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PVsites

MS4. Demonstration installation process completed

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PVSITES

“Building-integrated photovoltaic technologies and systems for large-scale market deployment”

Start date: January 2016. Duration: 4.5 Years

Summary

This document contains the information related to the fulfilment of Milestone 4 of PVSITES project, as defined in the Grant Agreement, Annex 1 (part A), corresponding to the completion of the installation process of the demo-systems at the chosen demo-sites.

Document Information

Title	Demonstration installation process completed
Lead Beneficiary	ACCIONA
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1 EXECUTIVE SUMMARY

1.1 Description of the milestone content and purpose

This document contains the information related to the fulfilment of Milestone 4 of PVSITES project, as defined in the Grant Agreement, Annex 1 (part A), corresponding to the completion of the demonstration installation process which form part of PVSITES project. The milestone was due in 30th June, 2019 and, although suffering important problems and delays, has been completed very satisfactorily.

1.2 Reference material

- PVSITES Grant Agreement, N° 691768, and amendment reference AMD-691768-76
- Deliverable “D8.1. Energy audit of buildings and identification of BIPV possibilities in every demo site”
- Deliverable “D8.2. Result of modelling and BIPV strategies for every demo site”
- Deliverable “D8.3. Design pack for every demo site”
- Deliverable “D8.5. Prototypes for demo-sites - Second batch”
- Deliverable “D8.6. Results of installation and commissioning for every demo site”
- Deliverable “D8.10. Installation and execution of monitoring of BIPV systems”

1.3 Abbreviation list

- BAPV: Building Attached Photovoltaics
- BEMS: Building Energy Management System
- BIPV: Building Integrated Photovoltaics
- CIGS: Copper indium gallium selenide
- C-Si: crystalline silicon
- EHG: Ecole Hôtelière de Genève
- EKZ: Elektrizitätswerke des Kantons Zürich
- EMPA: Swiss federal laboratories for materials science and technology
- PV: Photovoltaics.

2 ISSUING OF DEMONSTRATION INSTALLATIONS DESIGN

Implementing the foreseen demo-system required, as logical, the previous design of the PVSITES products and demo-systems themselves. These tasks included the assessment and pre-audit of the chosen demo-sites and the generation of a set of building integration proposals for each one, in order to choose amongst them the most suitable and viable option.

These tasks included on-site visits, negotiation with the property and local authorities, building drawing consultations, PV production simulations, energy needs assessment, building modelling, and other works aimed to assess the real implementation possibilities and the better options for the demo-systems. On the other hand, great efforts were dedicated to put in common the key issues between the partners involved: demo-site owners or responsible (FORMATD2, FLISOM, CRICURSA, VILOGIA and TECNALIA), the PVSITES' architect partner (BEAR), the PV modules manufacturers (FLISOM and ONYX) and the BOS manufacturers (CEA and TECNALIA), the main responsible of the modelling tasks (CADCAMation) and finally the main responsible of the monitoring activities (NOBATEK and ACCIONA).

After all these actions, the complete characterization of the PVSITES products and demo-systems (geometrical and material PV modules design, architectural building integration projects, carports design, etc.) was successfully achieved. Process followed and final results constitute the contents of following deliverables, some of them with complete technical specifications annexes: "D8.1. Energy audit of buildings and identification of BIPV possibilities in every demo site"; "D8.2. Result of modelling and BIPV strategies for every demo site"; and "D8.3. Design pack for every demo site".

3 ISSUING OF PROTOTYPES MANUFACTURING

Once the final design of products and demonstration systems developed in PVSITES were closed, prototypes intended to be installed in the demonstration sites were manufactured and delivered.

Manufacturing process required in all cases the proper optimization and due quality control of the manufacturing procedures and the validation tests needed to check the fulfilment of the technical specifications expected, in each case, for every prototypes produced.

Manufacturing of prototypes was a total success in most cases. Only the solar inverter developed by CEA was not finished and validated on time, and it is being currently tested in lab. Table below gathers the whole of prototypes manufactured in this phase and finally installed in the demo-sites.

Table 3.1 Balance of PVSITES prototypes produced and finally installed at the real demonstrators

Manufacturer	Typology		Prototypes produced	Prototypes installed	Last batch delivery date	Demo-system
FLISOM	CIGS black aluminium roof-tile		144	144	04/2019 (M40)	Single family house
	CIGS black aluminium ventilated facade panel	Model 2x1 P1	42	21	06/2019 (M42)	Catering School
		Model 2x1 P2	104	96	06/2019 (M42)	
	CIGS flexible thin steel carport module	Model 3x1	76	74	06/2019 (M42)	Carports EKZ & EMPA
	CIGS flexible thin steel carport module	Model 4x1	76	74	06/2019 (M42)	
CIGS thin steel industrial roof panel			336	324	06/2019 (M42)	Industrial building
ONYX	C-Si opaque glass-glass ventilated facade module		145	112	03/2019 (M39)	Apartments building
	Back contact C-Si semi-transparent glass-glass ventilated facade module	Model 1	116	48	07/2018 (M31)	Office building
		Model 2		48	07/2018 (M31)	
CEA	Silicon carbide MOSFET 3-phase AC solar inverter		4	0	-	Industrial building
				0	-	Apartments building
TECNALIA	3-phase DC-coupled PV storage inverter		4	1	06/2019 (M42)	Single family house
				2	06/2019 (M42)	Apartments building

Since tasks essential to be able to start the production of prototypes suffered important delays and the manufacturing processes were also complicated and required adjustments, delivery dates of final products also were delayed, so that it was needed to request the EU Commission a one year extension of the project, through an amendment, to finish the demo-system and carry out the monitoring works.

A complete report about the manufacturing task, as well as storage, transport, handling and installation guideline, can be found in deliverable “D8.5. Prototypes for demo-sites - Second batch” (it includes the whole and updated contents of “D8.4. Prototypes for demo-sites - First batch”).

4 ISSUING OF DEMO-SYSTEMS INSTALLATION AND COMMISSIONING

Every demo-system was successfully implemented as foreseen in the Grant Agreement, despite the mentioned delays, on the basis of the final integration designs and using the prototypes manufactured in the previous task. Through the implementation of demo-systems, it has been possible to assess the power performance of the PVSITES products and the integration effectiveness in the chosen real scenarios, among which a wide range of constructive functionalities and energy uses are included. From this analysis, it can be concluded that most products developed in PVSITES projects, specially BIPV and BAPV modules, are sufficiently mature to be replicated in the market (in fact some of them have already succeeded in this target).

Demo-systems implementation basically consisted, in every cases, in: the previous works needed to prepare the architectural environment chosen to hold the PV and BOS elements; the installation of the mounting and attaching structures, the PV modules assembly; the placement and interconnection of the BOS equipment, protections and cabling included; the commissioning of the systems, together with the first tests carried out to ensure the well-functioning of the system; the implementation of the BEMS and monitoring systems; and the permitting actions related to all this process, mainly related to the architectural interventions and the grid connection.

Final result was successful in all the cases, although important delays were suffered in some of them, generally related to the difficulties to negotiate with the demo-site owners, to achieve every needed permissions, to connect the systems to the electricity distribution grids, to solve the jointly functioning of the involved equipment, and to implement the BEMS and the monitoring systems.

Specific goals achieved and difficulties found in each case are briefly reported below:

Demo 1. Solar roof in a Single-family house, Belgium (FORMAD2):

- System: 8,2 kWp total PV power. CIGS black aluminium roof-tile by FLISOM & 3-phase DC-coupled PV storage inverter by TECNALIA.
- Installation: excellent planning and execution. Careful architectural integration design in a new based on energy passive criteria building, ideal to accept BIPV solutions.
- Permitting: easy with short deadlines. Aesthetical requirements obliged by the municipally. The use of the non-commercial inverter was accepted by the grid manager.
- Commissioning: executed as planned in May, 2019 (M41).

Demo 2. Ventilated facades in the Catering school of Genève, Switzerland (FLISOM):

- System: 7,0 kWp total PV power. CIGS black aluminium ventilated facade panel by FLISOM.
- Installation: easy and quick, on a simple mounting structure attached to brick walls, in two facades of different buildings.
- Permitting: long and difficult negotiation with the building property.

- Commissioning: successfully carried out in November 2019 (M47).

Demo 3. Solar carports at EKZ and EMPA facilities, Switzerland (FLISOM):

- System: 7,0 kWp (EMPA) and 7,3 kWp (EKZ) total PV power. CIGS flexible thin steel carport module by FLISOM. Production addressed to cover demand of electric vehicles chargers.
- Installation: very successful carport design and easy installation procedure, by FLISOM.
- Permitting: justifying the suitability of the system location was needed at EKZ.
- Commissioning: executed as planned in June, 2019 (M42). No problem detected.

Demo 4. Solar industrial roof of a glass factory, Spain (CRICURSA):

- System: 19,3 kWp total PV power. CIGS thin steel industrial roof panel by FLISOM.
- Installation: easy and quick mounting procedure, due to the perfect matching between the BIPV module and the existing industrial roof panel.
- Permitting: relatively easy permitting process.
- Commissioning: executed in July, 2019 (M43). Problems raised later with the implementation of BEMS and monitoring system, due to the commercial inverters and batteries.

Demo 5. Solar ventilated facade of a multi-store apartments building, France (VILOGIA):

- System: 17,0 kWp total PV power. C-Si opaque glass-glass ventilated facade module by ONYX & 3-phase DC-coupled PV storage inverter by TECNALIA.
- Installation: final integration design, with a great aesthetical result, highly conditioned by aesthetical criteria coming from to the architectural design of the retrofit project.
- Permitting: municipal allowance achieved after a long and tricky permitting process due to the public housing character of the building. Technical conditions and agreements required by the electricity provider to get the grid connecting permission.
- Commissioning: long and hard commissioning process due to the presence of an external protection making difficult the grid connection. Commissioning done in June, 2020 (M54).

Demo 6. Solar ventilated facade of an office building, Spain (TECNALIA):

- System: 18,4 kWp total PV power. Back contact C-Si semi-transparent glass-glass ventilated facade module by ONYX.
- Installation: successful building integration, with a ventilated facade structure reproducing the existing curtain wall. Improvement of the indoor climate conditions due to the shadows projected.
- Permitting: different permissions were required, related to the construction works and the self-consumption PV system. All of them were achieved with no significant problems.
- Commissioning: commissioning carried out in June, 2019 (M42), according to the self-consumption legislation.

Additionally to all these works, monitoring equipment were also installed to establish the baseline situation of the demo-sites in terms on energy performance and indoor environmental conditions, and to measure the generation performance and passive influence of the PV systems implemented. Deliverable “D8.10. Installation and execution of monitoring of BIPV systems” reports the planning and final results of the works carried out within these tasks.

On the other hand, Building Energy Management Systems (BEMS) was implemented in the foreseen demo-sites, according to the planning of WP6.

Installation, permitting and commissioning works referred in this section were explained in detail in deliverable “D8.6. Results of installation and commissioning for every demo site”.