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12-16 April 2021 - Training School on “Simulation tools and models for the analysis of PV system performance”, Transilvania University of Braşov, Romania

Welcome

Dear PEARL PV members,

We hope that you are all fine and healthy in this unusual year which is dominated by Covid-19. In our January Newsletter, we had high expectations for 2020. Ignorance about the dramatic changes which would occur to our daily lives and society was reflected by our welcoming introduction, stating that “In 2020 we look forward to continuing our networking and PV research activities”.... Unexpectedly the reality turned out to be totally different.

Only one week after our last major network event in Utrecht in February, large parts of Europe were subjected to lockdowns, leading to minimized international travel opportunities, which halted most collaborative research projects whether they were national or international. Fortunately, none of the attendees of our meetings in Utrecht got infected with Covid-19 through our event. We are very grateful for this. Now in September, due to the uncertainties regarding international travel and further developments of Covid-19 infections, we have made the logical decision to prioritize

your health and safety by postponing all onsite network events to 2021.

We have rescheduled the Seminar and Training School on “Simulation tools and models for the analysis of PV system performance” from October to 12-16 April 2021. It will be held at the Transilvania University of Braşov, Romania, and trainee registration will remain open until the end of 2020, see PEARL PV’s [website](#) for more details.

In general, we would like to advise you to please keep an eye on the announcements on the PEARL PV website regarding onsite meetings in 2021, because we cannot foretell yet how the situation will develop in the forthcoming months.

However, we would like to stimulate our participants to continue collaborations by online meetings such as monthly webinars and workshops which will be programmed around selected topics. The first online workshop is scheduled on 3 November 2020 (9-12:30h CET) and will be focused on the topic of PV data sharing by means of PEARL PV’s data server. Please save this date! The event program as well as online access to this workshop will be further communicated in October.

Subsequently we will organize every first Tuesday of the month a webinar or online workshop about a topic which is related to research in this Action or which is of interest to various stakeholders. These webinars will be communicated by PEARL PV's website and mailings.

Despite the lockdown, PEARL PV has made progress! This is amazing and very positive news. This newsletter highlights the progress made by each Working Group. In addition to this, Wilfried van Sark will report about the last pre-Covid-19 onsite PEARL PV network meetings which he hosted at Utrecht University. Those were the good old times, with personal interactions and less than 1.5m distanced conversations! We are sure that you will enjoy reading about the MC4 meeting with a subsequent, interesting workshop program and a nice excursion, when we were all together in a tour bus!

A major ambition of PEARL PV is to deliver a Country Report in 2020. Until now, 30 countries in our network have committed to supply data and information about their countries PV system installations, PV research activities and national policies with regard renewables and PV. Istvan Farkas will update you on the progress of this enormous task in an interesting article in this newsletter.

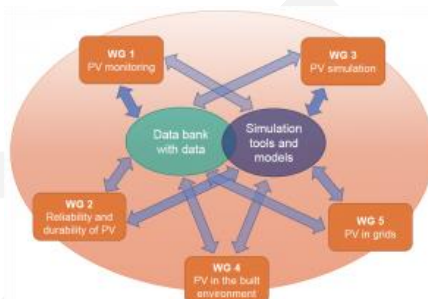
Maybe you have noticed that Nicola Pearsall has been elected to be this year's EU PVSEC Conference Chair. We would like to congratulate her with this milestone in her scientific career. Moreover, we are particularly proud of her important role in the European PV conference as a PEARL PV representative. Our Training School team was strengthened by a new Training School Manager, Cedric Caruana from University of Malta. We are very happy with his voluntary involvement in PEARL PV, and if you would like to get to know him better, then you should read his article in this Newsletter.

This newsletter is the fifth since the start of PEARL PV. We would like to thank and congratulate Sarah McCormack with this wonderful jubilee. Sarah has been doing a great job with editing and promoting this newsletter for our research network. Big thanks!!!

To end with, we would like to sincerely thank you, that despite Covid-19 we still have the opportunity to connect with all of you, volunteering PV experts, if not onsite then online by Teams, Zoom, Skype or by telephone. Moreover, we would like to warmly thank you for your energy, enthusiasm and efforts for solar energy and PV system research! Naturally, in 2021, we will meet again in reality, and hopefully also often online in 2020!

Sunny regards,
Chair Prof Angèle Reinders (*University of Twente*) & Vice Chair Dr David Moser (*EURAC*)

Introduction



The aim of PEARL is to improve energy performance and reliability of PV systems in Europe leading to lower costs of electricity produced by PV systems by a higher energy yield, a longer life time eventually beyond the guaranteed 20 years as specified by manufacturers, and a reduction in the perceived risk in investments in PV projects. This Action entails the formation of an inclusive network of PV system researchers, data resources that will be analysed by researchers, forming a very large agglomeration of PV systems performance data for Europe, and experts that can include more-nuanced evidence-based reliability in PV system, evaluation methods and simulation and design tools.

Five Working Groups (WG) have been set up which will conduct research using a shared data bank and shared simulation tools and models. An update on each WG follows.

WG1: PV Monitoring

After the realisation of the fully functional data bank based on CKAN, the focus of the work in the past months was to collect data. At the Utrecht workshop in February 2020 (see also report in this newsletter), several sessions were organized in order to streamline data upload based on research questions. To date, 20 data sets are available in the databank. We are eager to receive much more and so would like to ask all participants to consider uploading system performance data.

As Carolin Ulbrich (HZB) is now on maternity leave, we are happy that Nikolina Shutnoska (Solarpro Holding, North Macedonia) has taken over her responsibilities as data manager. In that role, she has approached all participants to collect data.

As a result of one of the workshops in Utrecht, a group of researchers has been working to collect and upload data on solar spectra, with the purpose to cover spectral changes (in terms of average photon energy) across Europe. If you want to join, please contact Anne Gerd Imenez (University of Agder, Norway).

Chair Dr Wilfried van Sark (*Utrecht University*) & Vice Chair Dr Christian Braun (*FhG-ISE*)

WG2: PV Reliability & Durability

WG2 aims to develop reliability and durability metrics for PV modules, components and systems, identify relevant data for reliability measurement of PV, develop the comprehensive methods for autonomous monitoring using the potential of big data bank and apply machine learning techniques in order to detect the failures, predict the performance and service life.

As part of deliverables (D5) of WG 2, the first review article entitled “Reliability and degradation assessment of photovoltaic materials and modules: conventional and emerging technologies” is being prepared by 17 contributors from 11 COST countries. In this review article, we will review the degradation mechanisms observed in mature PV technologies. One of the purposes of this review is to help inform future reliability growth programs in emerging technologies.

WG 2 also plans to initiate a comparison reliability study and degradation analysis of PV modules and systems located in the COST countries in cooperation with its members from different countries using performance and meteorological datasets provided by the contributors in which can be uploaded into Pearl PV CKAN data server.

The primary goal of WG2 is to share the knowledge via workshops, seminars and joint publications originating from WG2 with a wider community of PV experts and other stakeholders. In line with this purpose, recently, some papers have been presented in 47th IEEE PVSC and 37th EU PVSEC conferences and also some articles have been published in peer-reviewed journals (i.e. Applied Sciences, Nono Energy, Renewable Energy) which were prepared with collaboration between the WG2's members.

Chair: Dr. Mohammadreza Aghaei, Eindhoven University of Technology, The Netherlands & Vice-chair: Dr. Jeffrey Kettle, Bangor University, UK

WG3: PV Simulation

The modelling of PV system performance is an important tool in optimising system designs and identifying operational issues. WG3

members are continuing to investigate approaches to modelling challenges for new system designs, particularly those involving non-uniform irradiance (e.g. curved surfaces, mobile systems or bifacial systems). As an example, a comparison of eight software models for the simulation of bifacial systems, using field data from the system at the Technical University of Denmark, was reported at the recent European Photovoltaic Solar Energy Conference (Riedel-Lyngskaer et al). Over the last few months, WG3 also prepared the programme for the third PEARL PV Training School, which was due to be held in Brasov in October 2020, and covers a wide range of topics in modelling, including technical, economic and environmental aspects. Unfortunately, due to the ongoing travel restrictions in Europe, we have had to postpone the training school to April 2021, but WG3 members are looking forward to a stimulating event next year.

Chair: Prof Nicola Pearsall (*Northumbria University*) & Vice Chair Prof João Serra (*Universidade de Lisboa*)

WG4: PV in the Built Environment

Over the last couple of months, the members of the WG4 have been busy working on an article for the Special issue of the Applied Science journal, titled “Performance Analysis of Photovoltaic Systems”, and edited by Prof. Dr Angele Reinders, Dr David Moser and Prof. Dr Wilfried van Sark. The article “Photovoltaics on Landmark Buildings with Distinctive Geometries” went through several revisions and has been accepted by the editors and reviewers for publication. The article illustrates that world-class architecture can be coupled with building integrated (BIPV) or building applied (BAPV) photovoltaic (PV) technologies and can significantly improve both the architectural quality and the energy efficiency. Further these building promote PV's diffusion in the built environment and as virtuous examples for a broader impact to society

and investors. The authors of the article come from four European countries.

Chair Dr Mirjana Devetaković (University of Belgrade) and Vice-Chair Dr Bogdan Burduhos (Transilvania University of Brasov).

WG5: PV in Grids

The Covid-19 crisis has slowed down the progress at WG5. Nevertheless, our work since the previous newsletter has produced two new journal articles that we are glad to share with you:

Leonardo Micheli et al., [Selection of optimal wavelengths for optical soiling modelling and detection in photovoltaic modules](#), Solar Energy Materials and Solar Cells, 2020.

Jonathan Leloux et al., [Performance to Peers \(P2P\): A benchmark approach to fault detections applied to photovoltaic system fleets](#), Solar Energy, 2020

Our WG5 Vice-Leader Sonia Pinto and other members of WG5 are promoting a Special Issue in the journal Energies "Impact of Interconnected PV Systems on Power Quality of Distribution Networks". Because of the Covid-19 crisis, the deadline for the submission of articles has been extended to the 30 April 2021. We welcome your contributions click [here](#) for more information.

Chair: Jonathan Leloux (*Polytechnic University of Madrid*) & Vice Chair Sonia Pinto (*University of Lisbon*)

Meeting Updates

PearlPV workshops in Utrecht, the Netherlands, February 2020

Combined with the MC4 meeting, a series of workshops and a technical excursion was organized in Utrecht from 25-27 February 2020, in the University Library at the Utrecht Science Park. See [here](#) for the full program of this event: The event was well attended by ~ 50 participants.



In preparing the workshops, WG leaders realized that it might be fruitful to promote interaction between the Working Groups by organizing cross-fertilization workshops on topics that would be connecting the work in various Working Groups. We thus designed a program with workshops per Working Group as well as topical workshops, in total ten parallel sessions were held.

The workshops kicked off with a plenary session where Karim Asali (First Solar) gave a keynote lecture on CdTe technology and field experience. This was followed by five parallel workshops of the Working Groups. WG1 focused on testing the databank user manual and a hands-on session on data uploads (see photo). Other WGs focused on sharing research progress and potential joint publications.



The next morning, five parallel topical sessions were organized twice on: S1 Big data analytics I, S2 PV systems integration, S3 Simulation of complex shading for BIPV, S4 Modeling and monitoring of bifacial system gain, S5 Assessment of spectral irradiance differences, S6 Big data analytics II,

S7 Assessment of performance of PV systems across Europe, S8 Simulation of performance of curved surfaces, S9 Increasing industry collaboration with the Action, S10 Sustainability of PV in the built environment. All presenters have been asked to consider submitting a paper based on their presentation to the Applied Energies special issue “Performance Analysis of Photovoltaic Systems”.

After lunch, the Working Groups reconvened and discussed the topics and ideas generated in the cross-fertilization workshops. From this at least one group evolved to collaborate on collection and analysis of spectral data, which are quite rare still.

During the closing plenary session in which WG leaders reported on the progress made during the workshops, Bonna Newman (TNO) gave a closing address on Safety, Compliance, and Reliability of Integrated PV. The day was closed with a dinner at the Senate Hall of Utrecht University’s historical Academic Building.

The last part of the workshops was the technical tour during which participants visited a 2.2 MW solar park close to Utrecht. The 500 kWp distributed PV systems in the district of Nieuwland, Amersfoort was the first city scale PV pilot in the Netherlands built 20 years ago, followed by a visit to a sustainable floating neighborhood “Schoon Schip” in Amsterdam, a development of 47 houseboats, 100 residents, which aims to realize 100% renewable heat and hot water supply and 100% renewable electricity.



Schoon Schip neighborhood

All in all, organizing this event was a rewarding job, with participants enjoying the WG and topical sessions, as well as the

Dutch scenery (even in the rain), as well as the PV systems. Thank you all for your active participation.

Wilfried van Sark (host).

EU PVSEC 2020 – a personal reflection by Nicola Pearsall (Conference Chair & WG3 Leader)



The 2020 edition of the European Photovoltaic Solar Energy Conference was held from 7-11 September. Since it was not possible for delegates to meet in person due to the ongoing coronavirus pandemic, the conference was held fully on-line for the first time. I had the honour to act as the General Chair of the conference.

Although I was not directly involved in the design or organisation of the on-line delivery, I did get to see some of the considerable efforts that went into holding an on-line conference of this size. Around 1,500 delegates from 65 countries participated over the week, listening to over 850 live presentations across a range of topics in photovoltaics, split roughly equally between the cell technologies and the areas of modules, systems and applications, and several parallel events. It was interesting to see the emphasis on how PV technology could contribute to a green recovery in many of the discussion sessions.

Personally, I think the choice to aim for as many live presentations as possible brought a closer link with the audience than using recorded presentations, even though it also brought some technical challenges. For the EU PVSEC, every presenter had a technical check in the two weeks preceding the conference to ensure compatibility of equipment and every session had a dedicated technician to sort out any issues. Certainly,

in the sessions that I attended, there were very few technical issues, apart from a tendency to forget to unmute microphones!

Of course, we missed the social interaction both at breaks and around the conference. Chat rooms were provided and used, but the distractions of normal life certainly affected attention at times. We should have been in Lisbon this year and so I am delighted that it has been decided that the 2021 conference will be held there from 6-10 September and looking forward to meeting everyone again next time.

Prof Nicola Pearsall

Country Reports

During the Lisbon project meeting a task group was set up to collate national PV performance information into a PEARL PV Country Report (CR).

First, a questionnaire was compiled and sent to all member countries to provide their relevant data including:

- general country information (area, population, GDP),
- climate data, (average irradiation, temperature, wind speed),
- energy consumption and production quantities,
- PV installed capacity and PV electricity generation,
- national PV policies and programs
- zooming into PV research,
- future plan for PV performance,
- some photos on the relevant applications,
- list of references.

During the collection of the country data, continuous checking and discussion took place between the countries and the CR task group committee members in order to improve and harmonise the reports. So far, we have collected the reports from all the 34 project countries, as well as short executive summaries from the five WGs. The post-processing period has already been started including:

- sending the textual part of the completed country reports to the graphic designer,
- making the common tables and figures,
- writing the introduction chapter to the final report,

The final Country Report will be published both in print and online. Following that, intensive PR and other communications are planned on our website, LinkedIn and Twitter.

Thanks to all the countries for their valuable contributions and working together on the Country Reports!

Task co-ordinator: Prof Istvan Farkas
(*Szent Istvan University, Hungary*)

STSM Updates

STSMs are Short Term Scientific Missions which are institutional visits aimed at supporting individual mobility, fostering collaboration between individuals. They are primarily intended for PhD students and early career investigators (ECI) to visit other research groups, to acquire new expertise, contribute their expertise to projects and exchange ideas between participating institutions. STSM topics are linked with ongoing work in the PEARL PV Working Groups. We strongly encourage researchers and institutions from Inclusiveness Target Countries (ITC) to participate in STSMs.

For detailed information on STSMs, please visit the [website](#).

ITC Conference Grants

ITC Conference grants allow us to support conference visits of PhD students and Early Career Investigators (ECIs) from ITC countries. ECIs include post-doc researchers up to 8 years after receiving their PhD. For the third grant period of our Action we can offer 3 ITC grants. Each grant is limited to a maximum of 1,500 EUR. We are looking forward to your applications! For details, requirements and applications, please visit the [website](#) or contact interim STSM Manager [Dr David Moser \(Eurac\)](#)

Publications

Tremendous advances were made in research outputs and publications by Pearl PV network members since 2019. The authors of more than 30 publications working together on this interesting research initiative come from many different countries participating in the COST Action such as Australia, Austria, Cyprus, Denmark, France, Germany, Greece, Hungary, Italy, Ireland, Indonesia, Netherlands, Norway, Romania, Serbia, Spain, Switzerland, and the UK, showcasing the strong connections across Europe and beyond fostered by Pearl PV activities. Authors' work focused on different aspects of the PV system design, performance and reliability, as well as data analysis, modelling and cost analysis and was presented in highly esteemed journals and high impact conferences including the IEEE PVSC and EU PVSEC, which was held virtually this year due to the restrictions imposed by the pandemic. In fact, EU PVSEC's 2020 General Chair was Prof. Nicola Pearsall, Pearl PV WG3 Leader, who stressed the importance of exchange and cooperation towards creating a sustainable energy supply.

Well-deserved congratulations to all authors/co-authors, speakers and presenters, for their successes and thank you for sharing knowledge and all the hard work especially during the challenging period of the Covid-19. Keep it up!

Applied Sciences Special Issue on "Performance Analysis of PV Systems"

Dear Colleagues, this Special Issue of the journal Applied Sciences is still accepting manuscripts until the closure deadline of 1 November 2020! This Special Issue has been established with the purpose to publish results of PV system research which were presented at the PEARL PV Workshops in February 2020, however other manuscripts

which comply with the scope of this Special Issue are also welcome of course.

Scope of this Special Issue: Authors are invited to submit manuscripts covering research about the analysis of the performance and reliability of PV systems. Manuscripts can be focused on monitoring methods, methods, and results applied to PV operational data analysis, climate-dependent PV performance, PV data banks, assessments of metadata of installed PV systems, comparison of simulations of PV performance with operational data, machine learning and artificial intelligence methods for operational performance and reliability assessments, and other topics that come up in this context.

The aim of this Special Issue is to encourage scientists to publish their experimental and theoretical results, in as much detail as possible so that they can be reproduced. If possible, a validation of simulated results should be included in a manuscript. Manuscripts containing interdisciplinary research results are particularly welcome in this Special Issue; for instance, about PV system performance in the context of bankability, operational issues, design features, and user and grid interactions. There is no restriction on the length of the papers.

Guest Editors Prof. Dr. Wilfried van Sark Dr. David Moser Prof. Dr. Angele Reinders. [Link to the journal](#)

that you circulate the author list and an abstract of the manuscript to the relevant WG leader(s), chair and vice chair:

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

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

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

Also please include the following standard acknowledgment in any publication (poster, paper, book)
"This article/publication is based upon work from COST Action CA16235 PEARL PV supported by COST (European Cooperation in Science and Technology)"

This text is compulsory for any PEARL PV publication!

Further texts are shown on page 55 of the Action's Workplan which you can access by the [website of PEARL PV](#):

Please also include the addresses of the COST website as well as the PEARL PV website, the COST logo and EU logo in any publication. If space is limited, then only the COST logo should be shown.

LinkedIn group

<https://www.linkedin.com/groups/8655031>



Contact Us

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Publication Policy

With several deadlines for international PV conferences and many journal manuscripts of the 5 Working Groups in the pipeline, it is useful to be informed about the publication policy of PEARL PV. Authors of papers are allowed to acknowledge PEARL PV only if at least 2 PEARL PV countries are represented. Please make sure

Join Us

For all the latest news check out PEARL PV's website at <https://www.pearlpv-cost.eu>

You can register for participation by this registration form <https://www.pearlpv-cost.eu/about/registration>. Please feel welcome to share this registration form with interested colleagues. PEARL PV is also visible in social media, namely you can follow PEARL PV by Twitter account <https://twitter.com/CostPearl> and by our

Vacancies

Vacancy STSM Coordinator and ITC Conference Grant Manager: At present we search for a volunteer for the joint positions of STSM Coordinator and ITC Conference Grant Manager, with the following qualifications. The candidate should be an MC Member of MC Substitute of this Action with experience in the evaluation of proposals and financial management. If interested then please contact David Moser for

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questions and feedback, at david.moser@eurac.edu. Please notice that because this vacancy is a Core Group position, the selected candidate will be approved by an online MC voting procedure.

We have a vacancy at WG2 for a volunteer who would lead Task 2 on **Identification of relevant data to be collected to measure reliability and durability.**

Task 2 aims to identify the required data and appropriate simulation models to be used in the framework of understanding reliability and durability given the challenges of (i) the often long elapsed duration before occurrence of both defects and degradation of PV modules in the field (ii) the climate dependency of these effects and (iii) relationships between the manufactured quality of PV module and observed reliability and durability in practice.

If you are interested please contact Reza Aghaei (m.aghaei@tue.nl)

Also in Working Group 1 a volunteer is sought to supervise various subtasks. Please contact the Working Group leader Prof. Wilfried van Sark (W.G.J.H.M.vanSark@uu.nl).

CA16235 - Performance and Reliability of Photovoltaic Systems: Evaluations of Large-Scale Monitoring Data – also called PEARL PV, supported by COST (European Cooperation in Science and Technology): www.cost.eu

PEARL PV Partners



Contribute

Thanks for reading, and if you would like to contribute to the next Newsletter please contact Sarah McCormack at mccorms1@tcd.ie.

Acknowledgement

This Newsletter is based upon work from COST Action

COST Description

COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. COST Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation.