated by self-consumption of electricity.

iv) Software tool for building energy performance. Business model could be based on direct commercialization, advanced simulation services and e-catalogues for the software, including construction and BIPV products for which manufacturers pay.

v) ESCo approach to finance BIPV investment including maintenance and servicing fees

For each identified business model, in addition to the specific description and needs for the model, we will: i) characterise the stakeholders involved and impacted (coming from the analysis of T1.1); ii) identify needed collaborations with relevant players (e.g., construction companies, technology developers, investors, dealers, utilities) both inside and outside the consortium, iii) reach needed agreements, iv) set in place possible financial instruments.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T1.6	**Business models**	**M7**	**M42**	**[R2M] (ACCIONA)**	**D1.13, D1.14, D1.15, D1.16**
1	Define potentially applicable business models	M7	M12	R2M + ACC	Database of business models
2	Identify potential existing and desired channels and rough financial flows	M8	M24	R2M + ACC, all	List of channels and financial figures
3	Identify key stakeholders and needed partnerships	M9	M24	R2M + ACC, all	List of stakeholders and partnerships
4	Identify needed structures, infrastructure and sourcing	M10	M24	R2M + ACC, all	List of structures needed
4	Finalise refined business model	M24	M36	R2M + ACC, all	Final business models
5	Reach needed agreements and activate financial instruments	M25	M42	R2M + all	Agreement and activation of financial instruments

Table 4.12 Timing of T1.6 planned activities

T1.7 Commercialization, replication plan and market uptake [R2M] (all)

Building on previous tasks, steps for the commercialization and market uptake will be defined. For instance, performance indicators (e.g., system performance, production cost, installation time, supporting structure needs), specific target costumers/channels and goals (e.g., target prices, volume sales, foreseen turnover) for each technology and for different time spans. Therefore, specific figures regarding financial indicators including cash flow, gross margin and earnings should be defined. If possible, this will be divided for different countries/geographical areas and applications. The market launch will be supported by dedicated dissemination and discussion with strategic organizations. We envision the launch of software demo versions and free trials or manufacturing facilities and prototyping for flexible BIPV elements. We will assess logistical and distribution aspects related to e.g., supply of prefabricated elements/modules to dealers and distributors. Marketing and communication strategy will be defined for each result based on the existing and innovative channels.

R2M will be responsible for coordination of the task and providing know-how regarding commercialization and market uptake. Others will be responsible for defining the replication and commercialization plan for their result, including targets and steps needed. WIP will be responsible for defining a dissemination plan for the results.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T1.7	**Commercialization, replication plan and market uptake**	**M19**	**M42**	**R2M (all)**	**D1.17, D1.18, D1.19**
1	Define KPI for the process involved from manufacturing to installations	M19	M24	R2M + all	KPIs definition.
2	Define specific targets for different time spans and areas	M20	M30	R2M + all	Specific targets identified.
3	Discuss commercialisation plans with strategic organisations	M24	M32	R2M + all	Related conclusions.
4	Launch of demo versions or free trials for costumer	M24	M42	R2M + all	Demo versions launched.
5	Develop ad-hoc dissemination plan for each result	M30	M42	R2M + all	Dissemination plan

Table 4.13 Timing of T1.7 planned activities

T1.8 Global risk analysis and mitigation [R2M] (all)

A map of the several potential risks regarding the topic and each development will be created. Likelihood of occurring will be defined for each as well as associated mitigation actions with increasing level of complexity and mitigation impacts will be defined. Some of the actions will be a-priori (e.g., to prevent the risk from happening), while other actions will be triggered only after a certain event occurred and will be seen as true mitigation. The map of the potential list will be disaggregated including technical, financial, legislative, social and environmental issues. This map will be updated periodically so to be able to consider the fast and dynamic markets and sectors, this way, mitigating actions and modifications in the innovation trajectories could be put in place rapidly.

R2M will be responsible for the coordination of the task and approach on risk analysis and mitigation. All others will define the risks and associated mitigation actions for their developments

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T1.8	**Global risk analysis and mitigation**	**M1**	**M42**	**R2M (all)**	**D1.20, D1.21, D1.22, D1.23**
1	Identify generic and result specific risks	M6	M24	R2M+all	List of risks
2	Disaggregate the risks into subcategories	M6	M24	R2M	Disaggregated list of risks
3	Define the likelihood of their occurrence	M7	M24	R2M+all	Likelihood of risk occurrence
4	Define mitigating actions for each of them	M8	M36	R2M+all	Mitigation actions for risks
5	Carry out the mitigating actions	M10	M36	All	Execution of mitigating actions
6	Revise the risk and actions	M24	M36	R2M+all	Revised mitigation actions for risks
7	Carry out the revised mitigating actions	M30	M42	All	Execution of revised mitigating actions

Table 4.14 Timing of T1.8 planned activities

4.1.4 WP1 Deliverables and milestones

The following tables show the deliverables and milestones linked to WP1, stating the associated task, responsibilities, type and dissemination level and the delivery month.

Ref	Deliverable title	Task	Responsible	Type	Diss. level	Delivery date
WP1	**BUSINESS CASE DEFINITION**		**R2M**			
D1.1	Market and stakeholder analysis	T1.1	R2M	R	PU	M10
D1.2	Regulatory framework	T1.2	ACCIONA	R	PU	M6
D1.3	Standardization needs	T1.3	CEA	R	PU	M6
D1.4	Identification and assessment of exploitable results	T1.4	R2M	R	CO	M6
D1.5	Identification and assessment of exploitable results (update 1)	T1.4	R2M	R	CO	M15
D1.6	Identification and assessment of exploitable results. (update 2)	T1.4	R2M	R	CO	M24
D1.7	Identification and assessment of exploitable results. (update 3)	T1.4	R2M	R	CO	M36

D1.8	Identification and assessment of exploitable results. (update 4)	T1.4	R2M	R	CO	M42
D1.9	Exploitation, IPR protection and agreement.	T1.5	R2M	R	CO	M15
D1.10	Exploitation, IPR protection and agreement (update 1)	T1.5	R2M	R	CO	M24
D1.11	Exploitation, IPR protection and agreement (update 2)	T1.5	R2M	R	CO	M36
D1.12	Exploitation, IPR protection and agreement (update 3)	T1.5	R2M	R	CO	M42
D1.13	Business model	T1.6	R2M	R	CO	M12
D1.14	Business model (update 1)	T1.6	R2M	R	CO	M24
D1.15	Business model (update 2)	T1.6	R2M	R	CO	M36
D1.16	Business model (update 3)	T1.6	R2M	R	CO	M42
D1.17	Commercialization and market update	T1.7	R2M	R	CO	M24
D1.18	Commercialization and market update (update 1)	T1.7	R2M	R	CO	M36
D1.19	Commercialization and market update (update 2)	T1.7	R2M	R	CO	M42
D1.20	Global risk and mitigation.	T1.8	R2M	R	CO	M12
D1.21	Global risk and mitigation (update 1)	T1.8	R2M	R	CO	M24
D1.22	Global risk and mitigation (update 2)	T1.8	R2M	R	CO	M36
D1.23	Global risk and mitigation (update 3)	T1.8	R2M	R	CO	M42

Table 4.15 WP1 deliverables

Ref	Milestone title	WP	Responsible	Delivery date	Mean of verification
MS7	Final exploitation strategy defined	WP1	R2M	M42	Overall exploitation strategy is completed and documented (D1.12, D1.16)

Table 4.16 WP1 milestones

4.2 WP2 FROM MARKET AND LEGAL REQUIREMENTS TO SYSTEM SPECIFICATIONS

WP number	2			Start Date		M1			End Date		M42		
WP title	From market and legal requirements to system specifications.												
Participant nº	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Participant short name	TECNALIA	ONYX	BEAR	NOBATEK	FOPTICS	CTCV	FLISOM	CRICURSA	CEA	ACCIONA	FD2	VILOGIA	R2M	CADCAM	WIP
Person/months	10	9	12	10	6	0	9	0	6	6	0	0	1,5	1	0

Table 4.17 WP2 general information

4.2.1 WP2 Purpose and Objectives

The set of market related barriers, needs, risks and requirements identified in WP1 will be translated in WP2 into a coherent set of specifications for the BIPV systems, energy conversion and management systems to demonstrate in the project.

These specifications cover: general description, product design, dimensions and materials, architectural integration, mechanical performance, electrical performance, thermal performance, optical performance, acoustic performance and economic performance.

In parallel, a BIPV products portfolio will be created to gather all the information on the products, -previous and generated during the project-, as a tool to facilitate BIPV prescription and design in building works. WPs from 3 to 8 will feed contents into the BIPV products portfolio. Advanced dissemination activities are foreseen based on this tool, which will be implemented both physically and online.

The specific objectives of the work package are therefore:

- BIPV modules, energy conversion and management systems: To develop a complete set of technical specifications attending to the different business models to demonstrate.
- Architectural integration: To incorporate bio-climatic requirements associated to European climate zones and energy efficiency considerations. Implementation of architectural and aesthetic demands into specific provisions for the products.
- BIPV products portfolio: to define the structure, contents and operational protocols of a multi-format portfolio gathering all the information generated on the products (performance, compliance with standards, architectural implementation possibilities, etc.).

4.2.2 WP2 Problem definition and timing of different tasks

In order to achieve the previous objectives, the following tasks will be performed:

Ref	Task title	Responsible	Estimated indicative person-months	Start month	End month
WP2	**FROM MARKET AND LEGAL REQUIREMENTS TO SYSTEM SPECIFICATIONS**	**BEAR**	**70,5**	**M1**	**M42**
T2.1	Specifications for BIPV modules	BEAR	24	M1	M10
T2.2	Specifications for energy conversion and management systems	TECNALIA	12,5	M1	M6
T2.3	BIPV products portfolio	BEAR	34	M1	M6

Table 4.18 WP2 tasks

		Sem1	Sem2	Sem3	Sem4	Sem5	Sem6	Sem7
WP2	FROM MARKET AND LEGAL REQUIREMENTS TO SYSTEM SPECIFICATIONS							
T2.1	Specifications for BIPV modules							
T2.2	Specifications for energy conversion and management systems							
T2.3	BIPV products portfolio							

Table 4.19 Timing of WP2 tasks

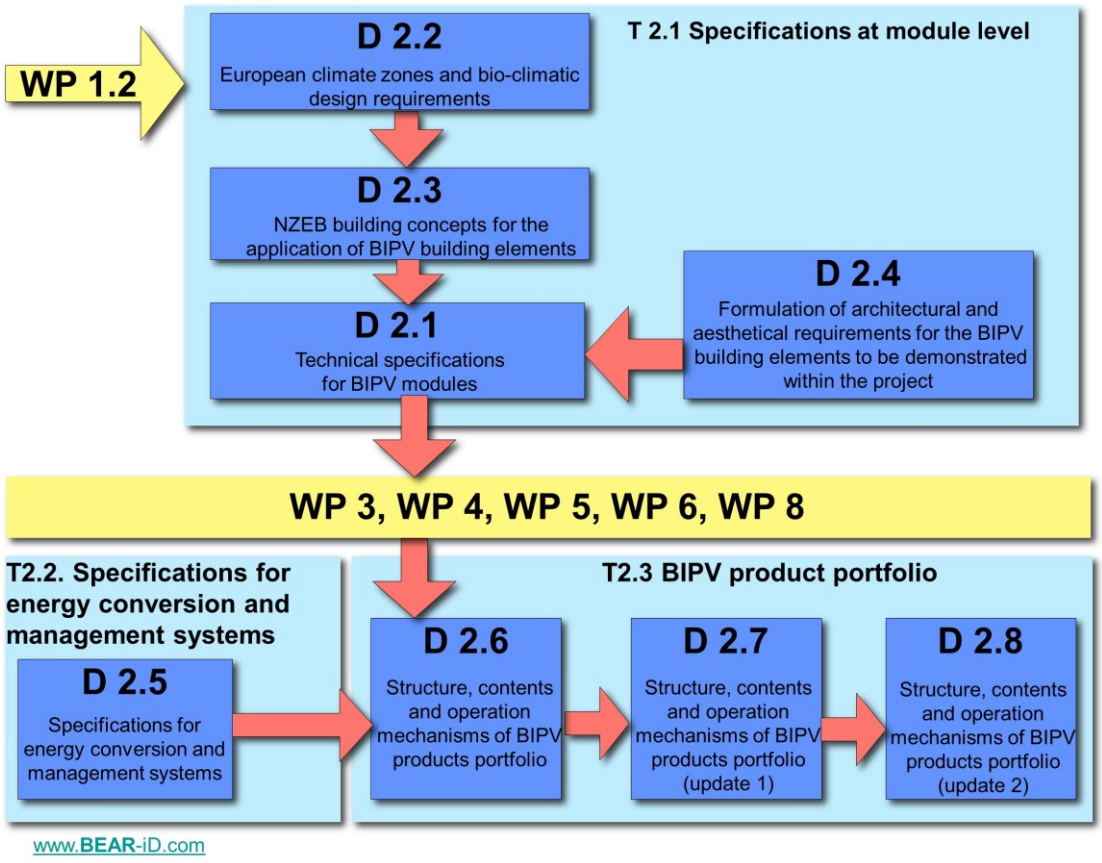

Figure 4.3 Relationship between WP2 tasks

As Figure 4.3 shows, the work developed in *T2.1 Specifications for BIPV modules* will be reported in deliverables D2.1, D2.2, D2.3 and D2.4. At the same time deliverables D2.2, D2.3 and D2.4 (all finished by M3) are the input for D2.1 (that has to be delivered M6)

D.2.1 is an input for WP 3, WP4, WP 5, WP 6 and WP 8.

Output from WP3, WP4, WP5, WP6 and WP8 will be the input for T2.3 BIPV products portfolio. The deliverables of *T2.3 Structure, contents and operation mechanisms of BIPV products portfolio* will be updated during the process D2.6(M12), D2.7(M24) and D2.8(M36)

There is one issue to mention: For D2.2 there is an input foreseen from T1.2 Regulatory framework of WP1. However this work (D1.2) is due in M6 and cannot delivered in time to integrate in D2.2. To solve this problem BEAR has worked extra time to do this research. The outcome of this work can be found in D2.2. If needed, BEAR can update D2.2 after D1.2 is finished in M6.

4.2.3 WP2 Tasks Description

T2.1 Specifications for BIPV modules [BEAR] (Nobatek, Flisom, Onyx, Film Optics, CEA, ACCIONA)

For the specification of BIPV modules different subtasks will be carried out in task T2.1:

ST2.1.1: Specifications at module level

Within this subtask, the technical specifications for the modules and their manufacturing processes will be defined, understood as the definition of the normative requirements to comply, quantification of expected performance at every level and selection of optimal manufacturing processes to achieve these targets. Technical specifications include mainly optical, mechanical and electrical aspects, together with photovoltaic performance. Particular aspects –specific regulations, synergies with other functional building elements, multifunctionality) related to the final applications within the building foreseen will also be considered, in conjunction with with subtasks 2.1.2 and 2.1.3. Boundary conditions related to the manufacturers quality systems and capabilities will be considered at this stage. Technical risks identification and development of mitigation strategies will also be a constant from this phase.

In order to achieve this objective, the roles of the partners are the following actions are envisaged:

- Onyx Solar, Flisom, and Film Optics have to describe the dimensions and materials of the module, the mechanical, optical, thermal and electrical performance of the modules and the manufacturing. This has to be done for each product.
- CEA will co-operate with Flisom and Onyx Solar to determine the photo-voltaic performance.
- BEAR and Nobatek will describe the architectural integration of the modules.
- Acciona will describe the construction aspects and mounting of the modules.

ST2.1.2: European climate zones and bio-climatic design.

BEAR with collaboration of NOBATEK, will formulate the design requirements for the different climates within the EU, taking the European Bioclimatic map as a starting point. These requirements will consider comfort, indoor climate, heating, cooling and daylight in relation to the different climate

zones. The regulatory framework including local standards (WP1) will be used as input as well. D2.2 will be generated as a result of this work.

NOBATEK, in collaboration with BEAR, will also design several building concepts, considering the architectural and aesthetical requirements gathered in subtask 2.1.3. The building concepts will show the possibilities to integrate the BIPV building elements and their related energy performance. This subtask work will result in a collection of concepts that reach the NZEB level (deliverable D2.3).
Deliverable D2.2 will be written by BEAR with contributions from Nobatek.
Deliverable D2.3 will be written by Nobatek with contributions from BEAR.

ST2.1.3: Architectural and aesthetical considerations.

This section deals with the description of a framework for the application of the building elements from an architectural point of view. This description will be drawn in 3D to make it more visible and provide a better understanding for other parties in the project. This subtask will also focus on the products, the dimensions in order to produce a wide range of building elements, the specific qualities like colour, transparency, etc. and the specific details for integration and mounting of the BIPV building elements. Other aspects like day-lighting, indoor shading patterns, indoor climate, user acceptance and acceptance from the inside out will be part of this stage. This task will be performed by BEAR and will result in a deliverable describing the main requirements from architectural and aesthetical considerations (deliverable D2.4, prepared by BEAR). Architect members of the consortium will be asked to review the deliverable.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T2.1	**Specifications for BIPV modules**	**M1**	**M6**	**[BEAR] (Nobatek, Flisom, Onyx, Film Optics, CEA, ACCIONA)**	**D2.1, D2.2, D2.3, D2.4**
2.1.1	Specifications at module level	M1	M4	BEAR, Nobatek, Flisom, Onyx, Film Optics, CEA, ACCIONA	D2.1
2.1.2.a	European climate zones and bio-climatic design - Climate	M1	M4	BEAR, Nobatek	D2.2
2.1.2.b	European climate zones and bio-climatic design - Designs	M1	M4	BEAR, Nobatek	D2.3
2.1.3	Architectural and aesthetical considerations	M1	M6	BEAR	D2.4

Table 4.20 Timing of 2.1 planned subtasks

T2.2 Specifications for energy conversion and management systems [TECNALIA] (ACCIONA, CEA, R2M)

First of all, use cases must be clearly defined from an energy conversion and management point of view. Although a preliminary classification of building typologies will be carried out within the market analysis in task 1.1, a more detailed categorization must be completed taking into account the following energy aspects:

- Potential BIPV capacity and expected energy yield in relation to building electrical demand.
- Consumption profile, characterization of active load management possibilities and critical loads (if any).

- Grid-connection requirements and added-value service possibilities (e.g., Virtual Power Plant).
- Market conditions: electricity tariffs, net-metering or net-billing scheme…

All these factors will determine specifications of grid interface and building energy management system, including complete functionality (basic/minimal and advanced/additional operating modes), general electrical parameters and required communication interfaces. Applicable standards will be taken into account.

In order to achieve this objective, the following actions are envisaged:

1. **Analysis of grid-connection requirements**

   TECNALIA will revise current and planned grid-connection regulations at European level in order to ensure Quality and Security of System.

2. **Specifications of PV storage inverter**

   TECNALIA will define detailed functional, electrical, communication and mechanical specifications of projected PV storage inverter in order to match prosumers needs and comply with previously defined grid-connection requirements.

3. **Specifications of SiC based inverter**

   CEA will define detailed functional, electrical, communication and mechanical specifications of projected SiC based PV inverter in order to match prosumers needs and comply with previously defined grid-connection requirements.

4. **Analysis of self-consumption market conditions (electricity tariffs, supporting schemes, etc.) and added value services (VPP, UPS, etc.)**

   On the one hand, ACCIONA will revise self-consumption market conditions at European level, determined by existing electricity tariffs, self-consumption regulations and potential supporting schemes. On the other hand, ACCIONA will also analyze potential self-consumption business models based on provision of added-value services.

5. **Characterization of consumption profiles and active load management possibilities**

   R2M will create a database through literature review mainly of potential for load shifting for different building and equipment types.

6. **Specification of Building Energy Management System (functionalities, building monitoring and grid communication interfaces, HMI, etc.)**

   ACCIONA will provide detailed functional and communication specifications of projected BEMS in order to match prosumers needs and comply with applicable standards.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T2.2	**Specifications for energy conversion and management systems**	**M1**	**M6**	**[TECNALIA] (ACCIONA, CEA, R2M.)**	**D2.5**
1	Analysis of grid-connection requirements	M1	M3	TECNALIA	Input for action 2 y 3
2	Specifications of PV storage inverter	M1	M4	TECNALIA	Input for D2.5
3	Specifications of SiC based inverter	M1	M4	CEA	Input for D2.5
4	Analysis of self-consumption market conditions (electricity tariffs, supporting schemes, etc.) and added value services (VPP, UPS, etc.)	M1	M5	ACCIONA	Input for action.6
5	Characterization of consumption profile and active load management possibilities	M1	M5	R2M	Input for action.6
6	Specification of Building Energy Management System (functionalities, building monitoring and grid communication interfaces, HMI, etc.)	M1	M6	ACCIONA	Input for D2.5

Table 4.21 Timing of 2.2 planned activities

T2.3 BIPV products portfolio [BEAR] (Onyx, Flisom, Nobatek, TECNALIA, CEA)

All the products and families of products demonstrated in the project will form part of a BIPV products portfolio which will be available on different formats. A first implementation will consist in an online matrix whose elements will be each product and all its related information. Secondly, each product will be turned into a BIM object (WP7) and will constitute an input data for the BIPV software tool to be developed in WP7. Third, the collection of products and product information will be the basis for dissemination materials (physical catalogues, flyers, etc.) to be developed in WP9.

The portfolio will contain all the information available on the product: PV technology, nominal power, possible architectural applications, customization, life cycle, price, etc. As for operation mechanisms, it will implement a search tool in order to select the optimum product at project design level; it will perform preliminary production estimates as a function of location, orientation, tilt, etc. to facilitate a first evaluation of economic viability (though more accurate, project specific predictions will be available through BIPV software tool, WP7). This tool will also contribute to the labor of the installation professionals by means of setting up maintenance and dismantling guidelines within the portfolio.Task 2.1, as well as work packages focused on BIPV systems technology (WP 3, 4, 5 and 6), lifecycle analysis and demonstration activities (WP8) will feed from this portfolio and self-consistently provide feedback to it.

The online portfolio and the BIPV software tool to be developed in WP7 are highly complementary in the sense that the portfolio will provide general information, data sheets and some degree of optimization and customization by the user (project design architects), while the BIPV software will allow detailed calculations on the performance of both the BIPV systems and the building in specific integration works, together with detailed analysis of economic viability. Final users of the software are design architects, thermal engineers, installers, construction products manufacturers, etc.

Protocols will be defined in order to add, correct, delete and comment information in the portfolio to improve contents and search methods.

In order to develop this task the role of each partner is:

- The selection of structure, contents and operational protocols will be performed by BEAR, Onyx, Flisom, CEA, Nobatek and TECNALIA.
- The specific gathering of information to be fed into the tool will be the responsibility of TECNALIA.

- Periodic reports on structure and contents will be issued. The specific implementation of the online portfolio will be made by in WP9, as part of dissemination & communication activities.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T2.2	**BIPV products portfolio**	**M4**	**M36**	**[BEAR] (Onyx, Flisom, Nobatek, TECNALIA, CEA)**	**D2.6, D2.7 D2.8**
1	Template/protocols for the structure of the deliverables. Review by partners	M4	M12	BEAR	D2.6
1	Structure, contents and operation mechanisms of BIPV products portfolio	M4	M12	BEAR	D2.6
2	Structure, contents and operation mechanisms of BIPV products portfolio (update 1)	M13	M24	BEAR	D2.7
3	Structure, contents and operation mechanisms of BIPV products portfolio (update 2)	M25	M36	BEAR	D2.8

Table 4.22 Timing of 2.3 planned activities

4.2.4 WP2 deliverables and milestones

The following tables show the deliverables and milestones linked to WP2, stating the task associated, the responsibilities, the type and dissemination level and the delivery month.

Ref	Deliverable title	Task	Responsible	Type	Diss. level	Delivery date
WP2	**FROM MARKET AND LEGAL REQUIREMENTS TO SYSTEM SPECIFICATIONS**		**BEAR**			
D2.1	Technical specifications for BIPV modules.	T2.1	BEAR	R	CO	M6
D2.2	European climate zones and bio-climatic design / requirements.	T2.1	BEAR	R	PU	M3
D2.3	NZEB building concepts for the application of BIPV building elements	T2.1	BEAR	R	PU	M3
D2.4	Formulation of architectural and aesthetical requirements for BIPV building elements to be demonstrated within the project	T2.1	BEAR	R	PU	M3
D2.5	Specifications for energy conversion and management systems.	T2.1	TECNALIA	R	CO	M6
D2.6	Structure, contents and operation mechanisms of BIPV products portfolio.	T2.2	BEAR	R	PU	M12
D2.7	Structure, contents and operation mechanisms of BIPV products portfolio (update 1)	T2.2	BEAR	R	PU	M24
D2.8	Structure, contents and operation mechanisms of BIPV products portfolio (update 2)	T2.2	BEAR	R	PU	M36

Table 4.23 WP2 deliverables

Ref	Milestone title	WP	Responsible	Delivery date	Mean of verification
MS1	Detailed functional requirements for BIPV systems defined	WP2	**BEAR**	M6	All the technical specifications for the BIPV modules, together with the energy conversion and management systems defined. Reports 2.1 and 2.5 issued and approved.

Table 4.24 WP2 milestones

4.3 WP3 BIPV MODULES BASED ON CRYSTALLINE SILICON TECHNOLOGY

WP number	3					Start Date			M4		End Date				M36
WP title	BIPV modules based on crystalline silicon technology														
Participant nº	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Participant short name	TECNALIA	ONYX	BEAR	NOBATEK	FOPTICS	CTCV	FLISOM	CRICURSA	CEA	ACCIONA	FD2	VILOGIA	R2M	CADCAM	WIP
Person/months	27	48	3	15	7	8,5	0	0	14	17	0	0	0	0	0

Table 4.25 WP3 general information

4.3.1 WP3 Purpose and Objectives

This work package is focused on providing a multiple answer to market needs defined in WP1 (Task 1.1) by taking to a pre-industrial stage a set of crystalline silicon technology-based products, specially designed to cope with these needs.

In this WP, semitransparent and opaque glass-glass implementations are aimed. Families of products are provided for different implementations within the building (horizontal or vertical curtain wall, ventilated façades, shading elements). All the modifications and progress needed to take all these solutions to successful demonstration in experimental and real buildings will be tackled in this WP.

The specific objectives are:

- Enhanced aesthetical appearance at the same or superior efficiency levels as conventional PV modules. Same or enhanced passive properties than traditional construction products.
- Possibility of customization in terms of geometry and formats.
- Compliance with PV, BIPV and construction standards.
- Generation of technical data from modelling at element and building level.
- Achievement of TRL 6 for the solutions through demonstration of performance in experimental test bench and building.
- Compliance with targeted cost-effectiveness: The target price should be within 250-400 €/m2 maximum, with an over cost of maximum 100 €/m2 with respect to the equivalent non-PV active glazing at same passive property performance ratio (deviation of materials parity of approx. 100 €/m2). Thus, considering net investment cost, electricity prices in given markets and added values due to passive properties, the payback time should be within 5-7 years or lower.

The developments coming from this WP will be demonstrated to a TRL6 in experimental facilities. The rest will be taken to TRL7 in real buildings within WP8.

4.3.2 WP3 Problem definition and timing of different tasks

In order to achieve the previous objectives, the following tasks will be performed:

Ref	Task title	Responsible	Estimated indicative person-months	Start month	End month
WP3	**BIPV MODULES BASED ON CRYSTALLINE SILICON TECHNOLOGY**	**ONYX**	**139,5**	**M1**	**36**
T3.1	Semitransparent low concentration and solar control BIPV solutions	TECNALIA	27	M1	M15
T3.2	Hidden busbars and L-interconnections for opaque BIPV solutions	ONYX	11	M1	M15
T3.3	Back-contact solar cells implemented as see-thru glass/glass BIPV solution	ONYX	11	M1	M15
T3.4	Framing systems compatible with XL formats and large thickness BIPV units	ONYX	3	M1	M15
T3.5	Glazing treatments for improved passive properties	ONYX	11	M1	M15
T3.6	Modelling at element and building level	NOBATEK	15	M15	M21
T3.7	Performance validation testing	TECNALIA	22,5	M15	M24
T3.8	Technology demonstration in test benches	ACCIONA	39	M18	M36

Table 4.26 WP3 tasks

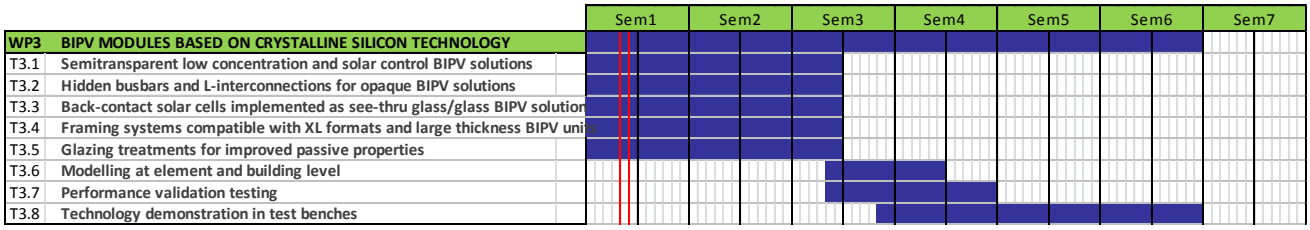

Table 4.27 Timing of WP3 tasks

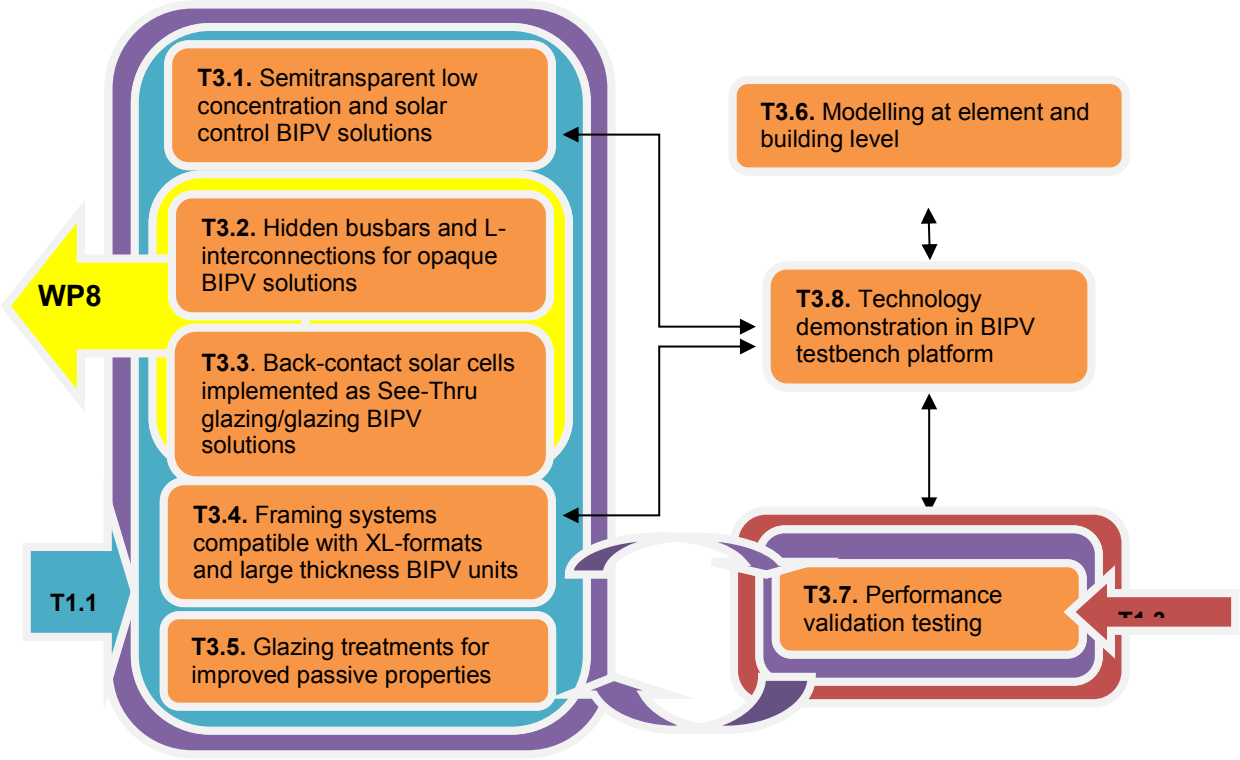

Figure 4.4 Relationship between WP3 tasks

4.3.3 WP3 Tasks Description

T3.1 Semitransparent low concentration and solar control BIPV solutions [TEC]

(ONYX, BEAR, NOBATEK, Film Optics)

Glass-glass semitransparent PV modules in conjunction with integrated optical elements are proposed to concentrate solar radiation onto the cells during the central part of the year and allow light passing towards the interior of the building during the winter. During the winter, the PV system works as a traditional installation. At the central part of the year, the lenses deviate solar radiation onto the cells with a double effect: (1) an increase in PV production in comparison with a traditional PV system of same installed power The savings provided by the system are obviously greatly enhanced in locations with high direct irradiation conditions. Implementations in skylight (curtain wall), ventilated façade and shading elements are proposed:

Skylight configuration: the optical elements (Fresnel lenses) will be integrated in the external glass, in principle using silicone-on-glass lenses, though other schemes could be considered during project development. The cells will be laminated in the internal glass element, within two panes of extraclear, toughened glass. The most internal glass behind the cells could be coloured, screen-printed or include other effects if required by aesthetical considerations. Other encapsulation schemes using lighter materials will be also considered, if compatible with architectural, legal and other technical requirements.

Ventilated façade configuration: the optical elements will be integrated in the external glass of a glass-glass ventilated façade, perpendicularly to the glass pane. This configuration is optimal, not only from the geometrical optics point of view, but also in the sense that Fresnel lenses placed along the glazing plane would considerably disturb building users' visual comfort. The inner glazing, containing the laminated cells, may also be part of a double glazing and incorporate further

elements The specific details of lens cladding to the external skin of the façade, cavity design, ventilation, etc., will be defined within the project.

Shading elements on curtain walling: the optical elements can also be integrated as slats directly on the PV laminate, which would form part of a vertical curtain wall. Optical design of the lenses remains intact, and the solution can be incorporated to an additional skin solution. PV production will be higher than in the previous case, as a glass pane is eliminated. Additional measures must be taken at the mechanical design phase to cope with increased exposure of the lenses to atmospheric agents.

The Fresnel lenses are a key component of the solution. They must be thoroughly designed to provide radiation redirection towards the cell or the building as needed to optimise PV production and the building solar control, not penalizing radiation entrance during the winter and minimizing it during the summer. A global optimisation algorithm, linking the commercial geometrical design tool ZEMAX with building energy performance simulation tool (WP7) will be developed to generate lens design. A range of designs will be generated as a function of latitude, orientation and tilt.

This range will also be optimized, so that a relatively small number of lens designs are able to cope with all possibilities with no significant performance losses. The relative position of PV cells and lenses is another variable to enhance the performance without lens modification.

The role of each partners involved in this task are:

- Tecnalia and Film Optics will work on the optimisation of the design of Fresnel lens in conjunction with Tecnalia to comply with performance and cost targets. Numerical optimization tool will be developed by Tecnalia in collaboration with subcontractor Optimal Computing.
- BEAR and Nobatek will support Tecnalia on the architectural integration of the system, introducing the related bio-climatic design considerations as well as framing, cladding, dimensions etc.
- ONYX, as manufacturer of the final system, will provide specifications (through task 2.1) guidelines and feedback on the work performed and results obtained.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T3.1	**Semitransparent low concentration and solar control BIPV solutions**	**M1**	**M15**	**[TEC] (ONYX, BEAR, NOBATEK, Film Optics)**	**D3.1, D3.2**
1	First optical designs of lenses	M1	M9	TECNALIA	Input geometries for action 2
2	Development of numerical optimization tool	M5	M9	TECNALIA	Optimization tool for action 3
3	Optimized lenses design	M9	M15	TECNALIA	D3.1
4	Definition of architectural integration for all implementations	M9	M15	TECNALIA	D3.2

Table 4.28 Timing of 3.1 planned activities

T3.2 Hidden busbars and L-interconnections for opaque BIPV solutions [ONYX]

One of the main BIPV market acceptability constrains is that most crystalline BIPV solutions show visible cell busbars (BB) and string L-interconnections with a metallic aspect. Therefore, for fully opaque glazing/glazing BIPV units, compatible with canopies and vertical ventilated façades, a well-defined strategy should be established. In this task, ONYX will develop prototypes where the

busbars will be hidden by means of implementing black conductive ribbons over the welded cells in a string. In addition, different fully black plastic sheets compatible with the lamination process will be integrated as interlayers to hide the L-interconnections. Finally a fully black frit patterned rear glazing will be used. As a result, a fully black PV glazing/glazing unit will be developed where all the aesthetics constrains will be covered while maintaining the performance level.

ONYX will work on process optimization for the achievement of fully operational prototypes complying with specifications.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T3.2	**Hidden busbars and L-interconnections for opaque BIPV solutions**	**M1**	**M15**	**ONYX**	**D3.3**
1	Study and implementation process of black conductive ribbons over the welded cells in a string	M1	M15	ONYX	Output for action 3
2	Study and implementation process of fully black plastic sheets compatible with the lamination process	M1	M15	ONYX	Output for action 3
3	Optimization process	M6	M15	ONYX	D3.3 The solution developed will be directly taken to demonstration in real buildings (WP8)

Table 4.29 Timing of 3.2 planned activities

T3.3 Back-contact solar cells implemented as see-thru glass/glass BIPV solution [ONYX]

For specific building solutions such as skylights and curtain walls, the decision maker is looking for certain light transmission values. In these cases, the approach described in task 3.2 is not suitable. Here, a compromise between cell density providing the see-thru degree, efficiency and aesthetical added value should be found. Attending to these needs, it is clear that the best possible solution is the implementation of back-contact solar cells within the BIPV architectural design. These cells offer the following advantages:

- Back-contact solar cells offer efficiencies as high as 22%, and thereby, efficiency per module can be as large as 160W/m2 (16%) even at cells densities offering 35% of light transmission.
- Back contact solar cells avoid visible front bus bars, leading to a superior aesthetical appearance of the BIPV module.

Within this task, ONYX will work to overcome the main challenge related to this technology, which is the development of cell to cell Sn/Cu welding process for back contact solar cells within a glazing/glazing lamination process.

No	Action/subtask	Start	Deadline	Responsible	Output/Comments
T3.3	**Back-contact solar cells implemented as see-thru glass/glass BIPV solution**	**M1**	**M15**	**ONYX**	**D3.4**
1	Development of cell to cell Sn/Cu welding process for back contact solar cells within a glazing/glazing lamination process	M1	M15	ONYX	Optimized welding process

2	Optimization process	M6	M15	ONYX	D3.4 (M15). The solution developed will be directly taken to demonstration in real buildings (WP8)

Table 4.30 Timing of 3.3 planned activities

T3.4 Framing systems compatible with XL formats and large thickness BIPV units [ONYX]

ONYX has been recently awarded with a SME-phase II project referred as 666057 ADVANCED-BIPV. The main scientific and technical objective of this project is the fabrication of large dimension BIPV units (as large as 4,5 m x 2,5 m) and as thick as 40 mm. There is a really high demand of this type of glazing units in the architectural glazing markets, where the client is searching to cover sprandel-to-sprandel distance (typically 4,2 m) within vertical façades, reducing the mechanical installation cost and providing the most robust mechanical solution possible. ADVANCED-BIPV covers all these needs form the glazing manufacturing viewpoint in terms of optimized lamination process, new equipment development, implementation of new encapsulation materials and interlayers. However, building integration strategy in terms of full PV system integration is not analysed or overtaken within the scope of ADVANCED-BIPV project.

Therefore, ONYX will face in this task the prototyping of framing solutions compatible with XL-formats and different building solutions (curtain walls, vertical façades and skylights) where the mechanical aspects and hidden wiring strategies will be elucidated.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T3.4	**Framing systems compatible with XL formats and large thickness BIPV units**	**M1**	**M15**	**ONYX**	**D3.5**
1	Framing solutions compatible with XL-formats prototypes for curtain walls and skylights	M4	M15	ONYX	D3.5
2	Framing solutions compatible with XL-formats prototypes for vertical façades and ventilated façades	M4	M15	ONYX	D3.5

Table 4.31 Timing of 3.4 planned activities

T3.5 Glazing treatments for improved passive properties [ONYX]

The aim of this task is to analyze different typically used glazing transformation processes in conjunction with the double glazing BIPV lamination process. Per today there is very little knowledge on the effects of surface treatments as low-e coatings, frit pattern coatings, adhesives and even the use of dedicated encapsulation materials within the lifespan of BIPV units. Moreover, the existing bibliography on the matter is rather poor and the effect of key parameters as PV thermal coefficients, encapsulation material adhesion properties over treated or surface coatings. A systematic analysis should be carried out and will be faced in this task, including different glass treatments, and the main feedback will come from prototype validation testing (task 3.7).

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T3.4	**Glazing treatments for improved passive properties**	**M1**	**M15**	**ONYX**	**D3.6**
1	State of the art study	M1	M4	ONYX	Selection of the different glass treatments to be done in action 2 and 3
2	Encapsulation materials	M5	M15	ONYX	D3.6
3	Coatings treatments	M5	M15	ONYX	D3.6

Table 4.32 Timing of 3.5 planned activities

T3.6 Modelling at element and building level [Nobatek] (TECNALIA)

This task complements the previous ones with a complete simulation of the BIPV modules at element and building level. The task provides as well direct feedback to task 2.3 (BIPV products portfolio) and the generation of information for dissemination materials.

At an element level, the following simulations will be performed:

• Optical calculations: analytical calculation of transmittance and reflectance of each element at the transparent and cell zones. The analytical calculation for a range of glass panes and thickness, laminates and multiple glazing configuration requires a reduced set of initial experimental UV-Vis-NIR spectrophotometry measurements.

• Thermal calculation of thermal transmittance values and solar factor. U value will be determined both according to standards, which give center-of-glass values for fixed environmental conditions, just for comparison purposes, and by using the Finite Elements Method (FEM) for a more precise determination of temperature profile in different environmental conditions.

• Mechanical: analytical and FEM calculations on service loads (wind and snow) and overloading due to manipulation and maintenance of BIPV elements.

• Electrical: calculations of PV production of each element.

At a building level, the development of BIM objects and BIPV software tool in WP7 will allow the simulation of performance of each BIPV product in real operation conditions. Each BIPV product will be simulated for several building typologies, locations, etc., and advanced information will be generated about PV and building performance. The synergies of BIPV elements and passive energy efficiency strategies in the building will be quantified and optimized.

The specific experimental buildings where the product will be demonstrated will be simulated with two purposes: (1) to select the optimum implementation for the product and have a first feedback on expected performance levels and (2) to validate the software output data with the results coming from the demo installations.

All simulations and spectrophotometry at element level will be performed by TECNALIA. Simulations at building level and the analysis of global performance of the BIPV elements within the building will be performed by Nobatek.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T3.6	**Modelling at element and building level**	**M13**	**M21**	**[Nobatek] (TECNALIA)**	**D3.7**
1	Modelling objectives definition /coordination with other tasks of the project (integration of calculations modules within the software tool developed as part of WP7)	M13	M16	NOBATEK	Objectives defined

2	Modelling protocol to be defined / Input (experimental characterisation of the PV cells+ design parameters) and output of the modelling	M17	M18	NOBATEK /TECNALIA	Protocol defined
3	Experimental optical properties provided	M13	M16	TECNALIA	Optical properties provided.
4	Optical preparation of the incident flux	M16	M18	NOBATEK	Incident flux determined.
5	Thermo-mechanical calculations (Finite Element Modelling)	M16	M18	NOBATEK	D3.7
6	Mechanical calculations of loads on the system (stress analysis)	M19	M21	TECNALIA	D3.7
7	Electrical calculations (production estimation)	M18	M19	TECNALIA	D3.7
8	Feedback for the design of technologies according to regulatory considerations	M19	M21	NOBATEK	D3.7
9	Models simplification for integration as BIM objects	M19	M21	NOBATEK	Input for task 7.2
10	Use of the reduced order model at building level for several building typologies	M19	M21	NOBATEK	D3.7

Table 4.33 Timing of 3.6 planned activities

T3.7 Performance validation testing [TECNALIA] (Onyx, Film Optics, CEA, CTCV)

Within previous WP3 tasks, some modifications and progress are proposed on BIPV systems in order to successfully take the solutions to higher technology readiness levels involving demonstration in real buildings. All the modifications performed will thus be subjected to intensive testing to guarantee the compliance with standards (one of the main concerns from end users) and to generate the corresponding information for technical data sheets and catalogues. The applicable standard for crystalline silicon PV modules is EN 61215. For glass panes, there is EN 14449 for laminated glass and all the test standards therein and EN1279-5 and standards therein for double glazing. In addition to this, a new standard for BIPV systems (currently pr-EN 50583) will be released in the following months. The final content of this standard will be analysed and the corresponding testing will be incorporated to the project, as compliance with this standard will become a pre-requisite for market introduction of BIPV systems in the next years. Testing needs for each product are previously established in task 1.3.
The manufacturer of the samples for testing will be Onyx, with the contribution of Film Optics for the Fresnel lenses. CEA will take charge of the testing of the modules according to photovoltaic standards. CTCV will undertake the testing related to glass panes and multiple glazing systems. TECNALIA will take charge of the testing of architectural systems (façades and curtain walls).

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T3.7	**Performance validation testing**	**M13**	**M24**	**[TECNALIA] (Onyx, Film Optics, CEA, CTCV)**	**D3.8, D3.9**
1	Fresnel lens manufacturing	M13	M15	Film Optics	Lenses for action 2, D3.8
2	Low concentration system manufacturing	M13	M15	ONYX	Samples for action 9 and 10, D3.8
3	Manufacturing of back-contact cell based modules	M13	M15	ONYX	Samples for actions 8 -10, D3.8

4	Manufacturing of hidden bus-bars cell based modules	M13	M15	ONYX	Samples for actions 8-10, D3.8
5	Manufacturing of framing systems compatible with XL formats	M13	M15	ONYX	Samples for action 10, D3.8
6	Manufacturing of modules with glass treatments	M13	M15	ONYX	Samples for action 8, D3.8
7	Façades elements assembling	M13	M17		Samples for action 10, D3.8
8	Testing according to PV standards	M16	M24	CEA	D3.9
9	Testing according to construction standards	M16	M24	CTCV	D3.9
10	Testing of systems according to construction standards	M16	M24	TECNALIA	D3.9

Table 4.34 Timing of 3.7 planned activities

T3.8 Technology demonstration in test benches [ACCIONA] (CEA, Onyx, Film Optics, TECNALIA)

The low concentration, solar control product (task 3.1) will be tested in ACCIONA TestCell infrastructure in Sevilla, Spain and Incas platform at CEA. Due to localization in Southern Spain, TestCell is specially indicated to test passive and active technologies in hot climate conditions. The building consists of two separated laboratories; around 30m2 surface each. The main structure made in steel allows easily assembling and disassembling of building components (facades, roofs, foundations, indoor partitions…) and is highly adaptable.

The testing process will involve the manufacturing and monitoring of the low-c system in skylight implementation (same optical concept), its PV performance and influence on the building temperature and cooling demands. For comparison, an identical system without the optical elements will be installed and monitored in the same conditions. In this way, overgeneration and reduction of cooling demands will be assessed in controlled conditions.

The Incas platform located at CEA will be used in this task to perform the same monitoring process for the façade implementation of the low concentration, solar control BIPV system (task 3.1). CEA will also test the performance of the XL format BIPV systems (task 3.4). The experiments will be carried out on Passys test cells (two identical cells exposed to outside real climatic conditions with variable orientation, testing components on one façade).

BIPV elements will be integrated on 10m² demonstration facades of the first Passys cell and standard BIPV modules (no additional optics) will be mounted on the façade of the second Passys cell as reference. Experimental parametric studies will be performed by varying the orientation of the BIPV façade to consider optimal and unfavourable integration configurations. The temperature and the electrical production of the both PV installations will be measured and compared. A full functional assessment of the demonstrated skylight and façade will be carried out by CEA and ACCIONA. One year measuring period is necessary for a complete comprehension of the prototypes developed.

In addition to the work performed by ACCIONA and CEA, described above, ONYX and Film Optics will work in prototypes manufacturing; Film Optics will provide Fresnel lens film samples with enhanced performance to partners for further integration in prototypes for demo in BIPV testbench platform. TECNALIA will participate in the results analysis and comparison with simulations and indoor characterisation (tasks 3.6 and 3.7). Products from task 3.2 and 3.3 will be directly taken to demonstration in real buildings (WP8).

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T3.8	**Technology demonstration in test benches**	**M19**	**M36**	**[ACCIONA] (CEA, Onyx, Film Optics, TECNALIA)**	**D3.10, D3.11, D3.12**
1	Prototypes manufacturing	19	21	ONYX	3.10
2	Installation at CEA	22	22	CEA	Previous to action 4
3	Installation at ACCIONA	22	22	ACCIONA	Previous to action 5
4	Monitoring activities at CEA (low- c system as skylight, XL formats)	23	36	CEA	Inputs for 3.11 and 3.12
5	Monitoring activities at ACCIONA (low-c system as façade)	23	36	ACCIONA	Inputs for 3.11 and 3.12
6	Analysis of results	30	36	ACCIONA, CEA, Onyx, Film Optics, TECNALIA	D3.11, D3.12

Table 4.35 Timing of 3.8 planned activities

4.3.4 WP3 Deliverables and milestones

The following tables show the deliverables and milestones linked to WP3, stating the task associated, the responsibilities, the type and dissemination level and the delivery month.

Ref	Deliverable title	Task	Responsible	Type	Diss. level	Delivery date
WP3	**BIPV MODULES BASED ON CRYSTALLINE SILICON TECHNOLOGY**		**ONYX**			
D3.1	Low-concentration, solar control system: report on lens and module designs and validity ranges.	T3.1	TECNALIA	R	CO	M15
D3.2	Low-concentration, solar control system: report on architectural integration.	T3.1	TECNALIA	R	CO	M15
D3.3	Operational prototypes with hidden busbars and L-interconnections.	T3.2	ONYX	DEM	PU	M15
D3.4	Operational prototypes, see-through back contact solar cells.	T3.3	ONYX	DEM	PU	M15
D3.5	Prototypes of framing systems compatible with XL-formats and large thickness BIPV units.	T3.4	ONYX	DEM	PU	M15
D3.6	Glazing treatments for improved passive properties, report on materials and processes.	T3.5	ONYX	R	CO	M15
D3.7	Report on simulation work, c-silicon based BIPV elements	T3.6	NOBATEK	R	PU	M21
D3.8	Samples for indoor validation tests, c-Si based products	T3.7	ONYX	DEM	PU	M15
D3.9	Report on indoor validation tests, crystalline-silicon based BIPV elements.	T3.7	TECNALIA	R	CO	M24
D3.10	Prototypes for demonstration in outdoor test benches.	T3.8	ONYX	R	CO	M21

D3.11	Analysis of BIPV platform exposure results	T3.8	ACCIONA	R	CO	M30
D3.12	Analysis of BIPV platform exposure results (update 1)	T3.8	ACCIONA	R	CO	M36

Table 4.36 WP3 deliverables

Ref	Milestone title	WP	Responsible	Delivery date	Mean of verification
MS5	BIPV systems performance proved	WP3, WP4, WP5	**TECNALIA ONYX, FLISOM, CEA**	M27	Modifications made within the project to c-Si and CIGS BIPV modules, together with the 10kW PV storage inverter and single-stage SiC PV inverter validated by means of laboratory tests. Test reports issued (D3.9, D4.6, D5.4, D5.5)

Table 4.37 WP3 milestones

4.4 WP4 BIPV MODULES BASED ON CIGS THIN FILM TECHNOLOGY

WP number	4				Start Date		M1			End Date		M36		
WP title	BIPV modules based on CIGS thin film technology.													
Participant nº	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Participant short name	TECNALIA	ONYX	BEAR	NOBATEK	FOPTICS	CTCV	FLISOM	CRICURSA	CEA	ACCIONA	FD2	VILOGIA	R2M	CADCAM	WIP
Person/months	12	10	3	12	0	10	36	0	11	0	0	0	0	0	0

Table 4.38 WP4 general information

4.4.1 WP4 Purpose and Objectives

This work package is focused on providing a multiple answer to market needs defined in WP1 (Task 1.1) by taking to a pre-industrial stage a set of CIGS thin film technology-based products, specially designed to cope with these needs.

The specific objectives are:

- Demonstration of a portfolio of BIPV products based on a new lightweight, flexible, monolithically connected CIGS solar modules on polymer films produced with roll-to-roll manufacturing methods.
- Solar roof tiles and façade elements with 10%-14% module efficiency modules integrated on metal sheets using cost effective encapsulation/lamination/bonding materials and processes.
- Large area BIPV elements on metal sheets and roofing membranes of different sizes, up to 3m^2, for integration in roofs and façades.
- Manufacturing and supply of BIPV products for installation on demonstration buildings fulfilling the regulations and compliance with building codes and standards

The developments coming from this WP will be demonstrated to a TRL6 in experimental facilities. The rest will be taken to TRL7 in real buildings within WP8.

4.4.2 WP4 Problem definition and timing of different tasks

This work package is about the integration of CIGS solar modules into building elements to create a portfolio of BIPV products. Based on the inputs from WP1 and WP2, opaque BIPV elements for roof and facades (Task T4.1) and curved CIGS solar modules (Task 4.2) will be developed. There will be intensive testing for all developed solar modules and BIPV elements on performance and safety aspects (Task 4.4) to ensure compliance with certification procedures and standards (input from Task 1.3). The specifications and characteristics of the BIPV elements will be used as inputs for modelling at element and building level (Task 4.3) which will be used for the development of the software tool (WP7). Finally the newly developed BIPV products will be demonstrated in test benches and experimental buildings (Task 4.5) as well as in large scale BIPV systems in real building (WP8).

Ref	Task title	Responsible	Estimated indicative person-months	Start month	End month
WP4	**BIPV MODULES BASED ON CIGS THIN FILM TECHNOLOGY**	**FLISOM**	**94**	M1	M21
T4.1	CIGS elements on metal substrates for opaque roofs and façades	FLISOM	19	M1	M15
T4.2	Flexible CIGS module technology to curved BIPV solutions	ONYX	15	M15	M24
T4.3	Modelling at element and building level	NOBATEK	23	M15	M27
T4.4	Performance validation testing	FLISOM	25,5	M19	M36
T4.5	Technology demonstration in test benches and experimental building	FLISOM	11,5	M19	M36

Table 4.39 WP4 tasks

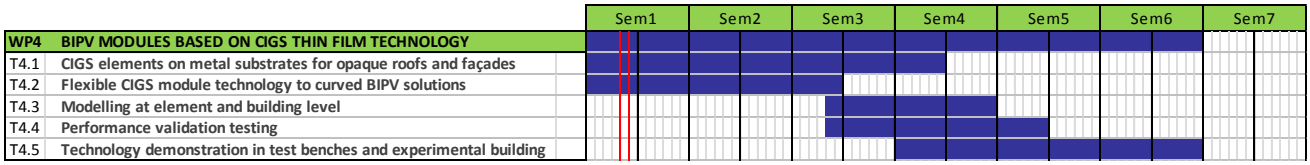

Table 4.40 Timing of WP4 tasks

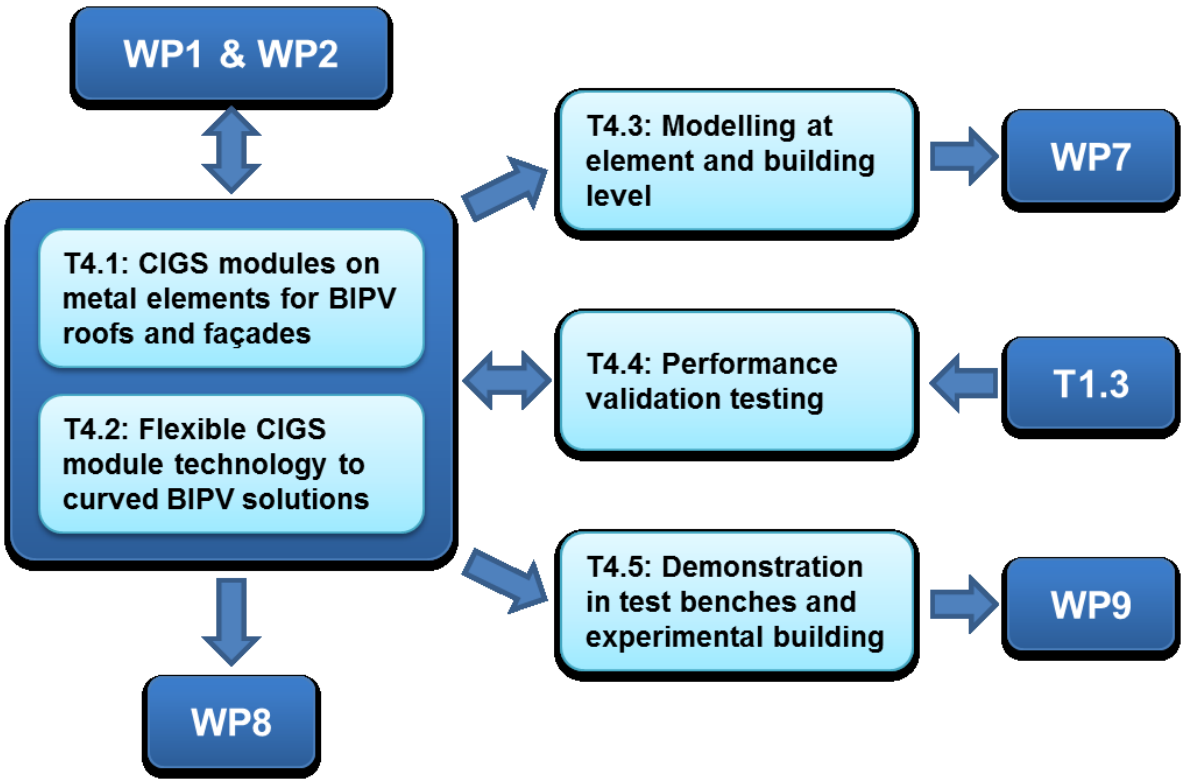

Figure 4.5 Relationship between WP4 Tasks

4.4.3 WP4 Tasks Description

T4.1 CIGS elements on metal substrates for opaque roofs and façades [Flisom] (BEAR)

Different types of front- and rear- laminations/encapsulations are used to produce solar modules in different configurations for different functionalities and applications. Long term performance (efficiency) stability and cost considerations require optimization of different materials. Selection of materials and processes will go through iterative rounds while the tests mentioned in task 4.4 will be performed to finally decide the components and material suppliers.

Flisom has developed a portfolio of BIPV prototype products on TRL 5 level and through the tasks of the work package the TRL 6-7 will be achieved through demonstration of the qualified BIPV products in buildings. Flisom's industrial R&D line uses 50cm wide rolls for layer deposition while the pilot-pilot production line is based on 100 cm wide rolls. The module efficiencies of 10%-14%, depending on size and configuration will be used for the BIPV products. BEAR will collaborate with Flisom to define architectural integration details for roofs and façades.

In order to achieve this objective, the following activities are envisaged:

1. **Definition integration details:** BEAR will collaborate with Flisom to define architectural integration details for roofs and façades.

2. **Development of BIPV modules:** Flisom will develop and integrate the CIGS modules on metal substrates for opaque roofs and façades integration.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T4.1	**CIGS elements on metal substrates for opaque roofs and façades**	**M1**	**M21**	**[Flisom] (BEAR)**	**D4.1, D4.2**
1	Definition of architectural integration details for roofs and façades	M4	M12	BEAR, Flisom	Integration details defined
2	Development of BIPV modules based on CIGS elements on metal substrates for opaque roofs and façades	M1	M21	Flisom	CIGS solar modules integrated in building elements

Table 4.41 Timing of 4.1 planned activities

T4.2 Flexible CIGS module technology to curved BIPV solutions [Onyx] (Flisom, TECNALIA)

Flisom's monolithically connected flexible solar module on polymer film is bendable and suitable for curved roofs and façades. Onyx will collaborate with Flisom towards an unprecedented BIPV product. Flisom will provide the necessary pre-encapsulated samples to Onyx, which will carry out the work on bending and lamination processes and provide the necessary samples for further testing (task 4.4). Onyx and TECNALIA will define the protocols and measurement procedures for performance testing of curved solar modules.

In order to achieve this objective, the following activities are envisaged:

1. **Preparation of flexible module samples:** Flisom will prepare and provide the necessary pre-encapsulated samples to Onyx.

2. **Perform bending and lamination:** Onyx will carry out the work on bending and lamination processes for curved solar modules and provide the necessary samples for further testing (task 4.4).

3. **Define procedures for testing of curved solar modules:** Onyx and TECNALIA will define the protocols and measurement procedures for performance testing of curved solar modules.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T4.2	**Flexible CIGS module technology to curved BIPV solutions**	**M1**	**M15**	**[Onyx] (Flisom, TECNALIA)**	**D4.3**
1	Prepare and provide flexible module samples	M1	M12	Flisom	Pre-encapsulated flexible modules
2	Perform bending and lamination	M7	M15	Onyx	Curved solar modules
3	Define procedures for performance of curved solar modules	M7	M15	TECNALIA	Testing procedures

Table 4.42 Timing of 4.2 planned activities

T4.3 Modelling at element and building level [Nobatek] (TECNALIA, Flisom)

In the case of curved glass-glass solution with CIGS technology, the objective and contents of this task are parallel to those of task 3.6, and optical, thermal, mechanical and electrical simulations will be performed by TECNALIA. For non-glazed, CIGS-based opaque products, thermal and mechanical FEM simulations will be performed.

As stated in task 3.6, the development of BIM objects and BIPV software tool in WP7 will allow the simulation of performance of each BIPV product in real operation conditions. Each BIPV product will be simulated by Nobatek for several building typologies, locations, etc., and advanced information will be generated about PV and associated building performance. The synergies of BIPV elements and passive energy efficiency strategies in the building will be quantified and optimized.

In order to achieve this objective, the following activities are envisaged:

1. **Modelling objectives definition:** NOBATEK will define and coordinate the modelling objectives with other tasks of the project (integration of calculations modules within the software tool developed as part of WP7).

2. **Modelling protocol definition:** NOBATEK will define together with TECNALIA the inputs (experimental characterisation of the PV cells+design parameters) and output of the modelling.

3. **Geometrical description of curved panel:** Onyx will provide the specifications based on inputs from WP2 and T4.2.

4. **Geometrical integration of incident solar flux on curved surface:** NOBATEK will simulate the geometrical integration of the incident solar flux on the surface of curved solar modules.

5. **Thermo-mechanical calculations:** NOBATEK will perform thermo-mechanical calculations by Finite Element Modelling.

6. **Mechanical calculations of loads:** TECNALIA will perform mechanical calculations of loads on the system by stress analysis.

7. **Electrical calculations**: TECNALIA will perform electrical performance calculations and estimate the electricity production.

8. **Feedback according to regulatory considerations:** NOBATEK will give feedback for the design of technologies according to regulatory considerations.

9. **Models simplification for integration as BIM objects:** NOBATEK will simplify models for integration as BIM objects.

10. **Use of reduced order model for several building typologies:** NOBATEK will use the reduced order model at building level for several building typologies.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T4.3	**Modelling at element and building level**	**M16**	**M24**	**[Nobatek] (TECNALIA, Flisom)**	**D4.4**
1	Modelling objectives definition	M16	M17	NOBATEK	Objectives defined
2	Modelling protocol definition	M17	M18	NOBATEK /TECNALIA	Protocol defined
3	Geometrical description of curved panel	M17	M17	Onyx	Providing specs
4	Geometrical integration of incident solar flux on curved surface	M17	M19	NOBATEK	Input for action 5
5	Thermo-mechanical calculations	M17	M19	NOBATEK	D4.4
6	Mechanical calculations of loads	M19	M21	TECNALIA	D4.4
7	Electrical calculations	M19	M21	TECNALIA	D4.4
8	Feedback according to regulatory considerations	M20	M22	NOBATEK	D4.4
9	Models simplification for integration as BIM objects	M20	M22	NOBATEK	Input for task 7.2
10	Use of reduced order model for several building typologies	M20	M22	NOBATEK	D4.4

Table 4.43 Timing of 4.3 planned activities

T4.4 Performance validation testing [Flisom] (Onyx, CTCV,CEA)

As in task T3.7, all the prototypes will be subjected to intensive indoor, outdoor and accelerated testing. Testing will support the screening of different designs. Standards to be applied are IEC 61646 (photovoltaic thin film modules), IEC 61730 (PV module safety qualification), EN14782 (self-supporting metal sheet for roofing), SIA 261 (for Switzerland), lightning protection, earthing concept of metal sheet modules, fulfillment of country specific and regional building regulations, regional grid code specifications, wind load, snow load. The new BIPV standard and construction products standards for glazing products also will apply. The specific testing plan for each product will come from task 1.3.

The manufacturers of the samples for testing will be Flisom, and Onyx (for curved glass). Flisom will take charge of the testing of the CIGS solar modules and BIPV products on metal sheets and roofing membrane according to photovoltaic construction and BIPV standards. CEA and CTCV will be responsible for the measurements and characterization of the CIGS solar modules in curved glass.

In order to achieve this objective, the following activities are envisaged:

1. **Testing of modules and BIPV products on metal sheets:** Flisom will take charge of the testing of the CIGS solar modules and BIPV products on metal sheets and roofing membrane according to photovoltaic construction and BIPV standards.

2. **Testing of curved solar modules:** CEA and CTCV will be responsible for the measurements and characterization of the CIGS solar modules in curved glass

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T4.4	**Performance validation testing**	**M16**	**M27**	**[Flisom] (Onyx, CTCV,CEA)**	**D4.5, D4.6**
1	Modules manufacturing	M16	M18	Flisom, Onyx	Samples for actions 2 and 3
2	Testing of modules and BIPV products on metal sheets	M19	M27	Flisom	Performance data
3	Testing of curved solar modules	M19	M27	CEA & CTCV	Performance data

Table 4.44 Timing of 4.4 planned activities

T4.5 Technology demonstration in test benches and experimental building [Flisom] (CEA)

Validation of the CIGS BIPV products in terms of preliminary testing and prototype demonstration will be done in advance to the actual installations on the demo buildings mentioned in WP8. Flisom will use outdoor installation on buildings including the NEST experimental building especially constructed by EMPA, Duebendorf (Switzerland) for the testing of innovative and futuristic building related products. The curved glass prototypes will be monitored and assessed in CEA INCAS platform.

In order to achieve this objective, the following activities are envisaged:

1. **Validation of CIGS BIPV products in NEST building:** Flisom will use outdoor installation on buildings including the NEST experimental building especially constructed by EMPA in Duebendorf Switzerland for the testing of innovative and futuristic building related products.

2. **Validation of curved prototypes in CEA INCAS platform:** The curved glass prototypes will be monitored and assessed in CEA INCAS platform.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T4.5	**Technology demonstration in test benches and experimental building**	**M19**	**M36**	**[Flisom] (CEA)**	**D4.7, D4.8, D4.9**
1	Validation of CIGS BIPV products in NEST building	M19	M36	Flisom	Demonstration
2	Validation of curved prototypes in CEA INCAS platform	M19	M36	CEA	Demonstration

Table 4.45 Timing of 4.5 planned activities

4.4.4 WP4 Deliverables and milestones

The following tables show the deliverables and milestones linked to WP4, stating the task associated, the responsibilities, the type and dissemination level and the delivery month.

Ref	Deliverable title	Task	Responsible	Type	Diss. level	Delivery date
WP4	**BIPV MODULES BASED ON CIGS THIN FILM TECHNOLOGY**		**FLISOM**			
D4.1	Roofing tiles and façade elements with 10%-14% efficiency modules of 0.5x1 m^2 and 1x1 m^2 area.	T4.1	FLISOM	DEM	PU	M21
D4.2	Large area roofing and façade elements of 0.5x2-3 m^2 or 1x2-3 m^2 using 10%-14% efficiency modules.	T4.1	FLISOM	DEM	PU	M21
D4.3	Curved CIGS glass elements.	T4.2	ONYX	DEM	PU	M15
D4.4	Results of modelling at element and building level CIGS products	T4.3	NOBATEK	R	PU	M24
D4.5	Samples for validation testing CIGS elements	T4.4	FLISOM	DEM	PU	M18
D4.6	Results on performance validation testing of CIGS modules.	T4.4	FLISOM	R	CO	M27
D4.7	Prototypes for test benches and experimental building.	T4.5	FLISOM	DEM	PU	M21
D4.8	Test bench and experimental building exposure results CIGS products	T4.5	FLISOM	R	CO	M30
D4.9	Test bench and experimental building exposure results CIGS products (update 1)	T4.5	FLISOM	R	CO	M36

Table 4.46 WP4 deliverables

Ref	Milestone title	WP	Responsible	Delivery date	Mean of verification
MS5	BIPV systems performance proved	WP3, WP4, WP5	**TECNALIA** **ONYX, FLISOM, CEA**	M27	Modifications made within the project to c-Si and CIGS BIPV modules, together with the 10kW PV storage inverter and single-stage SiC PV inverter validated by means of laboratory tests. Test reports issued (D3.9, D4.6, D5.4, D5.5)

Table 4.47 WP4 milestones

4.5 WP5 ADVANCED GRID INTERFACE FOR THE BIPV SYSTEMS

WP number	5					Start Date		M4			End Date		M18	
WP title	Advanced grid interface for the BIPV systems.													
Participant nº	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Participant short name	TECNALIA	ONYX	BEAR	NOBATEK	FOPTICS	CTCV	FLISOM	CRICURSA	CEA	ACCIONA	FD2	VILOGIA	R2M	CADCAM	WIP
Person/months	24	0	0	0	0	0	0	0	30	0	0	0	0	0	0

Table 4.48 WP5 general information

4.5.1 WP5 Purpose and Objectives

The aim of this WP is the definition, progress and validation of interface of the BIPV generator with the grid as well as the electrical loads, in order to make solar PV generation more manageable, grid-friendly and profitable in terms of building energy savings.

- For the integration of electrical storage systems, this WP identifies the best candidates for integration into BIPV systems. A design solution which integrates the storage system on DC level is developed.
- For the reduction of costs and increasing the flexibility in system design, a novel low cost robust PV inverter is developed, which is based in SiC technology. These innovations developed in this WP are characterized and validated in the lab before demonstration.

4.5.2 WP5 Problem definition and timing of different tasks

Four tasks are included in WP5:

- T5.1 Definition of best PV storage solution for each use case.
- T5.2 Integrated grid interface using storage system with DC coupling.
- T5.3 SiC based inverter technology for cost reduction and flexibility in system design.
- T5.4 Characterization and validation of the novel solutions.

Inputs are required from task 1.2: *Regulatory framework* and task 2.2: *Specifications for energy conversion and management systems*.

Developed static converter prototypes are manufactured in task 8.2: *Manufacturing of prototypes* and there characterization test result will be used for their electrical modeling in task 3.6. *Modelling at element and building level.*

Ref	Task title	Responsible	Estimated indicative person-months	Start month	End month
WP5	**ADVANCED GRID INTERFACE FOR BIPV SYSTEMS**	**CEA**	**54**	**M4**	**M18**
T5.1	Definition of best PV storage solution for each use case	CEA	12	M4	M15
T5.2	Integrated grid interface using storage system with DC coupling	TECNALIA	12	M4	M15
T5.3	SiC based inverter technology for cost reduction and flexibility in system design	CEA	18	M4	M15
T5.4	Characterisation and validation of the novel solutions	TECNALIA	12	M13	M18

Table 4.49 WP5 tasks

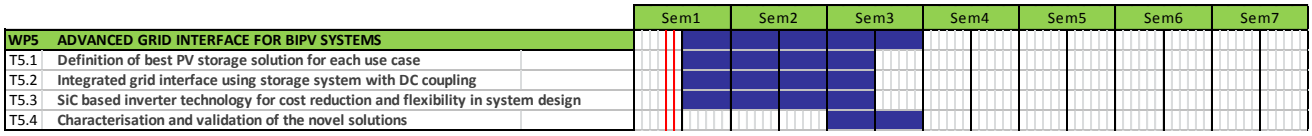

Table 4.50 Timing of WP5 tasks

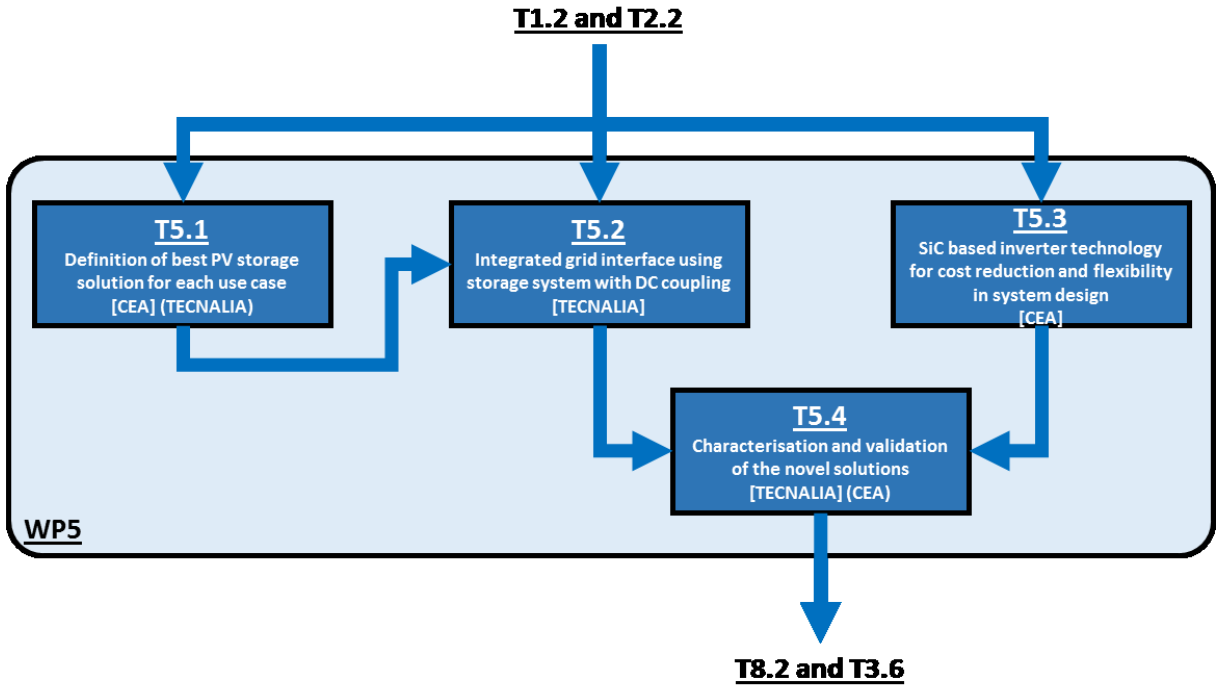

Figure 4.6 Relationship between WP5 tasks

4.5.3 WP5 Tasks Description

T5.1 Definition of best PV storage solution for each use case [CEA] (TECNALIA).

Storage systems are necessary to match production and demand maximizing the value of PV energy through self-consumption. Additionally, electrical storage makes solar power become manageable and reduce the impact of building electrical performance on grid operation. In fact, if properly designed, PV self-consumption with integrated electrical storage can ease the planning and operation of distribution grids. Modern PV storage concepts can save local grid capacity by reducing peak load and creating a stable demand side.

On the other hand, apart from the control of electrical peaks in the building, PV storage can contribute definitively to the requirements of auxiliary generation systems (diesel generators) or uninterruptible power supplies (UPS). Both of them are focused to prevent from the cut-off electricity supply; such systems imply high cost of maintenance, and investment, with extremely short economic return, because their function is auxiliary/emergency. The implementation of PV Storage will have both functions, to provide self-produced energy and to serve as a UPS, reducing also the requirements of diesel generators. After categorizing different use cases in task 2.2 – Specifications for energy conversion and management systems, the most suitable PV storage topology will be selected for each of them in this task. Two topologies are clearly differentiated depending on the connection between PV generator and storage system, AC and DC coupling. Both of them show pros and cons and the best option will be subject to expected energy flows depending on BIPV generator capacity, building electrical needs, grid requirements, market conditions, etc. All these factors must be carefully analyzed and weighted for the selection of the most suitable alternative in each use case.

Once PV storage topology is clear, the most suitable storage technology must be selected. Due to the high cost of batteries and wide-ranging performance, a wrong selection can severely impact on the economic feasibility of the whole system. As a consequence, most of PV storage systems in the market are still far from being worthwhile. Thus, the objective is to find the storage technology with the best lifetime throughput in terms of cost per unit of energy served. However, this is not a straightforward question. On the one hand, technology forecasting is necessary since storage technology is being rapidly upgraded. On the other hand, battery performance is a function of working conditions (number of daily cycles, depth of discharge, discharge current…). Furthermore, not all batteries are created equal, even batteries of the same chemistry. The main trade-off in battery development is between power and energy, but the chemistry can be also modified to provide higher battery lifetime at the expense of power and energy. Taking into account the lack of standardization of battery manufacturer specifications, characterization tests will be carried out in CEA`s facilities for the assessment of preselected batteries performance. These tests will consist of measurement of battery cycle efficiency and testing of cycling degradation under different operating conditions.

As a result of this task, a report on recommended PV storage system for each use case will be delivered. Finally, these guidelines will be applied to demonstration installations in order to select the most suitable PV storage system in each demo site.

Following actions are envisaged:

1. **Analysis of SoA and preselection of most suitable storage technologies for BIPV**
   From specification of T2.2, Tecnalia and CEA choose at most 3 battery technologies suitable for BIPV to be characterized in accordance with the technologies state of the art.

2. **Definition of battery characterization procedures for BIPV application**

Battery characterization procedure, matching with BIPV application specificities are defined by Tecnalia and CEA.

3. **Battery characterization tests implementation**
   Once the battery technologies are selected and the characterization procedure are defined, performance characterization tests are made in CEA battery laboratory facilities.
4. **Recommendations on storage systems for BIPV systems**
   According to the characterization tests results, CEA and Tecnalia writes in D5.1 recommendations on batteries for BIPV storage systems.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T5.1	**Definition of best PV storage solution for each use case**	**M4**	**M15**	**[CEA] (TECNALIA).**	**D5.1**
1	Analysis of SoA and preselection of most suitable storage technologies for BIPV	4	6	TECNALIA	Input for action.3
2	Definition of battery characterization procedures for BIPV application	4	6	TECNALIA	Input for action.3
3	Battery characterization tests implementation	6	15	CEA	Input for action.4
4	Recommendations on storage systems for BIPV systems	12	15	CEA	D5.1

Table 4.51 Timing of 5.1 planned activities

T5.2 Integrated grid interface using storage system with DC coupling [TECNALIA]

Most of PV storage solutions in the market show AC coupling between PV generator and batteries. The main reason is that electronics manufacturers have adapted their stand-alone or UPS battery inverters for this application. In traditional stand-alone and UPS systems, battery inverter used to perform as grid master generating grid voltage and PV inverters play as current generators. AC coupling also eases the upgrade of old BIPV installations by means of incorporating batteries without substituting existing equipment. However, this solution is quite inefficient for maximizing self-consumption. The PV energy, that is not directly self-consumed, must go through DC-AC and AC-DC converters before being stored with the corresponding conversion losses. As a result, main PV manufacturers are releasing new PV storage systems with DC coupling. However, most of them are single-phase PV storage inverters oriented to residential market with low power range and low bus voltage reducing their efficiency and economic feasibility.

As a consequence, in PV SITES a high efficiency, low cost and flexible 10kW three-phase PV inverter is proposed in order to cope with different storage requirements and operating modes. The 10kW PV inverter will be easily parallelized to make larger systems up to hundreds of kW, attending all the targeted markets: residential, commercial and industrial. DC coupling is achieved by means of multilevel DC-DC converters for PV generator and batteries and a high-voltage DC link, increasing conversion efficiency of the whole system.

Though particularized and adapted to PVSITES specifications prearranged in task 2.2, this HW/FW development will be based on a functional prototype previously developed and validated by TECNALIA, reducing uncertainty. The first step will be the redesign of the system, both in terms of hardware and control algorithms, with special attention to cost of bill of materials (<8c€/W). On the other hand, communications with specified BMS (Battery Management System) and BEMS (Building Energy Management System) will be developed. Once the detailed HW/SW design of electronics is

completed, all the information required for Printed Circuit Board (PCB) routing will be generated. The validation procedure of the functional prototypes will be also defined at this stage. At the end of this task, 2 prototypes will be manufactured.

Following actions are envisaged:

1. **Redesign of the system according to specifications defined in task 2.2**

   Tecnalia redesigns its PV and storage conversion system in order to be in accordance with the specifications given on energy conversion in T2.2.
2. **Manufacturing and set-up of 2 functional PV storage inverter prototypes**

   From Action1, Tecnalia manufactures and set-up two redesigned functional converter prototypes and describe it in D5.2.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T5.2	**Integrated grid interface using storage system with DC coupling**	**4**	**15**	**TECNALIA**	**D5.2**
1	Redesign of the system according to specifications defined in task 2.2	4	12	TECNALIA	Input for action.2
2	Manufacturing and set-up of 2 functional PV storage inverter prototypes	12	15	TECNALIA	D5.2

Table 4.52 Timing of 5.2 planned activities

T5.3 SiC based inverter technology for cost reduction and flexibility in system design [CEA]

Today's inverters for BIPV systems suffer some drawbacks which are addressed in this task:

- Although mature products, are still offered with guarantees which are far below the performance guarantees provided by PV modules which often reach 30 years. The reason behind this is the use of voltage source topology requiring unreliable link capacitors at the entrance of the inverter, and a separate Boost Chopper to adapt voltage levels.
- Module integrated inverters are often based on single phase output, requiring even high link capacitors.
- Centralized inverters reduce the flexibility in BIPV system design as they require that each series connection of modules has the same size, and as they do not accept partial shading of BIPV generator.

With the availability of novel 1200V semiconductor devices based on Silicon Carbide, it is possible to switch to the current source topology which has many advantages. Key points of this inverter technology further developed in this task are:

- Elimination of the classical Boost Chopper which is usually followed by a voltage source converter in today's inverters. This reduces costs and increases reliability.
- Use of three phase output to eliminate the 100Hz power ripple at the inverter input which allows eliminating unreliable and bulky input capacitors. This reduces costs and increases reliability.
- Easy grid integration with balanced three phase output.

- Increased switching speed (1.6kA/µs) made possible by Silicon Carbide switches for reducing size and cost of inductors and capacitors and provide higher efficiencies.
- Wide input voltage range facilitating flexible system of the electrical system of the BIPV systems.
- Avoidance of module integration for cost reasons, as the DC cabling of small group of BIPV modules even in BIPV system is not a problem thanks to the standardized module connectors.
- Selection of an inverter power which is low enough to allow for flexible systems design, but high enough to limit costs.
- As the intermediate DC/DC converter is eliminated with this inverter concept, integration of storage systems is done on AC level, which is advantageous when most of the BIPV energy is consumed during day time, and for which commercial solutions are available.

CEA has developed and prototyped this novel topology which has been validated in lab and will be validated for the relevant environment before the start of the project. The current source inverter prototyped operates at 25kHz as well at 100kHz and injects the energy to the 400V three phase grid, and uses 1200V silicon carbide semiconductors. Activities in this task focus on the further development of this prototype to prepare the inverter for the BIPV demonstration systems of this project.

The following actions are envisaged:

1. **Design, sizing, simulation of the CSI according to specifications defined in task 2.2**
   From its current SiC based current-source PV inverter prototype, CEA revises the design and the sizing in order to match to the specifications on energy conversion of T2.2.
2. **Assembly, control implementation and laboratory test of the CSI prototypes**

   A laboratory first prototype followed by an integrated one are assembled by CEA and tested with the full controls implemented. Description is then given in D5.3.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T5.3	**SiC based inverter technology for cost reduction and flexibility in system design**	**M4**	**M18**	**[CEA]**	**D5.3**
1	Design, sizing, simulation of the CSI according to specifications defined in task 2.2	4	12	CEA	Input for action.2
2	Assembly, control implementation and laboratory test of the CSI prototypes	12	15	CEA	D5.3

Table 4.53 Timing of 5.3 planned activities

T5.4 Characterisation and validation of the novel solutions [TECNALIA] (CEA)

Both functional prototypes, 10kW PV storage inverter and single-stage SiC PV inverter, will be tested. This testing activity will be used for debugging of the inverters developed. Fine tuning modifications and improvements can be implemented in order to comply with the specifications. Validation plan will be carried out to check the proper operation of all the functionalities and to evaluate their performance parameters. Furthermore, additional testing procedures will be carried out to certify the compliance with specified international standards regarding overall efficiency of

inverters (EN 50530) grid connection requirements (EN 50438), and even including test protocols for advanced inverter interoperability functions. The standards to be considered will be defined in task 1.3 Standardization needs. All these tests will be carried out in TECNALIA`s facilities where 110kW AC grid and 150kW PV generator simulators are available. Only some of the functional tests of the SiC inverter will be realized by CEA. As a result, the corresponding reports on validation test results will be generated. The electrical characterization of the prototypes will be useful for its electrical modeling in task 3.6. Modelling at element and building level.

The following actions are envisaged:

1. **Set-up of PV inverter interoperability and grid-connection requirements tests bench**

   Tecnalia specifies and set-up in its facilities a test bench for inverter testing on interoperability and grid-connection requirements.

2. **Set-up of PV inverter performance tests bench**

   CEA specifies and set-up in its facilities a test bench for inverter efficiencies (conversion and MPPT) performance evaluation

3. **PV inverter performance tests**

   T5.2 and T5.3 conversion systems are tested in CEA facilities using the action 2 test bench in order to evaluate their performances

4. **PV inverter interoperability and grid-connection requirements tests**

   T5.2 and T5.3 conversion systems are tested in Tecnalia facilities using the 5.4.1 test bench in order to test them in term of interoperability and grid-connection requirements

5. **Reports on tests results**

   Tecnalia presents the results on CEA's and Tecnalia's inverter prototypes tests on interoperability and grid-connection requirements in D5.4.

   CEA presents the results on CEA's and Tecnalia's inverter prototypes performances tests in D5.5

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T5.4	**Characterisation and validation of the novel solutions**	**M13**	**M27**	**[TECNALIA] (CEA)**	**D5.4, D5.5**
1	Set-up of PV inverter interoperability and grid-connection requirements tests bench	13	15	TECNALIA	Input for action 4
2	Set-up of PV inverter performance tests bench	13	15	CEA	Input for action 3
3	PV inverter performance tests	15	18	CEA	Input for action.5
4	PV inverter interoperability and grid-connection requirements tests	15	18	TECNALIA	Input for action 5
5	Reports on tests results	16	18	TECNALIA	D5.4 and D5.5

Table 4.54 Timing of 5.4 planned activities

4.5.4 WP5 Deliverables and milestones

The following tables show the deliverables and milestones linked to WP5, stating the task associated, the responsibilities, the type and dissemination level and the delivery month.

Ref	Deliverable title	Task	Responsible	Type	Diss. level	Delivery date
WP5	**ADVANCED GRID INTERFACE FOR BIPV SYSTEMS**		**CEA**			
D5.1	Recommendations on storage systems for BIPV systems	T5.1	CEA	R	PU	M15
D5.2	Operational prototype of 10kW PV storage inverter.	T5.2	TECNALIA	DEM	CO	M15
D5.3	Operational Prototype of single-stage SiC PV inverter.	T5.3	CEA	DEM	CO	M15
D5.4	Report on results of 10kW PV storage inverter validation tests.	T5.4	TECNALIA	R	CO	M18
D5.5	Report on results of single-stage SiC PV inverter validations tests.	T5.4	TECNALIA	R	CO	M18

Table 4.55 WP5 deliverables

Ref	Milestone title	WP	Responsible	Delivery date	Mean of verification
MS5	BIPV systems performance proved	WP3, WP4, WP5	**TECNALIA ONYX, FLISOM, CEA**	M27	Modifications made within the project to c-Si and CIGS BIPV modules, together with the 10kW PV storage inverter and single-stage SiC PV inverter validated by means of laboratory tests. Test reports issued (D3.9, D4.6, D5.4, D5.5)

Table 4.56 WP5 milestones

4.6 WP6 BUILDING ENERGY MANAGEMENT SYSTEM FOR DIFFERENT BUILDING USES

WP number	6					Start Date			M4			End Date		M18
WP title	Building Energy Management System for Different Building Uses.													
Participant nº	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Participant short name	TECNALIA	ONYX	BEAR	NOBATEK	FOPTICS	CTCV	FLISOM	CRICURSA	CEA	ACCIONA	FD2	VILOGIA	R2M	CADCAM	WIP
Person/months	24	0	0	0	0	0	0	0	0	11	0	0	9	0	0

Table 4.57 WP6 general information

4.6.1 WP6 Purpose and Objectives

The aim of WP6 is the development and validation of smart building energy management systems based on prediction of building electrical performance, in order to make solar PV generation more predictable, grid-friendly and useful for meeting building electrical needs. With this aim, the specific objectives are:

- Development of a simulation tool for sizing fittingly PV storage systems and estimating their ROI.
- Analysis and characterization of manageable electrical loads in buildings for active load management.
- Refinement of low-cost and reliable BIPV generation and electrical consumption forecasting tools.
- Progress on building energy management strategies for maximizing BIPV value.

4.6.2 WP6 Problem definition and timing of different tasks

With the aim of developing an innovative Building Energy Management System (BEMS) as specified in task T2.2, characterization of manageable electrical loads and improvement on current BIPV generation and building consumption forecasting tools must be carried out. In parallel, a simulation planner tool able to run parametric analysis of overall system performance will be developed. This planner tool will be useful not only for the design and dimensioning of BIPV storage systems, but also for the validation of BEMS upgrades. In fact, development of BEMS and planner tool will be a cyclic iterative process, since planner tool will be also refined through BEMS upgrades. Finally, both developments will be used in task T8.1 for the design of demonstration installations.

Ref	Task title	Responsible	Estimated indicative person-months	Start month	End month
WP6	**BUILDING ENERGY MANAGEMENT SYSTEM FOR DIFFERENT BUILDING USES**	**TECNALIA**	44	M4	M17
T6.1	Planner tool of PV storage system for each use case	TECNALIA	11	M4	M12
T6.2	Analysis and characterisation of manageable electrical loads in buildings	R2M	8	M4	M12
T6.3	Refinement of BIPV generation and building electrical consumption forecasting tools	TECNALIA	6	M4	M15
T6.4	Building Energy Management System for each use case	TECNALIA	19	M4	M18

Table 4.58 WP6 tasks

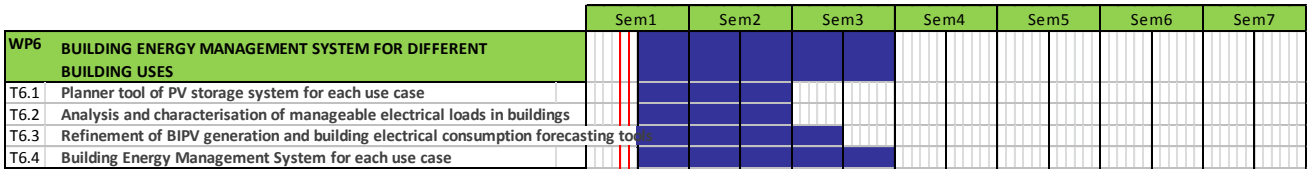

Table 4.59 Timing of WP6 tasks

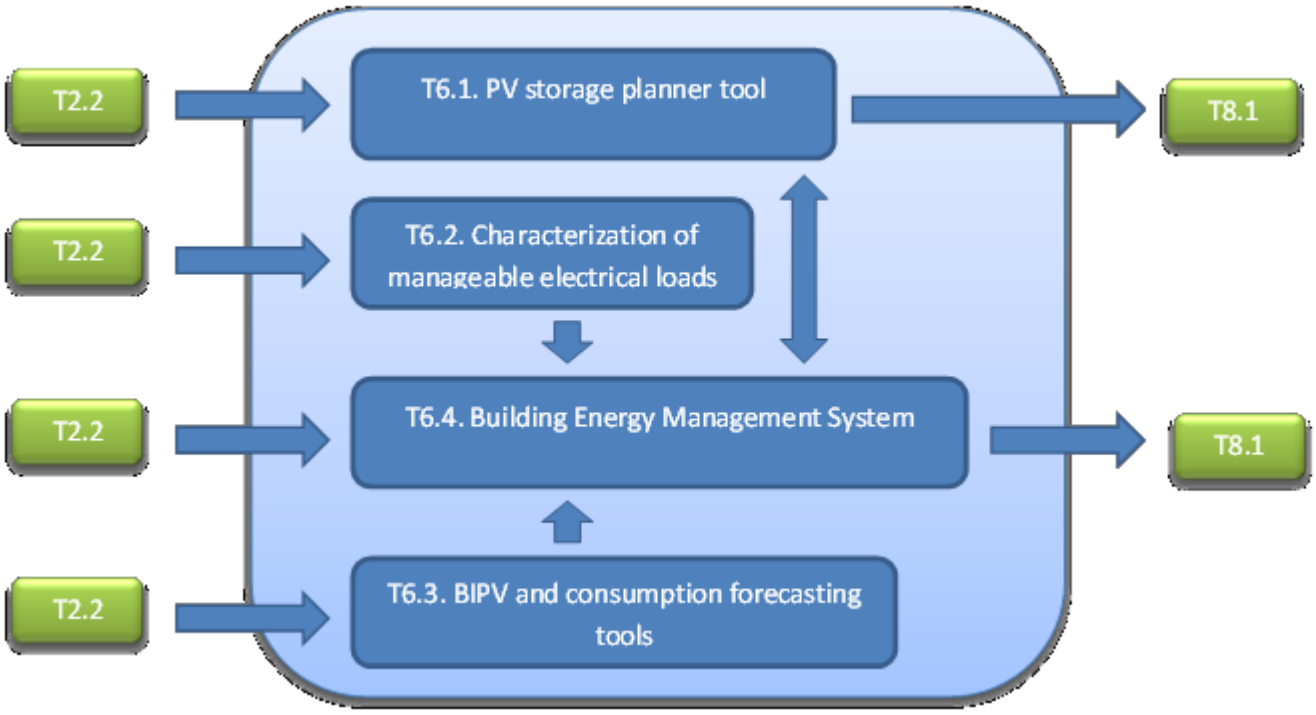

Figure 4.7 Relationship between WP6 tasks

4.6.3 WP6 Tasks Description

T6.1 Planner tool of PV storage system for each use case [TECNALIA] (ACCIONA)

PV storage systems in the market are still far from being worthwhile. One of the main reasons is that storage systems are generally oversized. The percentage of self-consumption and the level of autarky increase with a bigger storage capacity. However, the effect is lower with increasing size. On the other hand, a high storage capacity means lower depths of discharge and, consequently, higher number of cycles during its lifetime. Nevertheless, since a battery pack attached to a PV system running for 20 years can be estimated to undergo 3.000 to 4.000 cycles, it would be quite difficult to get maximum value from Lithium batteries before their calendar life. As a conclusion, a proper sizing of the storage system is required in order to reduce their cost per unit of energy served and optimize their value in terms of reduction of energy and power shares of the building electricity bill. With this aim, the development of a planner tool is proposed in this task. This planner tool will consist in a simulation program developed in Python running parametric analysis of electrical system performance. For this purpose, the BEMS strategy to be used during system operation will be also simulated. In fact, this simulation program will also be used for the conceptual design of this BEMS algorithm by means of comparative analysis of proposed alternatives. The simulation tool will determine the suitable BIPV generator and storage system capacities to optimize ROI. Of course, solar resource, building electrical consumption profile and rest of use case constraints (grid requirements, market conditions, active load management capabilities…) must be previously defined. The expected benefits of proposed planner tool will be CAPEX optimization and engineering cost reduction thanks to an easy to use interface.

In order to achieve such goal, the following tasks will be carried out:

1. **Input and output data interface**

   ACCIONA will be in charge of the definition and provision of input and output data format for planner tool. Input data will consist on solar resource, building electrical consumption profile and rest of use case constraints (grid requirements, market conditions, active load management capabilities…), while output data will be the conceptual design of the proposed solution, including selection and sizing of BIPV generator and storage system, and its estimated economic performance indicators. Obviously, the planner tool must show user-friendly HMI, that is directly related to input data introduction and output data display.

2. **PV storage system performance calculations**

   TECNALIA will define PV storage system performance calculations. This means, for a given input data (mainly solar resource and building consumption profile), estimation of directly self-consumed energy and characterization of storage system operation (including increment of self-consumption rate and battery SoH affection) depending on some parameters to be defined (like BIPV generator and storage system capacities).

3. **Economic performance calculations**

   ACCIONA will make use of results of PV storage system performance calculations in order to estimate economic performance of every proposed solution. Thus, comparative analysis of different alternatives will be carried out in order to select the best one in terms of payback period and economic profitability.

4. **Development of planner tool for optimal sizing of PV storage**

   Once PV storage system performance and economic figures calculations are defined in detailed, TECNALIA will integrate all the previous developments and implement in Python a simulation tool running parametric analysis of different alternatives of BIPV storage systems in order to suggest the best one during system design and dimensioning.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T6.1	**Planner tool of PV storage system for each use case**	**M4**	**M12**	**[TECNALIA] (ACCIONA)**	**D6.1**
1	Input and output data interface	M4	M10	ACCIONA	Input for action 4
2	PV storage system performance calculations	M4	M10	TECNALIA	Input for action 4
3	Economic performance calculations	M6	M10	ACCIONA	Input for action 4
4	Development of planner tool for optimal sizing of PV storage systems	M6	M12	TECNALIA	D6.1

Table 4.60 Timing of 6.1 planned activities

T6.2 Analysis and characterisation of manageable electrical loads in buildings [R2M] (TECNALIA)

In order to avoid possible limitations in the applications of BIPV due to the creation of electricity flux imbalances and grid stress, the installation of BIPV should be coupled with solutions to manage electrical loads. In order to do this the flexibility potential of different end uses will be characterized based on literature review and dynamic simulations. The potential to shift and shave some electrical loads will be investigated. The analysis will be based on representative buildings coinciding with demo sites. Therefore, we will characterize the flexibility for: heating and cooling, ventilation, refrigeration (if present), DHW, plug loads, electrical storage. Some of these are associated with built-in flexibility (e.g., thermal mass, ventilation setting) without compromising the functionalities and user comfort, since the management will occurred within defined acceptable ranges. These potential will be classified according to relevant boundary conditions and building features, including building type, structure properties and schedule among others. Additionally, the management also depends on the BEMS installed and its control and actuation capabilities.

Once these flexibility potentials are characterized, suggestions of electric load management concepts will be defined to support the best alignment of on-site electricity production and demands with the goal of exploiting favorable tariff conditions. This will be based on the identified potentials, applicable management solutions and weather forecasting (affecting both demands and PV production).

Planned activities for T6.2 are explained below:

1. **Characterization of flexibility potential of different end uses**

   R2M will study in detail the flexibility potential of pilot energy loads and perform dynamic simulations for specific subsystems (heating and cooling, ventilation, refrigeration, DHW, plug loads, electrical storage, etc.) that coupled with the forecasted PV production and grid constraints should lead to develop recommendations for active management. Some of these subsystems are associated with built-in flexibility without compromising the functionalities and user comfort, since the management will occurred within defined acceptable ranges. These potential will be classified according to relevant boundary conditions and building features, including building type, structure

properties and schedule among others. Additionally, the management also depends on the BEMS installed and its control and actuation capabilities.

2. **Design of electrical load management strategies based on forecasting techniques**

   Starting from these recommendations for active management, TECNALIA will design particular electrical load management strategies based on BIPV generation and rest of building consumption forecasting tools.

3. **Report on characterization of manageable electrical loads in buildings**

   Finally, R2M will prepare a report on characterization of manageable electrical loads in building with the aim of showing local demand response potential for self-consumption optimization.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T6.2	**Analysis and characterisation of manageable electrical loads in buildings**	**M4**	**M12**	**[R2M] (TECNALIA)**	**D6.2**
1	Characterization of flexibility potential of different end uses	4	10	R2M	Input for action 3
2	Design of electrical load management strategies based on forecasting techniques	6	10	TECNALIA	Input for action 3
3	Report on characterization of manageable electrical loads in buildings	10	12	R2M	D6.2

Table 4.61 Timing of 6.2 planned activities

T6.3 Refinement of BIPV generation and building electrical consumption forecasting tools [TECNALIA]

Regarding advanced building energy management system, the main innovation proposed in PVSITES is the use of BIPV generation/building electrical demand forecast for cost function optimization. Most of solutions in the market use only instantaneous monitoring data to control the system. Only SMA incorporates weather forecast but only for active load management in domestic applications.

The starting point of this task will be the low-cost and reliable forecasting algorithms that TECNALIA has already developed and preliminarily tested. These algorithms make use of low-cost satellite weather forecast and reduce its systematic error by means of applying regressive and self-learning techniques. As a result, errors lower than 10% for one hour time interval forecasts for the next 24 hours are achieved with these tools. In this task a further development of the algorithms will be necessary in order to improve their reliability, robustness and versatility.

Planned activities of 6.3 are explained below:

1. **Validation tests on robustness, reliability and versatility of upgraded forecasting tools**

   TECNALIA will validate previously developed low-cost and reliable forecasting algorithms under different weather conditions and building consumption profiles in order to test their robustness and versatility. For this purpose, monitoring data from demo sites will be collected. This task will be an iterative process, since any proposed upgrade will be validated over again in order to obtain comparative results.

2. **Improvement on PV generation forecasting tool based on new BIPV models**

   TECNALIA will improve BIPV generation forecasting tools by means of new analytical models based on experimental knowledge on BIPV modules performance.

3. **Improvement on building electrical demand forecasting tool based on new monitoring information**

   TECNALIA will improve building electrical demand forecasting tools by means of inclusion of new monitoring parameters with significant affection on building consumption profile, like working planning in industries or occupancy rate in hotels.

4. **BIPV generation and building electrical demand forecasting tools for BEMS integration**

   Once improvements on generation and demand forecasting tools are developed and validated through simulation, TECNALIA will implement them in Python in order to integrate them in projected BEMS.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T6.3	**Refinement of BIPV generation and building electrical consumption forecasting tools**	**M4**	**M15**	**[TECNALIA]**	**D6.3**
1	Validation tests on robustness, reliability and versatility of upgraded forecasting tools	M4	M12	TECNALIA	Input for action 2, 3 and 4
2	Improvement on PV generation forecasting tool based on new BIPV models	M4	M12	TECNALIA	Input for action 1 and 4
3	Improvement on building electrical demand forecasting tool based on new monitoring information	M4	M12	TECNALIA	Input for action 1 and 4
4	BIPV generation and building electrical demand forecasting tools for BEMS integration	M12	M15	TECNALIA	D6.3

Table 4.62 Timing of 6.3 planned activities

T6.4 Building Energy Management System for each use case [TECNALIA] (ACCIONA, R2M)

Advanced Building Energy Management System (BEMS), integrating PV production and electrical consumption forecasting tools and active load management capabilities is proposed in this task in order to increase electricity savings and reduce the impact of building electrical consumption on grid operation. Based on the flexibility potential and need for management defined in 6.2 for each subsystem, specific sensors, actuators and control strategies will be defined by R2M.

Once detailed specifications of the BEMS will be defined in task 2.2 (including definition of basic/minimal and advanced/additional operations, required communication interfaces and system monitoring channels, and data management capacity), the optimization algorithm will be developed in order to decide the best storage charge/discharge and active load management strategies in order to maximize economic system efficiency for the next 24 hours. The required inputs for the operation of this algorithm are instantaneous monitoring and estimation of PV production and local consumption, battery pack state of charge, load management possibilities along the day and sale/purchase electricity prices. All this information will be collected and managed by the monitoring platform “Building Control Center” developed by ACCIONA.

As a result, the developed BEMS will optimize energy flows and increase overall economic performance. Economic benefits come from a better utilization of BIPV excess for peak-shaving and maximizing self-consumption at the most profitable time, taking advantage of known daily evolution of electricity tariffs (adaptation to each country regulation needed). In addition to this, the new BEMS will smarten the interface between the prosumer and the rest of the electricity system exchanging information about anticipated performance, a field of expertise in which the first–mover advantage will be decisive.

Planned activities of 6.4 are explained below:

1. **Definition of specific sensors, actuators and control strategies for active load management**

   Based on the flexibility potential and need for management defined in 6.2 for each subsystem, specific sensors, actuators and control strategies will be defined by R2M.

2. **Development of required communication interfaces and database within "Building Control Centre"**

   The required inputs for the operation of this algorithm are instantaneous monitoring and estimation of PV production and local consumption, battery pack state of charge, load management possibilities along the day and sale/purchase electricity prices. All this information will be collected and managed by the monitoring platform "Building Control Center" developed by ACCIONA.

3. **Definition of BEMS control strategies for different end uses**

   TECNALIA will define the best control strategies in order to optimize energy flows and increase overall economic performance, based on a better utilization of BIPV excess for peak-shaving and maximizing self-consumption at the most profitable time, while maximizing battery performance and lifetime.

4. **Development of BEMS control strategies in Phyton**

   TECNALIA will be responsible for the implementation in Phyton of previously defined BEMS control strategies.

5. **BEMS integration and validation tests within "Building Control Centre"**

   Finally, ACCIONA will be in charge of integrating BEMS control strategies within "Building Control Center" platform and carrying out interoperability validation tests.

No	Action/subtask	Start	Deadline	Responsible	Output/ Comments
T6.4	**Building Energy Management System for each use case**	**M4**	**M18**	**[TECNALIA] (ACCIONA, R2M)**	**D6.4**
1	Definition of specific sensors, actuators and control strategies for active load management	4	12	R2M	Input for action 2 and 3
2	Development of required communication interfaces and database within "Building Control Centre"	4	15	ACCIONA	Input for action 5
3	Definition of BEMS control strategies for different end uses	4	15	TECNALIA	Input for action 4
4	Development of BEMS control strategies in Python	12	15	TECNALIA	Input for action 5

5	BEMS integration and validation tests within "Building Control Centre"	15	18	ACCIONA	Input for D6.4

Table 4.63 Timing of 6.4 planned activities

4.6.4 WP6 Deliverables and milestones

The following tables show the deliverables and milestones linked to WP6, stating the task associated, the responsibilities, the type and dissemination level and the delivery month.

Ref	Deliverable title	Task	Responsible	Type	Diss. level	Delivery date
WP6	**BUILDING ENERGY MANAGEMENT SYSTEM FOR DIFFERENT BUILDING USES**		**TECNALIA**			
D6.1	Planner tool for optimal sizing of PV storage systems.	T6.1	TECNALIA	DEM	CO	M12
D6.2	Report on characterization of manageable electrical loads in buildings.	T6.2	R2M	R	CO	M12
D6.3	BIPV generation and building electrical demand forecasting tools.	T6.3	TECNALIA	DEM	CO	M15
D6.4	Building energy management system for each demo site.	T6.4	TECNALIA	DEM	CO	M18

Table 4.64 WP6 deliverables

Ref	Milestone title	WP	Responsible	Delivery date	Mean of verification
MS3	BEMS completed	WP6	TECNALIA	M18	Achieved at the successful completion of BEMS for each demonstration site. Deliverable 6.4 issued and approved.

Table 4.65 WP6 milestones

4.7 WP7 BIPV SOFTWARE TOOL

WP number	7					Start Date		M1			End Date		M42	
WP title	BIPV software tool.													
Participant nº	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Participant short name	TECNALIA	ONYX	BEAR	NOBATEK	FOPTICS	CTCV	FLISOM	CRICURSA	CEA	ACCIONA	FD2	VILOGIA	R2M	CADCAM	WIP
Person/months	12	0	4	6	0	0	0	0	0	0	0	0	0	30	0

Table 4.66 WP7 general information

4.7.1 WP7 Purpose and Objectives

An important barrier to the deployment of building-integrated photovoltaics is the lack of accurate, validated, predictive performance tools for PV manufacturers, architects & designers, installers, etc. to evaluate on-site BIPV modules production together with their influence on building energy performance. Compliance with Energy Performance of Buildings Directive, energy efficiency essential requirements of the Construction Products Regulation and national building codes is mandatory for BIPV installations. Although there exist several PV-oriented simulation software tools available in the market, none of them accounts for the special features of building-integrated photovoltaic products, innovative technology and interaction with the building.

The objectives of this WP are:

- To develop an integrated, holistic and user-friendly software tool in order to predict both BIPV products and building energy performance in real operation conditions. The solution will be implemented as a SOA (Services Oriented Architecture) for building energy performance calculations simulation and optimization, providing various services to the market, such as financial dashboard, technical reports, modules and glass configurators,
- To develop BIM objects / eCatalogs for every products proposed in PVSITES project, as inputs for the SOA, and high value outputs for the market. These objects should interoperate between the users of the SaaS platform (designers, engineers), and the manufacturers to provide commercial return and market uptake,
- To validate SOA results from data coming from the experimental test benches (WP3 and WP4) and BIPV products demonstration in real buildings (WP8).

4.7.2 WP7 Problem definition and timing of different tasks

The problem addressed in this Work Package is mainly commercial: the BIPV industry is promising success within the next years but the market challenge remains open regarding the way of prescribing high performance innovative products at the earliest phase of the project.

BIM should be the digital part of the response to address this challenge, because of the agility offered by our technology and our methodology towards software development.

To solve the problem, modeling and simulation within 3D user friendly interfaces will be combined to provide Webservices to any kind of users and to support marketing and commercial efforts for the manufacturers. Products should be able to meet projects since the conceptual design phase.

Feedback should be given to every stakeholder during the project's cycle.

The development methodology will be mainly centered on AGILE process involving the consortium.

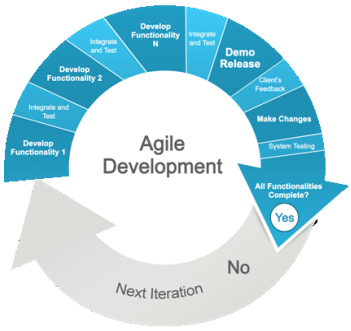

Figure 4.8 Agile development methodology for WP7

Ref	Task title	Responsible	Estimated indicative person-months	Start month	End month
WP7	**BIPV SOFTWARE TOOL**	**CADCAM**	**52**	1	42
T7.1	Development of BIPV software tool	CADCAM	24	1	18
T7.2	BIM objects for PVSITES products	CADCAM	15	13	18
T7.3	Validation of software results and software optimization	TECNALIA	13	30	42

Table 4.67 WP7 tasks

		Sem1	Sem2	Sem3	Sem4	Sem5	Sem6	Sem7
WP7	BIPV SOFTWARE TOOL (PM planned)							
T7.1	Development of BIPV software tool							
T7.2	BIM objects for PVSITES products							
T7.3	Validation of software results and software optimization							

Table 4.68 Timing of WP7 tasks

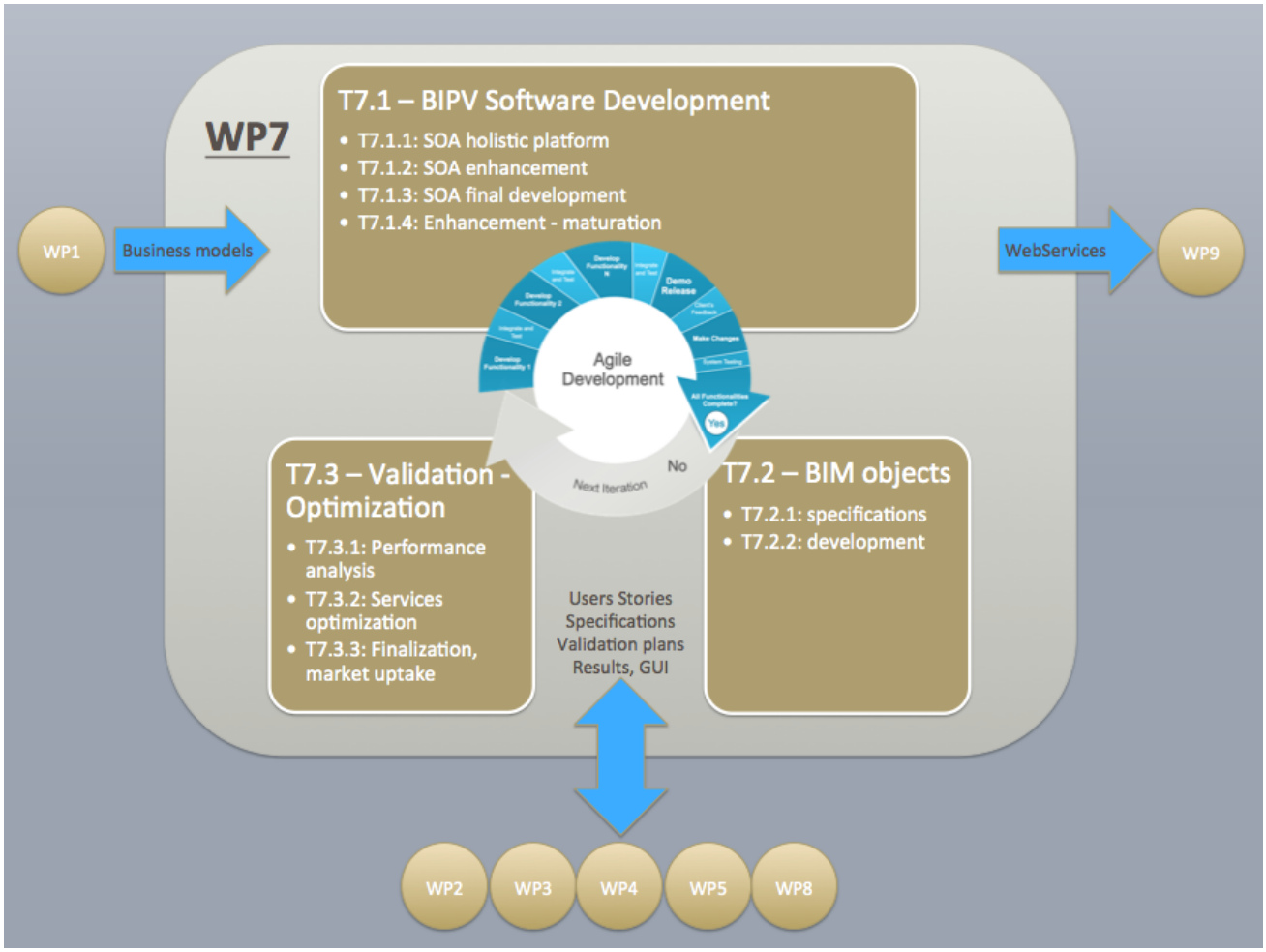

Figure 4.9 Relationship between WP7 tasks

4.7.3 WP7 Tasks Description

T7.1 Development of BIPV software tool [CADCAMation](BEAR, TECNALIA, Nobatek)

Within BIPV-INSIGHT project TECNALIA and BEAR worked together on the first stages of an integrated BIPV software tool BIM ready. The output of this project consisted mainly in a set of specifications and initial software design, as well as the physical models for the description of BIPV elements. In this task, these specifications and design will be reviewed in order to guarantee that they cover all the necessary inputs for PVSITES design (BEAR) and modeling (TECNALIA and Nobatek) processes. After this revision, the final phases of development will be tackled

Subtask 7.1.1: Development of SOA holistic platform [CADCAMation] (BEAR, TECNALIA, Nobatek)

A Service Orientated Architecture platform is common today in many digital applications such as banking, sale of goods and B2C services. Within the Architecture, Engineering and Construction (AEC) industry, market demand for SOA is strong to overtake traditional vertical standalone solutions. Versatility, flexibility of the software, holistic but layering capability are the drivers to develop SaaS and addressing every BIPV stakeholder. “Easy to use” and “online” automation will be traduced through smart interfaces and real time simulation.

Inputs:

- Bioclimatic simulation towards sustainable design will be run for any location defined by its latitude and longitude coordinates (GPS tracking) any orientation, reflectivity of the neighborhood…the typical building can be a simplified model. The software will run simulations with various widths, lengths and heights, as well as natural elements like trees.
- The building envelope will be described by the percentage of glazing on the facades / roofs, thermal, solar and optical characteristics of opaque and transparent elements,
- BIPV systems will be described through a density of panels on facade / roof, as well as their thermal characteristics.

Outputs:

- The software will compute the hourly amount of solar income on the building. It can be computed separately on various elements of the building (facades, roof),
- Depending on the envelop characteristics and typical heating / cooling set points, the user will be able to get evaluate the amount of positive (in winter) and negative (in summer) extra heating energy, thus getting information on heating and cooling deltas,
- Hourly PV production.

The actions and role of the partners involved to achieve the objectives of this task are:

1. Fill-in “users stories for the architect” forms (AGILE process), concept design and system design specifications (including BIPV products classes) [CADCAMation](BEAR)
2. Provide simplified virtual use cases at different stages of the design, evaluate the workflow and give feedback regarding key factors (aesthetic issues, energy production, economy), [CADCAMation](BEAR)
3. Test prototype, alpha version towards beta version. [CADCAMation](BEAR, TECNALIA, Nobatek)
4. Write and manage specifications about system design (challenging products and projects issues), [CADCAMation](BEAR, TECNALIA, Nobatek)
5. Provide simplified calculation models related to system design; evaluate and give feedback regarding key factors (accuracy, holistic approach, versatility), [CADCAMation](TECNALIA)
6. Challenge the software with existing / reference solutions. [CADCAMation](TECNALIA, Nobatek)
7. Specify engineering workflow; evaluate and give feedback regarding key factors (accuracy, holistic approach, versatility, regulatory commitment); specify and evaluate results and professional reports, [CADCAMation](TECNALIA, Nobatek)

DELIVERABLES: ALPHA version of PVSITES platform + set of technical specifications (D7.1)

Subtask 7.1.2: Enhancement of SOA holistic platform [CADCAMation] (BEAR, TECNALIA, Nobatek)

After a successful feedback during the project, the SOA will be enhanced to provide more information and more accuracy:

→ **Building description**: the building can have any geometry (i.e., import from a CAD or an openBIM format file),

→ **Accurate description of building elements**: precise positioning of glazing areas, PV modules, optical elements,

- → **Occlusion elements**: modeling of neighboring buildings, vegetation and topography,
- → **Detailed outputs**: heating / cooling differentials should be computed on specific areas of the building (floors or rooms),
- → **Impact on natural lighting** (after #2): with a few more inputs from the users (lighting demand and lighting schedule), we will evaluate the impact of the system over natural lighting. For an office building for example, this is necessary to evaluate the amount of extra energy used for lighting due to the system (this extra energy must be converted into heat and thus can lead to extra cooling costs in summer).

The actions and role of the partners involved to achieve the objectives of this task are:

1. Update "users stories for the architect": enhance the BIPV workflow and challenge the software against the bioclimatic assessment for sustainable design and NZEB issues, [CADCAMation](BEAR)
2. Update specifications about system design, [CADCAMation](TECNALIA Nobatek)
3. Update engineering workflow; specify and evaluate results and professional reports , [CADCAMation](BEAR, TECNALIA, Nobatek)
4. Provide detailed calculation models related to system design; evaluate and give feedback regarding key factors (accuracy, velocity, holistic approach, versatility), [CADCAMation](TECNALIA, Nobatek)
5. Evaluate and validate beta version to set up public version. [CADCAMation](BEAR, TECNALIA, Nobatek)

DELIVERABLES: BETA version of PVSITES platform + set of technical and business model specifications (D7.2)

Subtask 7.1.3: Final stages of development and public release

- Full web services model as a SOA. Benchmarking and integration to computing. User friendly interfaces, developed through AGILE process,

- Development of **economic models based on the innovative business models for BIPV** worked in this project and integration within the software calculation of cost-effectiveness of installations. TECNALIA and every partner involved in business development

- **Alpha and beta testing**: as a key stage of software development, a rigorous testing process will be carried out. Bugs within the code will be traced and corrected. Performance against requirements, as well as installation procedures, databases, and even user manuals will be tested. BEAR, NOBATEK and TECNALIA will perform beta testing from the end-user perspective, providing feedback on results, easiness-of-use and suggestions from improvement.

The preparation of web services related documentation (user-guides), web-training seminars for designers and engineers, etc. have been included as part of WP10 for dissemination and communication activities. During the project and beyond it, CADCAMation will continuously support the integration and demo of this software solution through our livingLAB, which is a multi-stakeholder platform for sharing innovation and encouraging pilot implementation, e.g. within the Smart Living LAB (Blue Factory) in Switzerland.

DELIVERABLES: public version of PVSITES SaaS platform + communication kit (D7.3, D7.4)

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T7.1	**Development of BIPV software tool**	**M1**	**M42**	**[CADCAMation](BEAR, TECNALIA, Nobatek)**	**D7.1, D7.2, D7.3, D7.4**
7.1.1	Development of SOA holistic platform	M1	M6	**[CADCAMation] (BEAR, TECNALIA, Nobatek)**	Holistic evaluation
7.1.2	Enhancement of SOA holistic platform	M6	M14	**[CADCAMation], (BEAR, TECNALIA, Nobatek)**	Detailed results
7.1.3.a	Final stages of development	M12	M18	**[CADCAMation], (BEAR, TECNALIA, Nobatek)**	Beta version
7.1.3.b	Software enhancement – Maturation	M18	M42	**[CADCAMation], (BEAR, TECNALIA, Nobatek)**	Public version

Table 4.69 Timing of 7.1 planned subtasks

T7.2 BIM objects for PVSITES products [CADCAMation]

A large community of professionals expects most of the economic return from the software tool through the use of eCatalogs. An **eCatalog** is a dynamic library of BIM objects sharing data with coupled BIM software. It can also be an expert configurator between the manufacturer database and the PVSITES platform.

An eCatalog contains various BIM objects representing PVSITES products, each one being a multi-criteria parametric object for simulation, optimization, related to the SOA functionalities and its manufacturer specifications.

CADCAMation will provide this new generation of numeric library to the end users through the PVSITES platform (i.e. architects, engineers, installers, utilities) and its specific web services:

- Upload of the users inputs and targets through interactive interfaces,
- Running of configurators in SaaS mode (simulation, optimization),
- Selection of the best configuration of products regarding every criteria,
- Settings/Improvement of the user's personalized

The activities to achieve the objectives of this task are:

1. eCatalog specifications (CADCAMation).
   - Define and validate specifications for PVSITES dynamic components (PVSITES virtual objects),
   - Define and validate digital protocols to translate PVSITES objects into BIM objects (CAD solutions),
   - Design the virtual objects and their related parametric components (glazing, cells, framing, mounting, wiring and connecting…),
   - Define and validate eCatalog architecture and relationship to Webservices.

   DELIVERABLES: set of technical and business model specifications (D7.5)

2. PVSITES eCatalogs development (CADCAMation)
   - PVSITES objects setup; BIM configuration (CAD) and interoperability,
   - Feedback from the consortium members; update and validation through GUI,

- ECatalogs setup; interoperability with the PVSITES Webservices (GUI, economic models)

DELIVERABLES: BETA version of PVSITES eCatalogs (D7.5)

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T7.2	**BIM objects for PVSITES products**	**M6**	**M18**	**[CADCAMation]**	**D7.5**
1	eCatalogs specification	M6	M12	CADCAMATION	Specifications
2	PVSITES eCatalogs development	M13	M18	CADCAMATION	PVSITES eCatalog

Table 4.70 Timing of 7.2 planned activities

T7.3 Validation of software results and software optimization [TECNALIA](BEAR, Nobatek)

TECNALIA and Nobatek will take charge of the gathering and selection of PV production data from the monitored installations (WP3, 4 and 8), as well as building energy performance data and the results from the simulation of the demo installations with the SOA platform from task 8.1. An analysis of performance and accuracy of software results will be carried out by BEAR, TECNALIA and Nobatek. The resulting feedback will lead, if necessary, to further software optimization (subtask 7.1.3).

CADCAMation also envisions forming a cluster with other EeB projects in order to cross-disseminating and co-validating respective results. Particular emphasis is expected to implement the BIPV elements and simulation features on the D4E platform (Design4energy project).

The actions and role of the partners involved to achieve the objectives of this task are:

1. Performance Analysis of the Software (TECNALIA)(CADCAMation, BEAR, Nobatek))
   - Validation Plan, critical issues, PDCA / AGILE process,
   - Performance evaluation results + report, set of specifications for PVSITES software enhancement.

   DELIVERABLES: validation plan, validation report, critical path to public release (D7.6)

2. SOA optimization [TECNALIA](CADCAMation)
   - Negotiation of the optimization feasibility with the project leader,
   - Final Planning implementation towards public release (M42).

   DELIVERABLES: ultimate beta version of PVSITES SaaS platform (D7.6)

3. Software final assessment – Market uptake [TECNALIA](CADCAMation, BEAR, Nobatek)
   - Use cases + validation plan in real conditions (refer to WP8),
   - Drafting of the PVSITES White Paper: digital innovation towards BIPV products and projects,
   - Public release: official communication, press release.

DELIVERABLES: PUBLIC RELEASE of PVSITES SaaS platform + set of technical and business model specifications (Milestone 2).

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T7.3	Validation of software results and software optimization	M12	M42	[TECNALIA](CADCAMation, BEAR, Nobatek)	**D7.6**
1	Performance Analysis of the software	M12	M18	TECNALIA, CADCAMation, BEAR, Nobatek)	Report - Specs
2	SOA optimization	M18	M42	TECNALIA, CADCAMATION	Webservices
3	Software final assessment – Market uptake	M36	M42	TECNALIA, CADCAMation, BEAR, Nobatek)	Commercialization of services

Table 4.71 Timing of 7.3 planned activities

4.7.4 WP7 Deliverables and milestones

The following tables show the deliverables and milestones linked to WP7, stating the task associated, the responsibilities, the type and dissemination level and the delivery month.

Ref	Deliverable title	Task	Responsible	Type	Diss. level	Delivery date
WP7	**BIPV SOFTWARE TOOL**		**CADCAM**			
D7.1	Prototype of BIPV simulation tool.	T7.1	CADCAM	OTH	PU	M6
D7.2	Second prototype of BIPV simulation tool.	T7.1	CADCAM	OTH	PU	M12
D7.3	First prototype of web services platform.	T7.1	CADCAM	OTH	PU	M12
D7.4	Pre-commercial version of web services platform.	T7.1	CADCAM	OTH	PU	M18
D7.5	E-catalogs delivery.	T7.2	CADCAM	OTH	PU	M18
D7.6	Software performance assessment.	T7.3	TECNALIA	R	CO	M42

Table 4.72 WP7 deliverables

Ref	Milestone title	WP	Responsible	Delivery date	Mean of verification
MS2	Software tool and web services available	WP7	**CADCAM**	M12	Achieved at the delivery of the second prototype of the pre-commercial version of the web services model. Deliverables 7.1 and 7.4 issued and approved

Table 4.73 WP7 milestones

4.8 WP8 LARGE SCALE DEMONSTRATION AND ASSESSMENT OF BIPV SYSTEMS IN REAL BUILDINGS

WP number	8					Start Date		M10			End Date		M42	
WP title	Large scale demonstration and assessment of BIPV systems in real buildings.													
Participant nº	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Participant short name	TECNALIA	ONYX	BEAR	NOBATEK	FOPTICS	CTCV	FLISOM	CRICURSA	CEA	ACCIONA	FD2	VILOGIA	R2M	CADCAM	WIP
Person/months	18	9	12	29	6	10	18	15	6	50	16	21	8	7	0

Table 4.74 WP8 general information

4.8.1 WP8 Purpose and Objectives

The general objective of WP8 is to take the solutions encompassed during the project to a TRL7, by demonstrating the performance of system prototypes in an operational building environment. 6 demonstrators have been selected to provide a highly representative sample of possibilities for BIPV technologies: new buildings and retrofitting; residential, commercial and industrial sector; façade and roof (shingles) implementations; semi-transparent and opaque applications; glass and metal substrates; C-Si and CIGS PV technologies; different installed power and building energy demand ratios and several climatic conditions throughout Europe:

- In Belgium, responsible: FormatD2
- In Switzerland (industrial), responsible: Flisom
- In Switzerland (carport), responsible: Flisom
- In Barcelona, responsible: Cricursa
- In Villeuneve d'Ascq, responsible: Vilogia
- In San Sebastian, responsible: Tecnalia

From this general framework, the following specific objectives can be established:

- To evaluate BIPV elements energy production, building energy performance in conjunction with economic viability (energy performance, investments, energy bill reduction, additional advantages) and associated business models.
- To produce high-quality monitoring results, obtained in controlled conditions, for the validation of the software tool developed in WP7.
- To provide a privileged frame for in situ training activities towards designers, construction companies, installers.

4.8.2 WP8 Problem definition and timing of different tasks

Module and BOS technologies will be demonstrated in operational building environment in WP8, Large scale demonstration and assessment of BIPV system in real buildings. 6 demonstrators providing a representative sample of building uses and energy demands, BIPV products, architectural implementations, installed power and climatic conditions have been selected. The results of this WP in terms of technical information, installation & maintenance procedures, public exposure and awareness, training activities, etc. are key towards the next stages towards commercialization of project results

In order to achieve this objective the following task will be developed:

Ref	Task title	Responsible	Estimated indicative person-months	Start month	End month
WP8	**LARGE SCALE DEMONSTRATION AND ASSESSMENT OF BIPV SYSTEMS IN REAL BUILDINGS**	ACCIONA	225	M10	M42
T8.1	**Design of demonstration installations**	ACCIONA	62,5	M13	M18
T8.2	**Manufacturing of prototypes**	ACCIONA	29	M15	M24
T8.3	**Installation and commissioning of installations**	ACCIONA	43	M15	M27
T8.4	**Monitoring of installations**	NOBATEK	48	M13	M40
T8.5	**Life cycle assessment at product and installation level**	CTCV	9	M10	M38
T8.6	**Analysis of results**	ACCIONA	33,5	M40	M42

Table 4.75 WP8 tasks

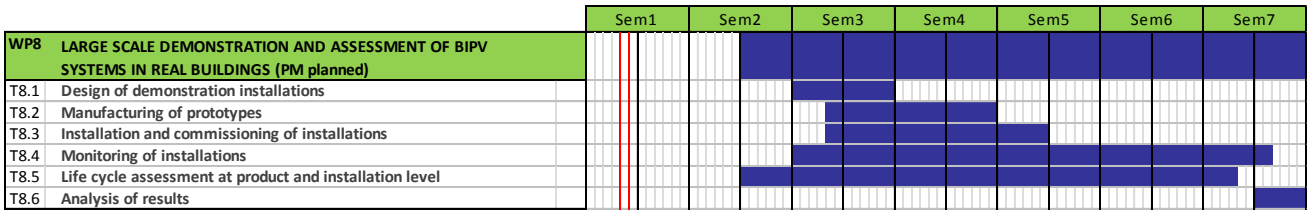

Table 4.76 Timing of WP8 tasks

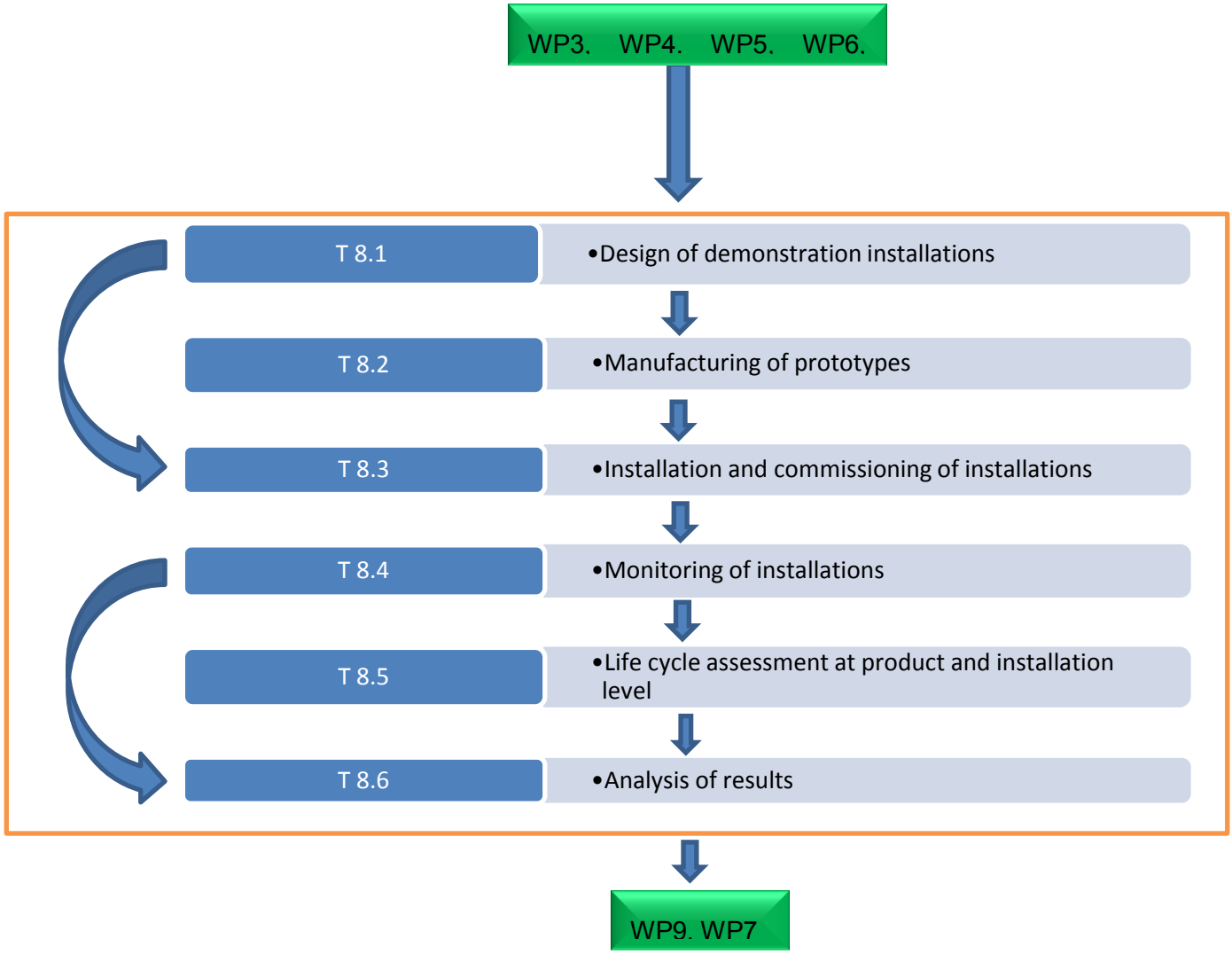

Figure 4.10 Relationship between WP8 tasks

4.8.3 WP8 Tasks Description

T8.1 Design of demonstration installations [ACCIONA] (CADCAMation, FD2, BEAR, TECNALIA, NOBATEK, Onyx, Flisom, Vilogia, Cricursa)

In this task, the complete design of the 6 pilot plants will be defined, based on the products developed in WPs 3 to 6, and according to the best integration of BIPV solution be done in every demo site.

Subtask 8.1.1: Current performance assessment (PreAudit).

In order to obtain a pre-dimensioning of the BIPV systems to install, a previous study will be done to establish an initial baseline. For every building site, an energy analysis will be done to identify the thermal and electrical real behavior of the buildings and their interactions with their districts. This

study will include detailed information related to energy consumption; in this step, energy data (energy bills, pre-existing monitoring, task 8.2) from the building owner will be used. The following magnitudes will be studied and classified:

- The building distribution, use and occupation patterns.
- The building envelope: isolation levels, walls, roofs, openings (type, orientation, fixing system), doors, etc.
- Mechanical systems; heating, cooling, domestic hot water and ventilation layouts, power, type of technology.
- Electrical and lighting systems.
- Available spaces for new installation rooms.
- Reliable and available strategies of the BIPV electric production and storage services in the building.

Subtask 8.1.2: Predimensioning of BIPV systems for every demo site.

The aim of this subtask is to analyse all the possibilities regarding BIPV integration, electrical layout configuration and operation strategy in each demo site. Results from previous subtask will be used as inputs. Different options will be posed to supply energy and other extra services to every building according to its respective objectives (load peaks control, extra energy storage, etc.) and over the current real operation conditions.

At this step, a number of possible options (2-3) of systems will be selected. The result is (2-3) pre-dimensioning for every demo site (including the description of total surfaces of BIPV and storage installation).

Subtask 8.1.3: Modeling of the building with BIPV systems.

Using the previous pre-dimensioning, a simulation of their behavior will be performed using appropriate software tools in order to assess between scenarios, and select the optimal configuration to be effectively installed.

The description of every pre-dimensioning will be analyzed through the BIPV modeling tool developed in WP7, with the support of TRNSys and Modelica for installations. Results will include real layouts and operation results of the new systems in the demo sites, as well as heat/cool/electricity load charts (energy demand) for a whole year of usual operation of every building.

Subtask 8.1.4: Final design of BIPV implementation on demo sites.

Based on the results from the simulations, the final design to meet the objectives of energy production/costs/savings, technology performance and architectural integration will be defined. All the supporting structures and additional components needed to perform each demo action will be selected (from commercial catalogues).

The following documents will be generated an integrated in a “design pack” for every demo site: guide for architectural integration of the BIPV products in every demo site, guide for commissioning and maintenance, installation guides, guide for electrical integration and available operation strategies, control strategies for each demo site. Health, safety and security procedures will be also gathered at this stage.

The role of each partner involved in Task 8.1 is the following:

- Onyx, Flisom, BEAR, CEA, TECNALIA and ACCIONA will carry out the design process of every demo site.
- CADCAMation, BEAR, Nobatek and TECNALIA will work on the different simulations of demonstration buildings and results analysis.
- The partners providing demo buildings will collaborate with the pre-audit and providing feedback to the design process.
- ACCIONA will coordinate the task and will take charge of the baseline assessment, the analysis of results and final designs proposal.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T8.1.	**Design of demonstration installations**	**M13**	**M18**	**[ACCIONA] (CADCAMation, FD2, BEAR, TECNALIA, NOBATEK, Onyx, Flisom, Vilogia, Cricursa**	**D8.1, D8.2 y D8.3**
8.1.1	Current performance assessment (pre-Audit)	M13	M15	ACCIONA,TECNALIA, Vilogia, Cricursa, Flisom, FormatD2	D 8.1
8.1.2	Predimensioning of BIPV systems for every demo site	M13	M18	ACCIONA,TECNALIA, Onyx, Flisom, BEAR, CEA	Input D8.2
8.1.3	Modelling of the building with BIPV systems	M13	M18	TECNALIA, NOBATEK, BEAR, CADCAMation	D8.2
8.1.4	Final design of BIPV implementation on demo sites	M15	M18	ACCIONA, TECNALIA, Onyx, Flisom, BEAR, CEA	D 8.3

Table 4.77 Timing of 8.1 planned subtask

T8.2 Manufacturing of prototypes [ACCIONA] (Onyx, Flisom, CEA, TECNALIA)

This task with deal with the manufacturing of prototypes for each demo site. The specific design performed in task 8.1 could lead to adjustments. The distribution of products-demo sites has been gathered in section 1.3.1 of the proposal.

Production of the BIPV systems will be intensely followed by the coordinator of demonstration activities (ACCIONA), in order to meet the dates, their production according final designs, and successful integration in every demo site.

The role of each partner in T8.2 is:

- Onyx, Film Optics, and Flisom will be involved in the manufacturing of the prototypes, which will be delivered in several batches according to production capabilities.
- Regarding BOS components, CEA and Tecnalia will manufacture and supply SiC based PV inverter and PV inverter with DC coupled, respectively, for the corresponding demo sites.
- The rest of required BOS components (including batteries and rest of power converters if any) will be bought.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T8.2	**Manufacturing of prototypes**	**M16**	**M21**	**[ACCIONA] (Onyx, Flisom, CEA, TECNALIA)**	**D8.4**
1	Planning to coordinate the manufacturing of different prototypes	M16	M21	**ACCIONA**, Onyx, Film Optics, Flisom	Input D8.4
2	Analyse if it is necessary to buy other components	M18	M21	**ACCIONA**, CEA, Tecnalia	Input D8.4
3	Manufacturing the prototypes	M16	M21	**ACCIONA**, Onyx, Film Optics, Flisom, CEA, Tecnalia	D8.4

Table 4.78 Timing of 8.2 planned activities

T8.3 Installation and commissioning of installations [ACCIONA] (Vilogia, Cricursa, TECNALIA, FD2, Flisom)

Before the installation works start, legalization and other administrative documentation will be managed and obtained for legal operation and maintenance of PVSITES demonstration installations by every building owner.

The development of the executive project (based on the final design achieved in task 8.1), and the permitting processes will be responsibility of the building owner, following the requirements from each national legislation. Project documents generation in subtask ST8.1.4 will be the basis for the redaction of such executive projects.

Local subcontractors will be selected by means of a tender process executed by every building owner. The subcontractor will perform the installation of the prototypes manufactured in previous task, together with all the additional elements needed.

Every building owner will appoint a local demo site coordinator with the following responsibilities:

- Providing support to their subcontracted engineers and architects to complete the permitting process with local authorities.
- Act as project manager supervisor for the subcontractor company, following the day-to-day execution process, assuming the responsibility of proper planning, minimizing deviations and economic resources devoted to the project.
- Ensuring compliance with health, safety and security requirements.
- Guaranteeing the contractual compliance from the subcontractor side.

ACCIONA will coordinate all these processes for the successful consecution of the demos, ensuring the commission of every demo installation, matching the objectives of the project. On time delivering of the pilot plants on time, in order to guarantee the required monitoring period within the project duration will be a priority within this WP.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T8.3	**Installation and commissioning of installations**	**M18**	**M27**	**[ACCIONA] (Vilogia, Cricursa, TECNALIA, FD2, Flisom)**	**D8.6**
1	Develop installation in Belgium	M18	M27	**FD2**,ACCIONA	Input for T8.4 and

					D8.6
2	Develop installation in Switzerland	M18	M27	**Flisom** , ACCIONA	Input for T8.4 and D8.6
3	Develop installation in Barcelona	M18	M27	**Cricursa**, ACCIONA	Input for T8.4 and D8.6
4	Develop installation in Villeuneve d'Asq	M18	M27	**Vilogia**, ACCIONA	Input for T8.4 and D8.6
5	Develop installation in San Sebastian	M18	M27	**Tecnalia** ,ACCIONA	Input for T8.4 and D8.6
6	Results of installation and commissioning for every demonstration site	M18	M27	**ACCIONA**	D 8.6

Table 4.79 Timing of 8.3 planned activities

T8.4 Monitoring of installations [Nobatek] (R2M, ACCIONA, FD2, Flisom, Vilogia, Cricursa, TECNALIA)

BIPV elements may affect building energy performance and passive properties in multiple ways: reduction of radiation into the building (affecting indoor temperature, heating and cooling demands, natural lighting, etc.), change of solar control factor, U value, etc. The monitoring task aims at evaluating the impact of the selected BIPV technologies introduction on the whole building performance in terms of energy consumptions as well as environmental conditions. It also includes the evaluation of the performances of the BIPV solutions themselves in real conditions (mainly production in correlation with solar irradiation but other relevant parameters can be considered such as temperature of the BIPV). This evaluation will be done once the BIPV solutions are implemented and all the problems have been solved and the control settings have been fine-tuned

Different subtasks will be carried out in task T8.4:

ST8.4.1 Design of monitoring:

A common set of monitoring guidelines and specific monitoring plan will be defined for the pilot sites in terms of monitoring objectives, IPMVP33 options to be selected to comply with these objectives, M&V 34plan definition for each pilot site. The monitoring approach will take into account both levels of intervention in the building:

- Whole building level in order to assess the impact of the implementation of BIPV technologies on the energy performances (electricity consumption, heating consumption, comfort conditions, etc.).
- BIPV system level in order to assess the performance of the implemented technologies.

Within the monitoring task, ACCIONA platform named "Building Control Center" will be used to recover, store and manage all the monitored data coming from all the demonstration sites. This will be considered earlier in the project in order to specify an IT infrastructure compatible with the transmission of the collected data to the BCC.

ST8.4.2 Monitoring and evaluation of the baseline of the buildings:

The baseline performance of the buildings will be evaluated before installing the project technologies. The target buildings will be monitored for one year period prior to the retrofitting. This

includes the planning of the measurement and data acquisition system. It will allow to establish the energy consumption baseline to compare the new consumptions after renovation and then for assessing the energy savings. The monitoring will last one year covering the four seasons of the year. In the case of new builds, the energy consumption will be established via simulation tools similar to Comfie-Pleiades. As the BIPV technologies will be integrated in the envelope from the start, a "business-as-usual simulated baseline" will be established via 3D modelling and energy performance simulation software, not using the project technologies but a standard solution

ST8.4.3 Monitoring and assessment of the buildings performance after implementation of the solution

Monitoring of the performance of the building and its technologies will be carried out during one year, in order to validate the systems functioning and energy savings and building performance improvement. In the case of retrofitting, the already existing monitoring systems will be used to monitor the buildings and the technologies. Within this task, a specific monitoring infrastructure will be devoted to the BIPV technologies evaluation

ST8.4.4 Measuring and evaluating the performance gap

Other than the "prior to operation" baseline that will allow compared performance assessment "before and after" intervention in the case of retrofitting, in all cases the project team will simulate the expected performance of the BIPV solutions. This eventual performance gap will be measured, assessed and evaluated, and the project team will elaborate a specific work on explaining the origin of the performance gap and address eventual failures to reduce it.

Nobatek will be in charge of the whole monitoring process, supported by R2M for ST8.4.4., reporting to ACCIONA as WP leader. Demo sites managing partners will provide access, facilities and all the necessary means to carry out this task.

No	Action/subtask	Start	Deadline	Responsible	Output/ Comments
T8.4	**Monitoring of installations**	**M13**	**M42**	**[Nobatek] (R2M, ACCIONA, FD2, Flisom, Vilogia, Cricursa, TECNALIA)**	**D8.7 – D8.10**
8.4.1	Detailed technical design of monitoring	M13	M15	**NOBATEK,**ACCIONA, FD2, Flisom, Cricursa, Tecnalia	Input for Subtask 8.4.2, D8.7, D8.8
8.4.2	Monitoring and evaluation of the baseline of the buildings	M15	M27	**NOBATEK**,ACCIONA, FD2, Flisom, Cricursa, Tecnalia	Input for T8.6, D8.9
8.4.3	Monitoring and assessment of the buildings performance after implementation of the solutions	M28	M40	**NOBATEK**,ACCIONA, FD2,Flisom, Cricursa, Tecnalia	Input for T8.6, D8.9, D8.10
8.4.4	Measuring and evaluating the "performance gap"	M40	M42	**NOBATEK**,R2M, ACCIONA	D8.11, D8.12, D8.13

Table 4.80 Timing of 8.4 planned subtasks

T8.5 Life cycle assessment at product and installation level [CTCV]

This task aims at the evaluation of the environmental profile (qualitative and/or quantitative) through life cycle assessment of the target building-integrated installations proposed in this WP. The technique used for this purpose will be the development of Life Cycle Assessment (LCA), in order to identify impacts and opportunities to improve the environmental performance, selecting relevant indicators for environmental performance including measurement techniques and also to support eco-marketing tools. This life cycle evaluation includes distinct stages, from raw material acquisition, production, installation, use, maintenance, end-of-life treatment, recycling and final disposal.

This task will start with a short state of the art analysis to identify the main inputs and outputs to the environment during the full life cycle of the building installations. Then, the LCA will be conducted according to ISO 14040, ISO 14044 guidelines namely:

- Definition of the goal and scope, the functional unit (reference for environment inputs and outputs) and the system boundary. This task is very relevant, namely to define the "functional unit" which is the reference for the environment inputs and outputs and will also allow to perform future comparison of environmental performance of the different BIPV products, manufacturing processes and building-integrated installations.
- Inventory analysis phase, including data collection for environmental characterization of products, processes and building installations. This will be the most time consuming phase, and involves special care on data quality requirements and possible allocation. The inputs will include energy inputs, raw material inputs, ancillary inputs among other physical inputs, use of resources, emissions to air, water and soil, including wastes.
- Life cycle impact assessment phase (LCIA) will include the selection of LCA methods that are more effective for building installations, according to pre-defined criteria. The starting point will be the ILCD Handbook Recommendations, the PEF Guide (European recommendation number 2013/179/UE), and EN15804 (based on CML). The selection of environmental impact categories will be studied in order to be adequate to the installations, environmental issues related to the product system being studied, taking the goal and scope into consideration. Among others, the following will be assessed: global warming (GW), acidification (A), eutrophication (E), photochemical oxidation formation (POF) and abiotic depletion (AD), ozone layer depletion (OD), human toxicity (HT), ecotoxicity (ET), particulate matter (PM), land use (LU) and water resource depletion (WD). The characterization model for impact assessment relates to the category indicator and characterization factors will be described.
- Life cycle interpretation – this will be the final phase of the LCA procedure, in which the results of previous tasks will be summarized and discussed as a basis for draw conclusions, improvement recommendations and decision-making for eco-marketing.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T8.5	**Life cycle assessment at product and installation level**	**M10**	**M38**	**CTCV**	**D 8.11, D 8.12**
1	BIPV system manufacture	M10	M15	CTCV	D 8.11
2	BIPV use	M15	M33	CTCV	Input D 8.12
3	End of-life treatment	M15	M33	CTCV	Input D 8.12
4	Recycling	M15	M33	CTCV	Input D 8.12
5	Final disposal	M33	M38	CTCV	D 8.12

Table 4.81 Timing of 8.5 planned activities

T8.6 Analysis of results [ACCIONA](TECNALIA, Onyx, BEAR, Nobatek, FilmOptics, CTCV, Flisom, Cricursa, CEA, FD2,Vilogia, R2M, CADCAM, WIP)

The analysis of results and global assessment of the whole demonstration process is a complex task, involving analysis at several levels:

- Electrical (energy) results: savings directly associated to PV production, reduction in peak power, etc.
- Impact of BIPV elements on the building heating and cooling demand.
- Economic results: real investment costs, savings, ROI of the installations.
- Environmental results: life cycle analysis of demonstration installations and suggestions for improvement (task 8.5).
- Comfort and social acceptance assessment will be investigated all along the demonstration phase by means of opinion polls amongst social organisations, public bodies, local energy agencies, building users and general public.
- Lessons learnt from the installation and maintenance processes.
- Assessment of factors like standardization, legal issues, regulatory framework found during the development of the project will be contrasted against analysis performed in WP1.

The technical data obtained from the demonstration stage will form part of the contents of the BIPV products portfolio. The results of this assessment will be integrated in a suitable way for presentation and dissemination to targeted groups. They will also be of extreme importance for business cases definition and exploitation of project results. Specific guidelines and recommendations for the replicability of PVSITES approach will be gathered to support the next steps towards market deployment of the demonstrated technologies.

The roles of each partner involved in T8.6 is:

- ACCIONA will coordinate all the analysis of results, gathering all the necessary information.
- Tecnalia will collaborate in analyzing the final results through simulations and provide all required information regarding the results of the implementation of BIPV in their building
- Onyx: will provide information about the characteristics of the BIPV components
- BEAR will collaborate in analyzing the final results through simulations.
- Nobatek will collaborate in analyzing the final results through simulations and data from monitoring
- Foptics will provide information about the characteristics of the BIPV components
- CTCV will provide information from Task 8.5 to compare the results and to suggest some improvements.
- Flisom will provide all required information regarding the results of the implementation of BIPV in their building and the characteristics of the system BIPV
- Cricursa provide all required information regarding the results of the implementation of BIPV in their building
- CEA will provide information about SiC based PV inverter

- FD2 provide all required information regarding the results of the implementation of BIPV in their building
- Vilogia will provide all required information regarding the results of the implementation of BIPV in their building
- R2M will provide information from WP1 to compare the information defined in that WP1 with the real issues found in the demo sides.
- CADCAM will collaborate in analyzing the final results through simulations.
- WIP will participate in order to prepare information to dissemination.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T8.6	**Analysis of Results**	**M40**	**M42**	**[ACCIONA](TECNALIA, Onyx, BEAR, Nobatek, FOptics, CTCV, Flisom, Cricursa, CEA, FD2,Vilogia, R2M, CADCAM, WIP)**	**D8.16, D8.17**
1	Report of General Characteristics	M40	M42	**ACCIONA**, all	D8.16
2	Develop a Guidelines and recommendations for replicability	M40	M42	**ACCIONA,** all	D8.17
3	Gathering information about the demos	M40	M40	**ACCIONA**, Cricursa, Tecnalia, Vilogia, Flisom, FD2	Input D8.16 and D8.17
4	Characteristics about BIPV components	M40	M40	**ACCIONA**, Onyx, Flisom, Foptics,	Input D8.16 and D8.17

Table 4.82 Timing of 8.6 planned activities

4.8.4 WP8 Deliverables and milestones

The following tables show the deliverables and milestones linked to WP8, stating the task associated, the responsibilities, the type and dissemination level and the delivery month.

Ref	Deliverable title	Task	Responsible	Type	Diss. level	Delivery date
WP8	**LARGE SCALE DEMONSTRATION AND ASSESSMENT OF BIPV SYSTEMS IN REAL BUILDINGS**		**ACCIONA**			
D8.1	Energy audit of buildings and identification of BIPV possibilities in every demo site.	T8.1	ACCIONA	R	PU	M15
D8.2	Result of modeling and BIPV strategies for every demo.	T8.1	TECNALIA	R	PU	M18
D8.3	Design pack for every demo site.	T8.1	ACCIONA	R	PU	M18
D8.4	Prototypes for demo sites – first batch.	T8.2	ACCIONA	DEM	PU	M21
D8.5	Prototypes for demo sites – second batch.	T8.2	ACCIONA	DEM	PU	M24
D8.6	Results of installation and commissioning for every demo site.	T8.3	ACCIONA	R	PU	M27

D8.7	Common monitoring guidelines.	T8.4	NOBATEK	R	PU	M15
D8.8	Specific monitoring plan for every demo site.	T8.4	NOBATEK	R	PU	M18
D8.9	Report on the baseline assessment of the demo sites.	T8.4	NOBATEK	R	PU	M27
D8.10	Installation and execution of monitoring of BIPV systems	T8.4	NOBATEK	R	PU	M27
D8.11	Impact of BIPV systems on the building performance and PV assessment from monitoring activities	T8.4	NOBATEK	R	CO	M32
D8.12	Impact of BIPV systems on the building performance and PV assessment from monitoring activities (update 1)	T8.4	NOBATEK	R	CO	M36
D8.13	Impact of BIPV systems on the building performance and PV assessment from monitoring activities (update 2)	T8.4	NOBATEK	R	CO	M40
D8.14	Life cycle assessment at product level.	T8.5	CTCV	R	CO	M15
D8.15	Life cycle assessment at installations level.	T8.5	CTCV	R	CO	M38
D8.16	Report on general architectural, photovoltaic, operational, economic and environmental assessment of the demo sites.	T8.6	ACCIONA	R	CO	M42
D8.17	Guidelines and recommendations for replicability of PVSITES approach.	T8.6	ACCIONA	R	PU	M42

Table 4.83 WP8 deliverables

Ref	Milestone title	WP	Responsible	Delivery date	Mean of verification
MS4	Demonstration installation process completed	WP8	**ACCIONA**	M24	Prototypes installed and monitoring running (D8.4, D8.5, D8.10)
MS6	Demonstration activities completed and assessed	WP8	**ACCIONA**	M42	The global results of the project regarding demonstration activities are gathered into a final assessment report (D8.16) and a document with detailed analysis of PVSITES results assessing the next steps needed for market uptake and replication will be generated (D8.17).

Table 4.84 WP8 milestones

4.9 WP9 DISSEMINATION AND COMMUNICATION

WP number	9					Start Date		M1			End Date		M42		
WP title	Dissemination and communication.														
Participant nº	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Participant short name	TECNALIA	ONYX	BEAR	NOBATEK	FOPTICS	CTCV	FLISOM	CRICURSA	CEA	ACCIONA	FD2	VILOGIA	R2M	CADCAM	WIP
Person/months	6	3	3	3	3	3	3	6	2	4	6	7	3	7	21

Table 4.85 WP9 general information

4.9.1 WP9 Purpose and Objectives

WP9 involves the dissemination and communication actions regarding the PVSITES activities. This WP crosses all other WPs of the project because it intends to create communication mechanisms to promote the project and BIPV as well as targeted dissemination to the relevant scientific community and stakeholders about the project results. The objectives of this WP are:

- To promote BIPV as a reliable technology to the market.
- To disseminate a portfolio of BIPV systems and their potential in terms of cost-effective renewable generation, reduction of energy demands and smart energy management.
- To engage the BIPV community into adopting PVSITES products.
- To identify target groups, communication tools and distribution channels.
- To guarantee that the results from the project test sites, pilot and demonstration facilities, or research infrastructures will be open and accessible for knowledge transfer and capacity building.
- To transform the demonstrations sites into educational mechanism for BIPV market uptake through training and knowledge exchange.
- To create recognition for the project by graphically coherent and consistent communications.
- To interact with a wide audience through the internet, promotional material and events.
- To contribute, upon invitation by INEA, to common information and dissemination activities to increase synergies between, and the visibility of H2020 supported actions.

4.9.2 WP9 Problem definition and timing of different tasks

In order to accomplish the dissemination and communication objectives of PVSITES project the following tasks will be developed:

Ref	Task title	Responsible	Estimated indicative person-months	Start month	End month
WP9	**DISSEMINATION AND COMMUNICATION**	**WIP**	**80**	M1	M42
T9.1	Dissemination and communication plan	WIP	14,45	M1	M42
T9.2	Project logo and visual identity	WIP	5,05	M1	M2
T9.3	Project website	WIP	7,75	M1	M2
T9.4	Media campaign	WIP	13,25	M1	M42
T9.5	Events	WIP	18,85	M1	M42
T9.6	Training courses for installers	TECNALIA	4,1	M22	M25
T9.7	Guided visits to demo sites	WIP	4,1	M25	M42
T9.8	Implementation of BIPV product portfolio	CADCAM	7	M37	M42
T9.9	Training courses on BIPV software tool	CADCAM	4,5	M37	M42

Table 4.86 WP9 tasks

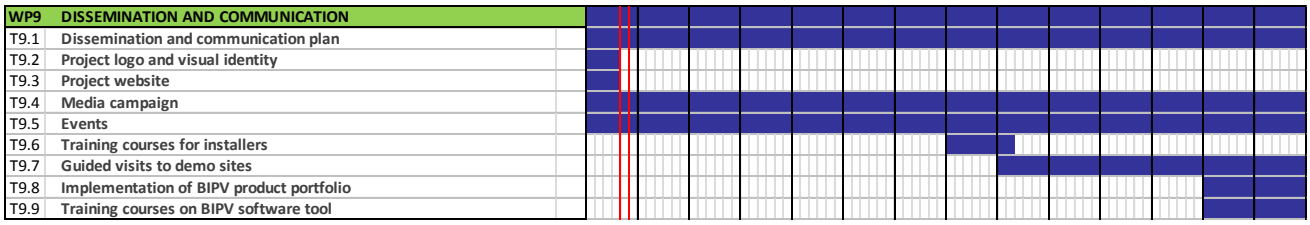

Table 4.87 Timing of WP9 tasks

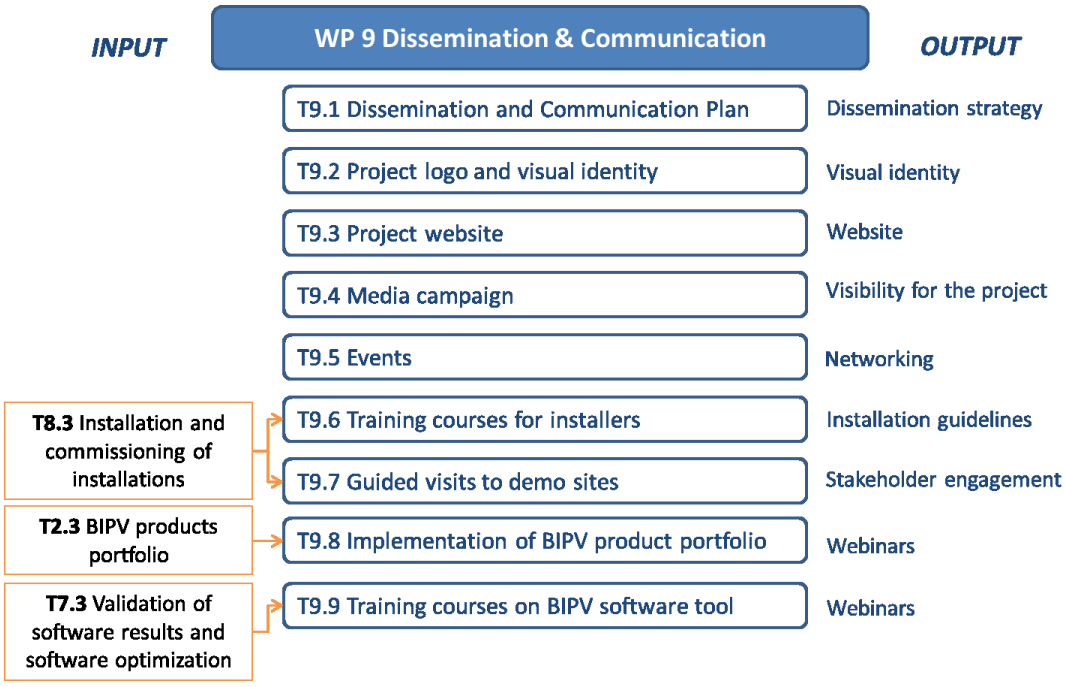

Figure 4.11 Relationship between WP9 tasks

4.9.3 WP9 Tasks Description

T9.1 Dissemination and communication plan [WIP] (all)

This task involves the development of a Dissemination & Communication Strategy for the activities throughout the project. The strategy forms a basis on which all partners will work in regards to the outreach and dissemination of the project and will be re-visited considering the monitoring of dissemination activities and results.

All partners must participate by giving input to the elaboration of the Plan and by implementing it throughout the project. Each partner should contribute by:

- Providing the necessary information when asked by the task leader WIP.
- Promoting the project within their networks.
- Participating in relevant events for the BIPV community and promoting the project.
- Providing contacts from stakeholders within their network for giving feedback in PVSITES activities.
- Letting the task leader know about their communication and dissemination actions for monitoring purposes.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T9.1	**Dissemination and communication plan**	**M1**	**M1**	**[WIP] (all)**	**D9.1**
1	Elaborate draft of the Plan	Week 1	Week 2	WIP	D9.1 draft
2	Collect feedback from consortium	Week 2	Week 3	All partners	D9.1 draft revisions
3	Compile feedback and make final version	Week 3	Week 4	WIP	D9.1

Table 4.88 Timing of 9.1 planned activities

T9.2 Project logo and visual identity [WIP] (all)

A logo will be created representing the theme of the project. A guideline will be developed to inform partners about the rules that should be applied for a graphically coherent and consistent presentation of project communications. For facilitating the uniform appearance of the project, templates for power point presentations and word documents will be developed and made available to the partners.

All partners must participate by giving input to the elaboration of the logo and by implementing the visual identity guidelines.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T9.2	**Project logo and visual identity**	**M1**	**M2**	**[WIP] (all)**	**D9.5**
1	Develop logo options	Week 1	Week 2	WIP	Logo options
2	Partners to vote preferred logo & feedback	Week 2	Week 3	All partners	Final logo & revisions
3	Development of final logo	Week 3	Week 4	WIP	Logo revised
4	Develop templates of documents	Week 4	Week 6	TECNALIA	Final templates
5	Prepare Communication Guidelines	Week 6	Week 8	WIP	D9.5

Table 4.89 Timing of 9.2 planned activities

T9.3 Project website [WIP] (all)

A project website will be developed targeted to the project's main audience and systematically updated. The website will also offer to download extensive documentation, working as a share-point for the consortium, a news section, user subscription, and a link to the major social media. The website will be promoted among specific target groups as well as the general public in different ways and through different distribution channels.

All partners must participate by giving feedback to the elaboration of the website and by providing input to the website content throughout the project. Each partner should contribute with:

Providing the necessary information when asked by the task leader WIP for the website.

Giving input and bringing ideas to update the website.

Promoting the website in their communication and dissemination activities.

No	Action/subtask	Start	Deadline	Responsible	Output/ Comments
T9.3	**Project website**	**M1**	**M2**	**[WIP] (all)**	**D9.6**
1	Contract a web developer	Week 1	Week 2	WIP	Subcontract
2	Development of website	Week 2	Week 4	Subcontractor	Draft website
3	Feedback from WIP and Coordinator	Week 4	Week 6	WIP	Website revisions
4	Development of final website	Week 6	Week 7	Subcontractor	Final website
5	Website CMS training	Week 7	Week 8	Subcontractor	
6	Launching of the website	Week 7	Week 8	WIP	D9.6

Table 4.90 Timing of 9.3 planned activities

T9.4 Media campaign [WIP] (all)

The media campaign involves the development and distribution of all media actions. Media actions include:

- Press and news releases for the achievement of each milestone and to inform about the project events.
- Two leaflets about the project. One produced in the beginning and another one in the end of the project.
- Two videos about the project. One produced in the beginning and another one in the end of the project.
- A social media campaign.

All partners must participate by giving feedback to the elaboration of the media material and by distributing the media material in their communication channels. Each partner should contribute with:

- Distributing the media material to information multipliers, such as their organization website, blogs and their media and press contacts.
- Distributing leaflets in all relevant events and meetings where project partners are participating.
- Posting news about the project in their social media accounts, such as Linkedin, YouTube and Twitter.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T9.4	**Media campaign**	**M1**	**M42**	**[WIP] (all)**	**Promotional material**
1	Develop press releases for each milestone	M1	M42	WIP	Press & news releases
2	1st Video for PVSITES promotion	M2	M6	WIP	2 min web video
3	1st Leaflet for PVSITES promotion	M2	M6	WIP	Leaflet
4	Establish social media channels	M5	M6	WIP	Social media campaign
5	2nd Video with PVSITES results	M30	M36	WIP	5 min web video
6	2nd Leaflet with PVSITES results	M30	M36	WIP	Leaflet

Table 4.91 Timing of 9.4 planned activities

T9.5 Events [WIP] (all)

This task involves the participation of the project partners in major relevant conferences and other events in order to present the project and disseminate its results. WIP will support the partners' strategy in upcoming events, such as exhibitions, conferences and workshops as well as identifying new possible BIPV events which could be interesting for project's results presentation.

WIP will pursue participations on sessions dedicated to BIPV in several events and especially within the European Photovoltaic Solar Energy Conference and Exhibition (EU PVSEC). WIP will also support close cooperation and networking with existing relevant platforms, especially the European Photovoltaic Technology and Innovation Platform.

All partners must contribute to this task by participating in events representing the PVSITES project and by raising possible events for PVSITES dissemination. Each partner should contribute with:

- Continuous efforts to identify additional relevant conferences and events where the project partners can participate to promote the project and its results.
- Connect PVSITES with other Horizon 2020 projects on BIPV topics which they are aware of.
- Networking on behalf of PVSITES in the participated events.
- Notifying the WP leader WIP, of participation in any event or conference relevant to PVSITES.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T9.5	**Events**	**M1**	**M41**	**[WIP] (all)**	**D9.11**
1	Collect events from partners	M1	M42	WIP	Events spreadsheet
2	Monitor events participated	M1	M42	All partners	Events spreadsheet revision
3	Annual reports on held events	M1	M42	WIP	D9.11

Table 4.92 Timing of 9.5 planned activities

T9.6 Training courses for installers [TECNALIA] (WIP, ACCIONA, BEAR, Onyx, Flisom, Nobatek)

During the demonstration activities developed under WP 8, specifically under Task 8.1.4, a design pack will be generated with guidelines for integration of the BIPV products in every demo site, including guidelines for: commissioning and maintenance, installation, electrical integration and operation.

The leader of this Task, TECNALIA, based on these guidelines, will conduct onsite training of installers at the demonstration sites. Several training sessions will be held for installers in each demo site. The gathering of technical information for the content of the training will be done by TECNALIA, with the support from ACCIONA, BEAR, Onyx, Flisom, and Nobatek. WIP will be responsible for the organization of the training.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T9.6	**Training courses for installers**	**M21**	**M27**	**[TECNALIA] (WIP, ACCIONA, BEAR, Onyx, Flisom, Nobatek)**	**D9.15**
1	Gather information for training	M21	M23	[TECNALIA] (ACCIONA, BEAR, Onyx, Flisom, Nobatek)	Training material
2	Organise training sessions	M21	M23	WIP	Training calendar
3	Perform trainings in each demo site	M23	M26	TECNALIA	Training sessions
4	Develop report	M26	M27	WIP	D9.15

Table 4.93 Timing of 9.6 planned activities

T9.7 Guided visits to demo sites [WIP] (FD2, Vilogia, Flisom, TECNALIA, Cricursa)

WIP will organize, at a local and regional level, guided visits for stakeholders (architects, engineers, construction sector professionals, students, etc.) to the demonstration installations. These visits will be hosted and supported by the demo buildings owners.

WIP will be responsible for gathering participants and informational material for performing the guided visits with the support of ACCIONA, FD2, Vilogia, Flisom, TECNALIA and Cricursa.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T9.7	**Guided visits to demo sites**	**M25**	**M42**	**[WIP] (FD2, Vilogia, Flisom, TECNALIA, Cricursa)**	**D9.16**
1	Develop calendar for guided visits	M25	M26	WIP	Visits calendar
2	List the stakeholders to be invited	M25	M27	WIP	List of stakeholders
3	Develop invitations and disseminate	M27	M30	WIP	Communication actions
4	Perform the guided visits	M30	M42	WIP	Guided visits
5	Develop report	M40	M42	WIP	D9.16

Table 4.94 Timing of 9.7 planned activities

T9.8 Implementation of BIPV product portfolio [CADCAMation] (BEAR, TECNALIA, WIP)

In WP2, a BIPV products portfolio will be developed containing all the information available on the products which are part of the project's demonstration. Within WP9, the implementation of the BIPV product portfolio will be done through different formats: a physical format and an online user friendly catalogue of products to be published on the project's website or other relevant platforms. A tool for a preliminary assessment of the products in the portfolio will be also available in order to provide the optimum product from the catalogue given location, orientation, tilt angle and economical aspects.

The programming of the web tool will be done by CADCAMation. TECNALIA will provide the inputs and, together with BEAR, will verify the correctness of the tool operation.

WIP will organize webinars in order to disseminate the tool considering main target groups, such as architects, urban planners, engineers, installers, and building managers.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T9.8	**Implementation of BIPV product portfolio**	**M36**	**M42**	**[CADCAMation] (BEAR, TECNALIA, WIP)**	**D9.17 & D9.18**
1	Programming of web tool for catalogue	M36	M40	CADCAMation	Web tool
2	Organise webinars for dissemination	M40	M42	WIP	Webinars presentations

Table 4.95 Timing of 9.8 planned activities

T9.9 Training courses on BIPV software tool [CADCAMation] (BEAR, TECNALIA, WIP)

In WP7, a BIPV software tool will be developed by CADCAMation. Within the scope of this task in WP9, trainings courses will be performed with the target public on how to use the software. Training sessions will be done remotely, via webinars for each Demo Site.

CADCAMation will be in charge of the training courses, supported by TECNALIA for photovoltaics and BEAR for architectural knowledge. WIP will support in the organization and dissemination of the training courses.

No	Action/ subtask	Start	Deadline	Responsible	Output/ Comments
T9.9	**Training courses on BIPV software tool**	**M36**	**M42**	**CADCAMation] (BEAR, TECNALIA, WIP)**	**D9.19**
1	Development of training material	M36	M40	CADCAMation	Use cases for each demo site
2	Organisation of webinars	M36	M40	WIP	Calendar of webinars sessions
3	Dissemination of webinars	M36	M40	WIP	Registration in the webinars
4	Webinars	M40	M42	CADCAMation	Webinars presentations
5	Develop report	M41	M42	CADCAMation	D9.19

Table 4.96 Timing of 9.9 planned activities

4.9.4 WP9 Deliverables and milestones

The following tables show the deliverables and milestones linked to WP9, stating the task associated, the responsibilities, the type and dissemination level and the delivery month.

Ref	Deliverable title	Task	Responsible	Type	Diss. level	Delivery date
WP9	**DISSEMINATION AND COMMUNICATION**		**R2M**			
D9.1	Dissemination and communication plan	T9.1	WIP	R	PU	M1
D9.2	Dissemination and communication plan	T9.1	WIP	R	PU	M12

	(update 1)					
D9.3	Dissemination and communication plan (update 2)	T9.1	WIP	R	PU	M24
D9.4	Dissemination and communication plan (update 3)	T9.1	WIP	R	PU	M42
D9.5	Guidelines for project's visual identity.	T9.2	WIP	DEC	PU	M36
D9.6	The project website.	T9.3	WIP	DEC	PU	M2
D9.7	Promotional material	T9.4	WIP	DEC	PU	M12
D9.8	Promotional material (update 1)	T9.4	WIP	DEC	PU	M24
D9.9	Promotional material (update 2)	T9.4	WIP	DEC	PU	M36
D9.10	Promotional material (update 3)	T9.4	WIP	DEC	PU	M42
D9.11	Annual report on held events.	T9.5	WIP	R	PU	M12
D9.12	Annual report on held events (update 1)	T9.5	WIP	R	PU	M24
D9.13	Annual report on held events (update 2)	T9.5	WIP	R	PU	M36
D9.14	Annual report on held events (update 3)	T9.5	WIP	R	PU	M42
D9.15	Training courses for installers.	T9.6	WIP	DEC	PU	M27
D9.16	Guided visits to demo sites.	T9.7	WIP	DEC	PU	M42
D9.17	BIPV product portfolio.	T9.8	CADCAM	OTH	PU	M41
D9.18	Webinars for BIPV product portfolio.	T9.9	CADCAM	DEC	PU	M42
D9.19	Training courses on the BIPV software tool.	T9.9	CADCAM	DEC	PU	M42

Table 4.97 WP9 deliverables

4.10 WP10 MANAGEMENT

WP number	10					Start Date		M1			End Date		M42		
WP title	Management														
Participant nº	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Participant short name	TECNALIA	ONYX	BEAR	NOBATEK	FOPTICS	CTCV	FLISOM	CRICURSA	CEA	ACCIONA	FD2	VILOGIA	R2M	CADCAM	WIP
Person/months	14	1	1	0,5	0,5	0,5	1	0,5	1	1	0,5	0,5	1	1	1

Table 4.98 WP10 general information

4.10.1 WP10 Purpose and Objectives

This work package will ensure the overall management of the work undertaken in PVSITES, including:

- The overall general strategic and operational management and steering of the project, ensuring the accuracy, quality and on time delivery of deliverables.
- Ensure the seamless integration of the activities (i.e. manage the time and result dependencies) by reviewing and assessing the progress of PVSITES activities towards the defined goals and objectives.
- Measure the project progress as much as possible in a quantitative way and to give feedback to the project partners in order to react accordingly.
- Formulate and implement a quality plan and create related tools for use in the whole project.
- Conduct the financial and administrative management of the project.
- Establish and manage effective collaboration and communications systems.
- Manage the public dimension of the project.
- Manage liaison with the European Commission, and the production of periodic reports.
- Co-ordinate and ensure the coherence of all the technical developments between Work Packages.

4.10.2 WP10 Problem definition and timing of different tasks

WP10 Management, will ensure an effective execution of the project, complying with the established timing, quality levels and resources. The main tasks to achieve this important objective are the following:

Ref	Task title	Responsible	Estimated indicative person-months	Start month	End month
WP10	**MANAGEMENT**	**TECNALIA**	**25**	M1	M42
T10.1	**Project management**	TECNALIA	**15**	M1	M42
T10.2	**Reporting and communication with EC officers**	TECNALIA	**5**	M1	M2
T10.3	**Monitoring and management of external relationships**	TECNALIA	**5**	M1	M2

Table 4.99 WP10 tasks

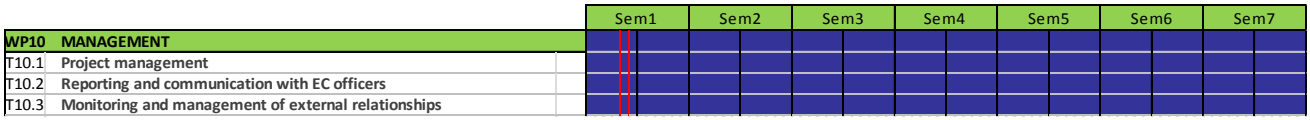

Table 4.100 Timing of WP10 tasks

The main responsible of this work package is TECNALIA with the contribution of all partners.

The planning for this work package is continuous from the beginning to the end of the project.

4.10.3 WP10 Tasks Description

T10.1 Project management [TECNALIA] (All)

This task is designed to make sure that the project delivers the results as expected in the Technical Annex. It will initiate, set and implement the consortium contract, including the consortium agreement, the overall financial and administrative management processes and routines. The task lasts for the entire duration of the project and provides full control of both the project technical focus and the financial and administrative aspects of the project. Specific subtasks will focus on project coordination and activities of the General Assembly (GA).This document D10.1 Quality management plan, stablish the bases for this management.

The actions for develop task T10.1 are:

1. Formulate and implement a quality plan (D10.1) and create related tools for use in the whole project
2. The overall management, by initiating and monitoring all activities, technical, market, etc.
3. Measure the project progress in a quantitative way and to give feedback to the project partners in order to react accordingly.
4. Collection of the WP progress reporting (collecting WP info and compiling summary reports with consolidated deviations) on a periodic basis.
5. All contacts with the European Commission, management of the project boards and WP leaders.
6. Handling deliverables due by Work Package leaders, submitting them to the EC, internal communication, archiving. The final versions of the deliverables are due to the Project Manager 15 days in advance with respect to their deadlines.

7. Periodic risk evaluation and control as well gender performance.

Project Management requires mechanisms which guarantee the needed flexibility, maintaining at the same time coherence and focus on the objectives.

The quality system adopted will be in accordance to the ISO – 9001 standard. A specific Quality Management Plan will be issued early in the project and is applicable to all project's activities, and the strict compliance being mandatory for all partners. All subsequent changes will need the approval of the General Assembly

T10.2 Reporting and communication with EC officers [TECNALIA] (All)

This task will be the responsibility of the PM and includes all the reporting aspects as defined in this document Quality Management Plan and required by the Horizon 2020 Programme Rules

- A Periodic Report will be produced at the end of each reporting period (month 15, 27 and 42) containing a management level overview of the activities carried out, a description of progress toward the technological objectives, a description of progress toward the milestones and deliverables foreseen, and identification of problems encountered during the project and the actions taken to correct the problem.
- A Summary Financial Report will be produced at months 15, 27 and 42 containing the cost statements prepared by each participant, linking these costs to the resources deployed and activities carried out by the participant. When needed, the Certificate on Financial Statement of each corresponding party will be sent at the end of the project. The Summary financial report brings together the incurred costs of the Consortium and the requested Community contribution.
- At months 12 and 24, WP achievements will be reviewed during General Assembly Meetings. As a result of these meetings, Interim Reports will be prepared and sent to the EC.
- A Final Report comprising a publishable summary, a plan for the dissemination and exploitation of results and a report on societal implications will be prepared at the end of the project (M42).

T10.3 Monitoring and management of external relationships [TECNALIA] (Onyx, BEAR, CEA, ACCIONA, WIP)

This task foresees the management and the monitoring of the potential external relationships that PVSITES may be interested in order to ensure the engagement of a broad spectrum of policy makers at different governance levels and European industry representatives (EC representatives – DG Research, Connect, Energy-, PV and European Construction Technology Platforms, PV and construction industry associations, standardization bodies –CEN, CENELEC-,etc .). Status of this activity will be reported in a specific section of the periodic report.

4.10.4 WP10 Deliverables and milestones

The following tables show the deliverables and milestones linked to WP10, stating the task associated, the responsibilities, the type and dissemination level and the delivery month.

Ref	Deliverable title	Task	Responsible	Type	Diss. level	Delivery date
WP10	**DISSEMINATION AND COMMUNICATION**		**TECNALIA**			
D10.1	Quality management plan.	T10.1	TECNALIA	R	PU	M3
D10.2	Revision of detailed project management plan	T10.1	TECNALIA	R	PU	M15
D10.3	Second revision of detailed project management plan	T10.1	TECNALIA	R	PU	M27
D10.4	Interim Report.	T10.2	TECNALIA	R	CO	M12
D10.5	Interim Report (update 1)	T10.2	TECNALIA	R	CO	M24

Table 4.101 WP10 deliverables

Ref	Milestone title	WP	Responsible	Delivery date	Mean of verification
MS8	Creation of Advisory Board	WP10	**TECNALIA**	M3	Creation of the Advisory Board for PVSITES project completed. The Advisory Board will be composed by six respected members of the BIPV community, providing advice during the project lifetime.

Table 4.102 WP10 milestones