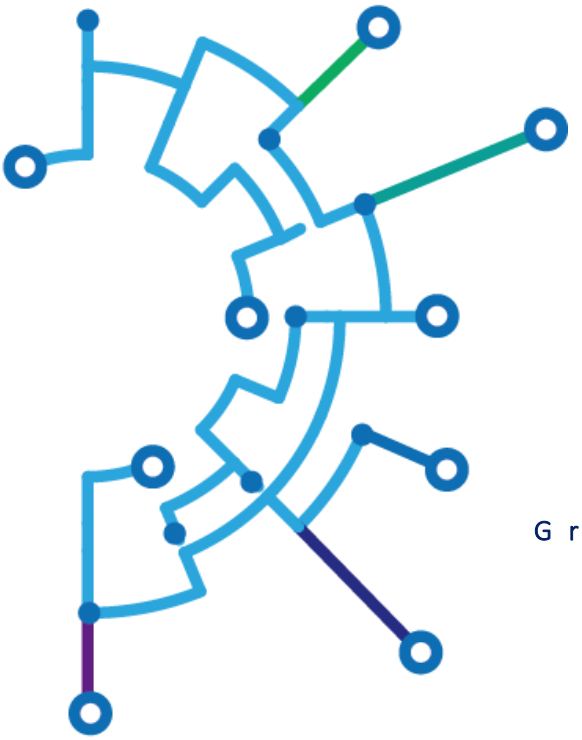

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PV IMPACT

Actual execution of the Implementation Plan for Photovoltaics and monitoring the Implementation Plan's delivery

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Deliverable 6.6 – Report on the relative effectiveness of WP1-3

Prepared by: EUREC

Disclaimer of warranties

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About PV IMPACT

PV IMPACT will try out a variety of approaches to stimulate PV research, development and innovation initiatives in Europe. The first part of the project will focus on inviting companies to matchmaking events so they can find partners with whom to work on future projects under EU and/or national funding schemes. The project will also target two specific industrial companies: ENEL Green Power and Photowatt. Another important part of the project will be to monitor progress in PV. Data will be collected on public spending in the EU, on private spending, on the kinds of projects being funded and on the overall performance of PV technology. Forecasts for future spending will be made according to various scenarios. The project will track whether improvements in the performance of technology are keeping pace with expectations and will make recommendations to European funding authorities.

PV IMPACT Partners

EUREC The Association of European Renewable Energy Research Centres

enel Green Power

Photowatt

eit InnoEnergy Knowledge Innovation Community

Fraunhofer ISE

3E

Consiglio Nazionale delle Ricerche

BECQUEREL INSTITUTE

imec

eurac research

WIP RENEWABLE ENERGIES

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Table of contents

1. Introduction

PV Impact's overall objective is to offer "support to the execution/realisation of the SET Plan Implementation Plan", hence the project functions in a way that supports IWG-PV and pursues monitoring of the status of PV projects (at portfolio level) and technology.

PV Impact has tried out a variety of approaches to stimulate the private sector to spend more on PV research, development and innovation in Europe. The first component of the project focused on inviting companies to matchmaking events so they can make new connections and find partners with whom to work on their plans. Further two components of the project were support tailored to two different contexts: industrial companies in Italy and France:

- ENEL Green Power, trying to make progress on the Implementation Plan by coordinating the many different PV actors in Italy;
- Photowatt, working mostly privately but tap the consortium's expertise and those of scientists whom it selects to help it make the right strategic technical choices to be a serious competitor in PV manufacturing.

PV Impact's approach with its industrial company partners was to give them lots of freedom to work independently if they wish. This was appropriate as the call topic was new, and experimentation in a variety of approaches was encouraged. There is no single approved way to "actually execute" the Implan.

The WP 2 leaders worked in a rather open way, bringing together as many Italian stakeholders as possible to organise work under two themes: "Innovative Technologies for Modern Utility-Scale PV" and "Italian BIPV/PIPV value chain"). Photowatt (in WP 3), by contrast, took a more individualistic approach. This is worth trying out, too, especially as it requests modest budgetary resources in relative and absolute terms. The success of the different approaches is commented on hereunder.

This report reflects on the relative effectiveness of each of these 3 main components in "actually executing the Implan".

2. Matchmaking and mentoring

From September 2019 until March 2022, the organizers of the PV IMPACT matchmaking events hosted 15 sessions. The objective of these interactive sessions was to push business-as-usual level of collaborations to a next level; to bring companies into contact with other companies that they might not know in a light-hearted and energetic way.

PV IMPACT project remained available beyond the matchmaking events to provide further support to the winning participant(s) with information on the know-how of forming a consortium and applying for calls different from EC funding mechanisms, focusing on local, national funding calls. This support included providing relevant information and creating contacts with the national funding agencies, dissemination, and collaboration spacing (i.e. support to consortium building by finding additional partners if required using the existing PV IMPACT project contact networks). The winners were selected by the participants through a voting and ranking scheme, as explained in D1.5 and D 1.6. Each participant of the Matchmaking event received a detailed individual report prepared by Work Package 1 PV IMPACT partners after each event, identifying the best "matching" interactions they had during the session, according to the scoring they gave and the scoring they received from each other participant.

2.1 Mentoring activity

The project required reporting on the success stories as an outcome of the matchmaking events. In practice, PV Impact's matchmaking events provided leaders and professionals from the PV industry an opportunity to network with other relevant experts and pitch their project ideas to find potential collaborations that would have potential to impact the industry. These networking events promoted innovative concept sharing, which would eventually aim to successful project applications. However, quantifying such success stories with straightforward, tangible outcomes within the timeframe of the PV Impact's project execution was proven to be complicated. After internal discussion among the project partners, based on the feedback received from the participants, these are the different hypotheses to explain the outcomes/impact obtained from the WP1:

- Participants who had concrete project ideas pitched their ideas during the matchmaking events and found a good overlap of expertise to prepare a consortium and apply for funding. This is the best-case scenario where a clear connection could have been drawn between PV Impact and a new consortium creation.
- Participants who didn't have concrete project ideas listened to each other's offerings. At some point, they were introduced to a secondary network through their primary contacts. A few months down the line, they formed project ideas/proposals to create a consortium and submit a funding application. However, by this point, it isn't easy to track those secondary network collaborations and link PV Impact matching as the root cause behind the collaboration.
- There were cases where participants who joined the matchmaking event knew each other professionally. As the participants are from a similar field of expertise, it is not surprising

that they had prior encounters. In this situation, even if the participants form a consortium and apply for funding, the connection between the PV Impact event and their application could have been the trigger, but this is hard to prove.

- Furthermore, the incubation period of any successful funding application is lengthy. Therefore, the impact cannot be quantified a few months after the matchmaking event has taken place.
- There was a key limiting factor within the scope of the mentoring activity. As it was limited to national applications, there were considerably lower collaboration opportunities among cross-national participants. Participants' feedback highlighted that it would have been more effective for the mentoring support to be based on financial support for launching the project proposal or consortium building. As PV Impact was limited to mentoring activity combined with knowledge base creation, it didn't have scope to expand to such context.

In report D1.6, the landscape was broadened to address such limitations to report success stories. Satisfaction surveys were also included in the reporting process, apart from successful funding applications or collaborations. The consortium partners periodically reached out to participants with the questionnaire — this provided feedback on the effectiveness of the PV Impact matchmaking events as a professional network initiator.

2.2 Impact of matchmaking events based on the answers from the surveys

As previously mentioned, to quantify the impact of the matchmaking sessions, WP1 partners sent out a survey to all the participants that had taken part in the sessions since the beginning of the project. The questions in the survey were oriented towards understanding the following critical success factors:

- What benefits did participants obtain from the session?
- Were participants still in conversations/business with any of the other participants?
- Were participants collaborating in any way?
- Were participants involved in a project proposal triggered by the matchmaking sessions?
- What was the status of participants' project proposal?

The survey was sent to a total of 140 participants who had attended the matchmaking sessions. Out of these, 25 had participated on more than one occasion, which was a positive indicator. The answer rate was 25 answers out of these 140, although it should be taken into consideration that some of them had already changed their email addresses (i.e. probably due to a change of company). From these 25 replies, it can be highlighted that all the participants found the matchmaking experience enriching and valuable. 50% of responding participants confirmed that they had followed up with interactions after the event, and 7% answered they were still working closely with some participants. Nine of them also explained that they were collaborating on a project definition, however, due to the long incubation period of funding applications, it would

take some time before a successful application can be reported. More details on the survey results were reported in D1.4. There were multiple successful partnerships and consortia that originated through PV IMPACT's matchmaking events. On top of this, through the mentoring support, both InnoEnergy and the technical partners accompanied some of the most voted entities to look for private investments, find research opportunities, or improve the quality of their business models or written applications.

3. Support tailored to Industrial company in Italy – Enel Green Power

3.1 Support to Implan Flagship projects in Italy

The overall effectiveness of the activities carried out in WP2 is considered very high for at least three reasons.

Pursuit of the objectives of the SET Plan Implan.
The Italian contribution to the PV Implan was articulated around two "flagship activities", one devoted to "Utility-scale PV" (USPV) and the other to "Building Integrated PV" (BIPV). The objective of the USPV flagship was to strengthen the R&I ecosystem in support of the new Italian PV manufacturing value-chain. EGP's Gigafactory project has taken off and the two important R&I national projects have been prepared by the Italian R&I Community to accelerate the development of (high efficiency) tandem solar cells and validate the new technology at the industrial scale.

The two proposals were submitted to the Italian Ministry for the Ecological Transition (MITE) within the call "Ricerca di Sistema Elettrico". One has already been funded (project "TANDEM" led by Olivotto Glass Technologies s.p.a, budget €3M) and one is still awaiting evaluation (project GoPV, led by ENEA, budget €5M).

A similar approach was pursued for the BIPV flagship. In this case the objective was to stimulate the emergence of new industrial value-chains by creating synergies between companies from the PV, the Energy and the Building sector and the R&I Community. Two important R&I projects were conceived thanks to the three workshops/matching events organised by PV-IMPACT as part of the WP2 planned activities. As for the other flagship, one project has already been funded (project "FOURIER" led by CAMLIN Italia s.r.l, budget €1.7M) and one is awaiting the final evaluation (project "CANVAS", led by CNR, budget €5M). The objective of both these projects are tightly connected to the KPIs of the SET Plan PV Implan.

In addition to these projects the Ministry (MITE) has promoted a strategic R&I programme on Photovoltaics as part of the new three-year plan of "Ricerca di Sistema Elettrico" (2022-2024). This €20M programme is currently (May 2022) being executed by the three largest national R&I organisations actively involved in PV, that is ENEA, RSE and CNR and directly funded by MITE under a commissioning agreement.

Analysis, networking and strategic inputs for the policymakers.

Alongside the definition of the R&I project proposals to be submitted for national funding, the series of four major national events organised as part of the WP2 action plan, were devoted to the definition of a comprehensive "Strategic Plan for Research and Innovation to Relaunch the Italian Photovoltaic Sector and Contribute to the Targets of the National Energy and Climate Plan". This is the sequence of events leading to the formulation of this document (called White Paper).

- September 2019: First workshop of the Italian R&I stakeholders of the PV sector, hosted by EGP in Catania. The basic structure of the present strategic plan was discussed and elaborated.
- December 2019: Second PV IMPACT workshop devoted to the national flagship "BIPV". The discussion was organised in 5 working groups covering a wide range of R&I, business and regulatory issues associated to the new emerging BIPV value chain.
- May 2020: Third workshop, was rescheduled as an online event after the cancellation of the original conference, set to be organised by ENEA in Naples in March. During the online event several of the proposed strategic projects, included in this document, were presented and discussed. In July 2020 the document was submitted to both the Ministry of the Economic Development and the Ministry of Research and Education.
- In June 2021, when the National Recovery and Resilience Plan was being discussed, the proposals contained in the White Paper were discussed in a major national (online) event ("Fotovoltaico Motore della Transizione Ecologica") in the presence of the two Italian delegated of the SET Plan Steering Committee, Marcello Capra and Riccardo Basosi, and all the stakeholders (R&I and industry) involved in all the previous activities and events. The proceedings of this event are publicly available and contain are considered of high strategic value. The contents of the White Paper and the results of this workshop have been disseminated in many other local and national events from July 2020.

Formation of the "National PV Network of R&I" (Network)

One of the major successes of Work Package 2 was the creation of an effective network of R&I stakeholders (i.e. more than 60) who have been actively involved both in the preparation of the White Paper and in the definition of the priorities of the national R&I projects described above. All the project proposals and the response to the MITE commissioning agreement, were finalized by means of a top-down approach where the partners were selected on the basis of the strategic objectives and by using the information contained in the national database of the R&I PV-labs in Italy, whose creation and maintenance was a deliverable of WP2.

During PV-IMPACT, the (informal) Network was coordinated by a Working Group (WG) of senior researchers and managers selected on the basis of their formal appointment in one of the European or International organisations dealing with PV such as, SET Plan IWG, ETIP-PV, EERA JP-PV, IEA. This WG was called "Permanent Consultation Board" and is still operating with the aim of transforming the informal Network in a formal Association by the date of the forthcoming WCPEC-8 to be held in Milan in September 2022. This formal step was not undertaken during PV-IMPACT

as the formal umbrella offered by this project was judged to be sufficient to accredit the Network for the tasks to be carried out in that phase.

The starting point of the work was the strategic document of the Italian R&I community of the PV sector, "Italian Flagship R&I Activities on Photovoltaics", edited by the National SET Plan Coordination Team and finalised in June 2017 with the contribution of all the R&I community. The document was the primary source of the Italian contribution to the SET Plan Implementation Plan for the POV sector and clearly defined the two national flagship activities: Utility-scale PV and BIPV. An executive plan was defined for the conversion of the R&I priorities defined in the 2017 document, into project proposals to be submitted to the Italian government for funding. Although it was already under way before the starting date of PV Impact, this process was accelerated by PV Impact and the clue event was organised in September 2019 at the EGP Innovation hub&lab next to 3Sun manufacturing site in Catania. All the major R&I stakeholders of the PV sector (i.e. industries, R&D organisations and others) participated in the workshop and contributed to the definition concept notes. The key concepts for a coordinated national strategy to relaunch the Italian PV sector were also discussed. These concepts were later developed into a comprehensive strategic plan and fully incorporated in the White Paper, that is one of the key impacts of this WP.

The initiatives promoted within task on "applying for funding for Italian flagships" had the general objective of increasing national competitiveness in the field of renewable energy in general and of photovoltaics in particular with the aim to ensure the definition of a unique know-how, capable of enormously enriching the technical assets of the photovoltaic sector.

The knowledge developed within the projects will therefore be able to trigger innovation processes in many sectors and strength the connection between National Research centres and Italian industrial environment with aim to promote the technology transfer and dissemination of know how. The reference sector of planning, namely the implementation of photovoltaic systems and therefore the production of energy from renewable sources, are crucial in two key aspects to fostering corporate and Italian growth and competitiveness; on the one hand for a progressive sustainable development aimed at reducing the impact of our production methods on the environment, allowing a more efficient and responsible use of natural resources, on the other hand the ability of the project outputs to generate an increase in efficiency and process accuracy that could trigger the virtuous drift of the entire Innovation Environment (Public and Private) towards digitalisation and innovative solution. The development of innovative processes aimed at fuelling competitiveness is also vital for the formulation of policies aimed at sectorial industrial growth as well as implementation governance guidelines.

The program presented in the "full project proposal" deliverables has been discussed with Government Funding entities and represents a global strategical framework that outlast the objective of the project itself giving a clear address for the whole Italian Photovoltaic development in the following years. The plan is a high-level summary of what has been evidenced by all the partners involved in the physical meeting in Catania that gives the picture of what as a country we should aim to.

As there is no dedicated Funding Agency for the submission of project proposals in Italy, the work under Task 2.2 and 2.3 were fully integrated in the deliverable “White paper of the R&I priorities in the Italian PV sector” which was then first under discussion with several key stakeholders in Italy and ultimately it was submitted to the Ministry of Economic Development (MISE) to be considered as a project to be included in the Italian Recovery Plan.

CNR coordinated the action to establish a National PV Facility Network as part of the strategic actions agreed by the network of Italian R&I labs and institutions to support the national Implan activities. At the first national PV Impact workshop in Catania (17-20 September 2019), the stakeholders defined the pillars of the strategy based on the interplay between a highly coordinated R&D network ("National Distributed Lab") and two National Industrial-Prototyping facilities to be established with the support of public funding as defined in the SET Plan Implementation Plan. The National Distributed Lab, whose internal structure and organisation are described in the White Paper, will be established during the second phase of PV Impact.

A key step towards the establishment of the Distributed Lab was the update of all the facilities, lab equipment and know-how in the >380 R&D laboratories throughout the country. This information was processed into a database which can be accessed through the PV Impact Web site.

EGP, EURAC and EGP have promoted and coordinated the participation of the National R&D stakeholders in national and regional projects. Among these, the most significant are "Ricerca di Sistema Elettrico" (RdS) (M14.1€ in 2019-2021 plan) and Mission Innovation (in progress) both managed by the Ministry of the Economic Development (MISE). Finally, CNR, EURAC and EGP have coordinated the preparation of the National White Paper of the national PV sector. The first version of White Paper is a Deliverable (D2.6) of PV IMPACT. It was presented at the national (Italian) SET Plan coordination meeting in the presence of the head of the Energy Department of the Ministry of Economic Development.

4. Support tailored to industrial company in France – Photowatt

4.1 Support to PV Implementation Plan for silicon-related R&I activities in France

The first way to achieve this goal was to support to Photowatt's medium term R&D plan in relation with Implan activities. It mainly consisted in gathering international experts to discuss scientific topics in relation with Photowatt's medium term R&D plan. Two Technical & Scientific meetings were organized: one in October 2019 (in Photowatt) and one in February 2022 (online). These two meetings covered the main R&I topics of interest for Photowatt: Ultra-Low Carbon cast-mono silicon material, its compatibility with the current cells architectures and its long-term reliability. Both meetings confirmed that Ultra-Low Carbon cast-mono modules would be of great benefit to achieve the PV implementation plan and especially the R&I activity n°2 by improving the environmental and societal sustainability of silicon-based modules. Moreover, the first meeting ended up with a tripartite collaboration between Photowatt, Fraunhofer ISE and EDF R&D focused on the manufacturing of high efficiency solar cells (TopCon) on Ultra-Low Carbon cast-mono material. This collaboration started in 2020 and is still on-going.

Secondly, Photowatt attended several meetings and conferences to plan and implement collaborative R&D projects by meeting potential future partners. The impact of the COVID-19 pandemic was not negligeable, as only one conference was attended in-person. To overcome the pandemic situation, Photowatt participated to several online events. A discussion with two French institutes, INES and IPVF ensued from a presentation held at IEEE PVSC2020. Photowatt worked with these French partners to apply to a project call from the French Research Agency (ANR) (project submitted on the 24th of March 2022). This project will fit both R&I activity n°2, as it plans to use Ultra-Low Carbon cast-mono silicon material and R&I activity n°3 as it aims to develop a Silicon-Perovskite Ultra-Low Carbon tandem modules.

Finally, Photowatt granted access to its cell production line and to its module reliability test platform. The objective was to bridge the gap from lab to industries: the opening of Photowatt's infrastructure and expertise to third parties allowed them to test the manufacturability of their process in a real industrial environment. Using its own networks and an advertising campaign together with PV Impact partner WIP Renewable Energies, 7 companies accessed the Photowatt's lines. Depending on the third party's needs, they accessed either one or several parts of the production lines. It was noted that almost all companies showed interest in the reliability platform. This part of the project is regarded as successful by Photowatt: Photowatt got to know new

interesting technologies, and the third-parties were able to develop their own products faster, having the opinion and the tools of a PV industry. Moreover, it covered four of the six R&I activities of the Implan (n°1, 2, 3 and 5), as the third parties had activities in one or several R&I activities of the Implan.

5. Conclusions

The innovative adaptation of matchmaking events was an overall success despite some challenges. All 15 sessions ran smoothly, and the overall feeling was very positive. From the satisfactory survey that was filled in by the participants after each event, results showed that the participants had very fruitful interactions and that most of them came out of the session with practical perspectives for collaboration. Participants also showed a high level of satisfaction with the design of the events. As almost all matchmaking events ran during the COVID-19 pandemic and were organised online, participants appreciated the possibility to meet and establish links with new peers, while in-person networking or brokerage events were not taking place. Therefore, the matchmaking events were successful in bringing stakeholders into contact with other stakeholders beyond their usual networking bubble.

PV IMPACT has offered, as planned, mentoring and general guidance to the winning participants from each workshop, including lessons learned from previous project funding applications, tips, and tricks to write a winning proposal, or finding potential partners for the companies´ project idea. The number of participants in each session was also reduced to provide more time and enable more focused pitches. To do this, a rigorous selection was done on the applicants list.

As it has previously been highlighted, not being able to provide support on EC funding opportunities has been proven one key limiting factor of the mentoring activity. Nevertheless, the consortium partners were able to find, on many occasions, other areas of support which added value to the winning participants such as introduction to interesting parties along their value chain, marketing and communication tips and opportunities, access to expert knowledge and feedback or guidance on national funding opportunities.

One of the conclusions drawn from the mentoring activities was that many participants were already satisfied with the interactions created during the matchmaking sessions, thus not requesting further support from the consortium partners. This has not been considered as a sign of little value added from the services offered through mentoring, but on the other hand, of a strong impact already created through the interactive sessions, also based on a good selection of profiles for the discussions.

All in all, based on the feedback received from the participants and the experience of organising partners, it can be concluded that the PV IMPACT project has succeeded in creating a right platform/environment to foster collaborations, which is very likely to lead to interesting and impactful projects in the PV industry.

In like manner, PV IMPACT's Work Packages 2 and 3 provided a very significant support and contribution tailored to two different contexts at national level: support to the actual execution of the SET Plan Implementation Plan of the Photovoltaic sector in Italy, as well as support for silicon-related R&I activities in France.

Activities in Work Package 2 led to structured interactions between R&I stakeholders in Italy (National PV Network of R&I), mapping the research projects and research facilities devoted to PV R&I throughout the country (Distributed Lab) and preparation of "A Strategic Plan for Research and Innovation to Relaunch the Italian Photovoltaic Sector and Contribute to the Targets of the National Energy and Climate Plan" (also called the White paper) to help Italian stakeholders realise the PV Implan efficiently.
The White Paper, originally released by the Italian PV-R&I Network in July 2020 was updated to include the follow up initiatives organised thanks to the support of PV IMPACT. The impact on the actual execution of the SET Plan Implementation Plan for Italy was compelling both from the point of view of the growth of public-private partnerships and the finalisation of R&I project proposals dictated by the priorities contained in the first release of the White Paper. PV Impact facilitated the emergence of new PV funding, i.e. The Ministry for the Ecological Transition (MITE) has promoted a strategic R&I programme on Photovoltaics as part of the new three-year plan of “Ricerca di Sistema Elettrico” (2022-2024) with a budget of €20M. In addition, about half of the subjects, actively involved in the three-year execution plan, from the definition of the strategies (i.e. White Paper) to the preparation of the national R&I projects are on the list of partners of the projects already being funded or submitted. The successful work initiated by PV IMPACT will be inherited by a national association which is due to be formed by September 2022.

In the same way, activities in Work Package 3 successfully supported the PV Implementation Plan for silicon-related R&I activities in France. Photowatt further developed its medium-term R&D plan in relation to several potential targeted objectives of the PV Implan. This led to, among other things, to a collaboration among Photowatt, Fraunhofer ISE and EDF R&D, on the manufacturing of high efficiency solar cells (TopCon) on Ultra-Low Carbon cast-mono material. Photowatt also opened, on a commercial basis, it´s industrial infrastructure and expertise to seven 3rd parties to foster collaborative R&D in order to turn PV objectives into a concrete reality.

All in all, based on the results and real-world impact of the activities performed in Work Packages 1, 2, and 3 presented above and in relevant PV Impact deliverables, it can be concluded that PV Impact's innovative tools utilised in these work packages were effective and their utilisation was an overall success, despite the challenges of the period (i.e. COVID-19).

6. Contacts

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