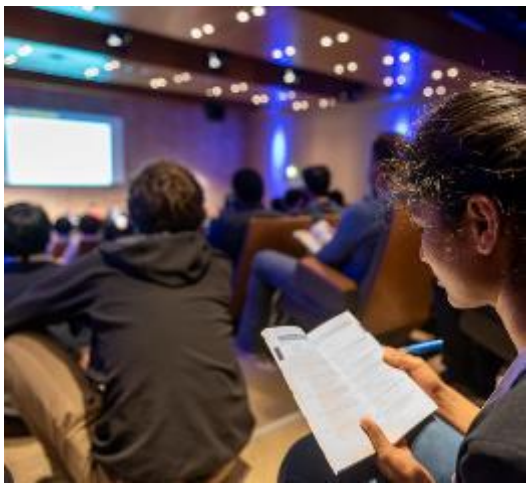
# CALL FOR PAPERS

## 8th WORLD CONFERENCE ON PHOTOVOLTAIC ENERGY CONVERSION

**26 – 30 SEPTEMBER 2022**
**MILANO CONVENTION CENTRE · MILAN · ITALY**

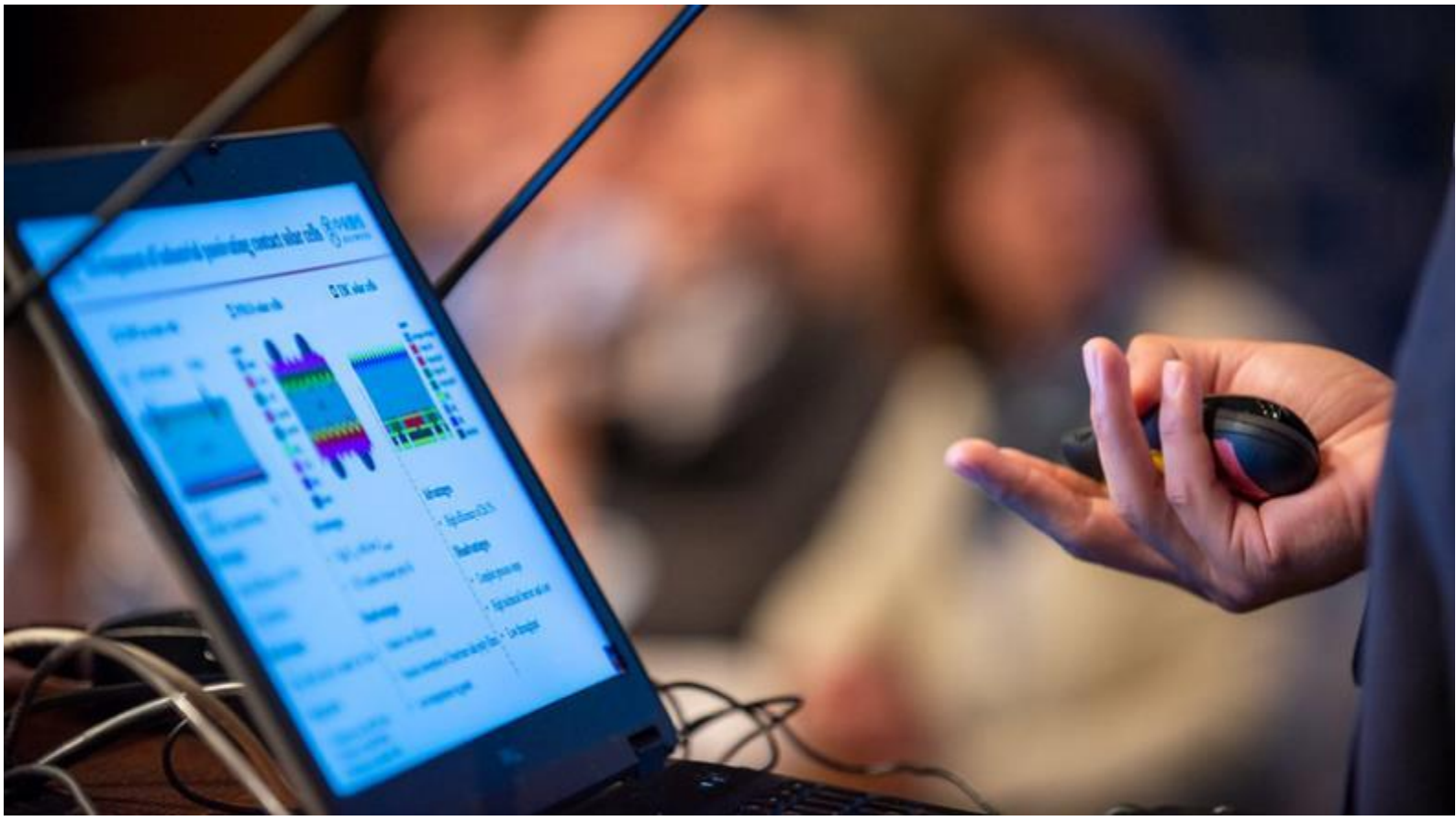
**EU PVSEC | PVSEC | IEEE PVSC**
European Photovoltaic Solar Energy Conference and Exhibition |
International PV Science and Engineering Conference |
Photovoltaic Specialists Conference

WPCEC-8 is hosted by EU PVSEC



**Authors** wishing to **contribute to the Conference Programme** of the WCPEC-8, 26 - 30 September 2022, Milan, Italy, should **submit an abstract** at the latest by **4 February 2022**.

Authors are invited to carefully read the topic descriptions and select the topic and subtopic which most closely matches the key novelty of their work. Please note that some topic areas have been renumbered and restructured. The subtopic descriptions are brief and non-exhaustive, while at the same time self-explanatory so that locating the correct area is straightforward.



## MESSAGE FROM THE TECHNICAL PROGRAMME CHAIR

# PHOTOVOLTAICS AT THE HEART OF THE ECOLOGICAL TRANSITION

I am honoured to be the Technical Programme Chair for the 8th World Conference on Photovoltaic Energy Conversion, hosted in Europe in 2022. It is especially gratifying that we will be able to meet together physically for the first time since 2019.

The technical programme for this truly global event is jointly prepared by the three principal regional photovoltaic conferences - the European Photovoltaic Solar Energy Conference (EU PVSEC), the Photovoltaic Specialists Conference (IEEE PVSC), and the International PV Science and Engineering Conference (PVSEC). I would like to acknowledge the contribution of the co-Chairs Arno Smets and Shuzi Hayase to setting out the technical programme in 5 topical themes. The themes cover topics ranging from silicon cells, evolving and emerging technologies and Tandems, modules, PV systems engineering and applications. The energy transition topic covers the wide range of multidisciplinary efforts required to ensure the rapid deployment of PV technologies on a massive and global scale as a key element of the ecological transition.

This year we aim to further increase the number of conference papers that may be put forward for publication in peer-reviewed journals. On top of our longstanding collaboration with Progress in Photovoltaics, we continue with the agreements in place to publish a selection of our best submissions in Solar Rapid Research Letters and EPJ Photovoltaics. Through these different offerings we increase the number of high quality peer reviewed papers being generated by the conference to more than 100 with a range of publication options, including Open Access.

As we launch our call for papers, we encourage researchers working in the broad range of fields covered by our technical programme from all around the globe to be part of this World Conference and take advantage of this truly global setting in the first physical event of this size in Europe in two long years. The "unstoppable growth" of the solar sector puts the industry on the path towards terawatt size in 2022 which we will celebrate and debate ways to go even further and faster. I look forward to following your presentations, and to exchange and connect with you over a freshly brewed espresso, experiencing la dolce vita Italian style.

See you in person once again, in Milan in 2022.

Dr. Robert Kenny
European Commission Joint Research Centre
WCPEC-8 Technical Programme Chair

# CONFERENCE TOPICS & SUBTOPICS

This topic description for the WCPEC-8, five topics this year, implements some changes which reflect the widening scope of the conference. In order to help and assist you in deciding to submit a contribution for this conference, we provide you with some explanations and clarifications, in particular in the new or re-arranged topics.

We appreciate that some level of overlap between different subtopics is unavoidable - if you have doubts about the appropriate subtopic to choose, please consider the one most appropriate to the main novelty of your work.

# TOPIC 1

## New Materials and Concepts for Photovoltaic Devices

*Topic 1 collects all presentations which deal with crystalline silicon up to cell level.*

*Amorphous and microcrystalline silicon is also covered in subtopic 1.4. The whole spectrum of Si technology is divided into 6 subtopics, which address typical issues and fields of technology development, many of them dealt with on a corporate R&D level.*

*An exception is tandem structures combining other materials with silicon which are grouped together in subtopic 2.1.*

*Contributions which focus on Si module encapsulation and reliability, or electrical performance measurement technologies are better placed in subtopic 3.1.*

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| **1.1 Feedstock, Crystallisation, Wafering, Defect Engineering**<br>Novel and advanced production technologies for silicon, ingots and wafers, solar-grade silicon properties and specifications, testing, performance, costs. Influence of crystallisation parameters, impact of residual defects and impurities, and their mitigation. | *This subtopic focuses on all the steps required for the production of high-quality silicon up to wafer stage ready for subsequent cell fabrication.* |
| **1.2 High Temperature Route for Si Cells**<br>Solar cell architectures based on high temperature poly-Si based and classical high temperature approaches (PERX, IBC, etc.). Subtopics 1.2 and 1.3 are where research work on crystalline Si cells is presented, divided into two main themes, which employ either high temperature or low temperature processing routes. | *This subtopic replaces a previous closely related one, which was titled 'Homojunction Solar Cells'. It includes technology development for these approaches.* |
| **1.3 Low Temperature Route for Si Cells**<br>Solar cell architectures based on classical a-Si passivation schemes (e.g., HIT), as well as approaches relying on other low temperature passivation-based systems. Subtopics 1.2 and 1.3 are where research work on crystalline Si cells is presented, divided into two main themes, which employ either high temperature or low temperature processing routes. | *This subtopic replaces a previous closely related one, which was titled 'Heterojunction Solar Cells'. It includes technology development for these approaches.* |
| **1.4 Thin Film and Foil-Based Si Cells**<br>Amorphous and microcrystalline silicon, thin crystalline silicon, silicon foils (<20µm): theoretical studies, innovation in processing and manufacturing technologies, manufacturing up-scaling. | *Although Topic 2 focuses mainly on crystalline silicon, this subtopic is the home for all work related to amorphous and microcrystalline silicon, thin crystalline silicon and silicon foils.* |
| **1.5 Characterisation & Simulation of Si Cells**<br>Measurement and modelling of innovative Si cell concepts. | *Characterisation and modelling of cells are of crucial importance in the development of innovative concepts and architectures. All such work should be submitted to this subtopic.* |
| **1.6 Manufacturing & Production of Si Cells**<br>Novel or improved manufacturing solutions and strategies, automated production processes and systems; quality and reliability in production. Various contacts for Si solar cells - pastes, screen printing, plating, etc. | *Improvements in manufacturing solutions for mass production are crucial in order to continue the drive towards lower costs, while maintaining high quality standards. New developments in manufacturing technologies should be submitted to this subtopic.* |

# TOPIC 2

## Evolving and Emerging Technologies: Tandems; Thin Film absorbers; III-V; New Materials and Concepts; Advanced Modelling

*This Topic is subdivided amongst the different photovoltaic materials in use today or in the conceptual or demonstration phase that are not based on silicon. An exception is tandem structures combining other materials with silicon which are grouped together in subtopic 2.1. The Topic comprises theoretical studies, innovations in processing and manufacturing technologies and upscaling, measurement and characterisation. If the paper describes the encapsulation on a module level, it probably is better to be presented under subtopic 3.1. For materials which don't fall under any of those listed in subtopics 2.1 to 2.4 you should consider subtopics 2.5 and 2.6, which present the ongoing high-end research with contributions to the understanding of photovoltaic conversion, including new or exotic materials and cross-fertilisation with other fields of optoelectronics.*

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| **2.1 Tandems**<br>Hybrid and other tandems with Si or other materials combined with perovskites, or other tandem absorbers. | *This subtopic brings together the increasing research into tandem structures combining a wide variety of materials. In the first instance this typically envisages structures on silicon, but all other combinations (such as all-thin-film tandems) are welcome. The subtopic comprises theoretical studies, innovations in processing and manufacturing technologies and upscaling, measurement and characterisation.* |
| **2.2 Perovskites**<br>Lead halide perovskites and their lead-free analogues, perovskite-based devices, manufacturing and up-scaling technologies and strategies, quality and reliability in production. | *Perovskites are of increasing research interest and have been given a separate subtopic. The subtopic comprises theoretical studies, innovations in processing and manufacturing technologies and upscaling, measurement and characterisation.* |
| **2.3 CI(G)S, CdTe and Related Thin Films; Organic and Dye-Sensitised Devices**<br>Devices, materials, surfaces/interfaces and contacts, processing and manufacturing technologies, measurement and characterisation, modelling. | *The broad family of chalcogenide and kesterite thin film technologies, e.g., CI(G)S and CdTe, are contained in this subtopic; Polymer, organic and dye-sensitised cells and devices are also included. Devices, materials, surfaces/interfaces and contacts, modelling, processing and manufacturing technologies, up-scaling technologies and strategies, quality control, lifetime and reliability measurement and characterisation are all covered.* |
| **2.4 III-V and Related Compound Semiconductors**<br>Novel cell architectures, materials, technologies and processing for III-V single and multi-junction cells. Electrical characterisation and modelling of cells. | *III-V and related compound semiconductors continue to demonstrate the highest efficiencies of all technologies. The subtopic comprises theoretical studies, innovations in processing and manufacturing technologies and upscaling, measurement and characterisation.* |
| **2.5 New Materials, Devices and Conversion Concepts**<br>New cell materials and concepts, e.g., use of nanotechnologies and quantum effects. New module materials and concepts. | *Here we invite papers which describe experimental research realising new materials and device concepts, with emphasis on a rather fundamental or prototype (i.e., low TRL) level.* |
| **2.6 Advanced Modeling and Characterization**<br>Theoretical studies of materials, cells and modules; new measurement techniques, modelling and simulation. | *This subtopic comprises all theoretical work on photovoltaic conversion as well as for instance measurement techniques to reveal e.g., atomic structures or electronic properties.* |

# TOPIC 3
## Photovoltaic Modules and BoS Components

*This Topic addresses all the components required to form a complete system. The PV module related aspects are divided into three subtopics, broadly dealing with manufacturing, reliability and performance respectively. The remaining balance of system components are grouped together in subtopic 3.4. Papers presented under this topic regard research, development, design, measurement, modelling, testing and operational experience. Disposal, recycling and resource issues regarding these components are dealt with in the Sustainability and Circularity subtopic of Topic 5.*

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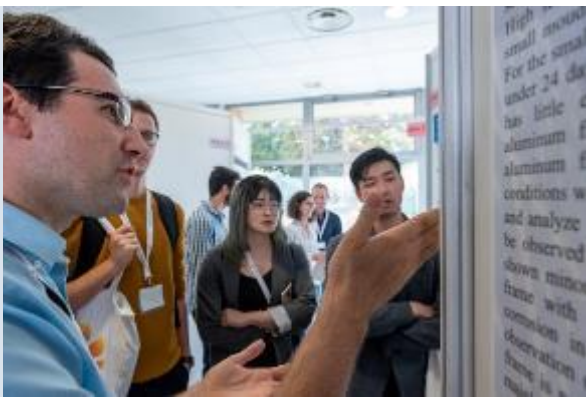
| **3.1 PV Module Design and Manufacturing**<br>PV module design, module manufacturing processes, techno-economic analysis. | *New module designs and hybrid technologies are also welcome here. For work relating to PV system performance, please refer to Topic 4.* |
| **3.2 Materials for PV Modules, Durability, Reliability and Accelerated Testing Methods**<br>Type approval testing, degradation, ageing and lifetime. | *This is the place for all work regarding making a PV device fit for prolonged outdoor exposure, including type approval testing, degradation, ageing and lifetime questions.* |
| **3.3 PV Module Performance – Modelling, Testing, Standards**<br>Measurement and characterisation methods, field performance, energy yield, energy rating. | *This subtopic looks at new and improved measurement and characterisation methods, correlation between laboratory testing and field performance, energy yield, energy rating. It includes modelling and methods for characterisation and calibration, independently of the particular device active material. Work supporting development and validation of standards is also reported here.* |
| **3.4 Balance of System Components**<br>Inverters, micro-inverters, power optimisers, monitoring systems, charge regulators, safety switches, mounting structures, trackers, cabling; measurements and testing of performance and reliability. | *This subtopic addresses the device-level of these components, and less their interaction within a PV system. The performance and reliability part includes operational performance, testing standards and measurement protocols. Electronic components, sensors and simulation tools that deal more generally with the grid interface, new services and functionalities, optimization, etc., are dealt with in subtopic 4.6. Regarding accumulators for stand-alone systems, please also see subtopic 5.6.* |



# TOPIC 4

## PV Systems Engineering, Integrated/Applied PV

*This Topic in general addresses single PV plants, where plant size may range from a few modules up to multi-MW. Consequently, this is the place for contributions on systems design, sizing, modelling, performance and operations.*
*This topic also deals with particular integration of PV, e.g., PV integrated into buildings, Infrastructure (I2PV) and nature-inclusive PV (eco-PV, floating PV, Agri-PV); vehicle integrated PV (VIPV), concentrating PV and PV for space applications. Advances in power electronics for advanced grid functionality are also covered. The subtopic on solar resources and forecasting is relevant to individual systems, but it covers scales ranging from the local to large geographical areas. The employment of batteries in stand-alone systems or for local use may form part of systems reported in this topic, but storage related to the wider grid is dealt with in subtopic 5.1.*

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| **4.1 Solar Resource and Forecasting**<br>Solar resource assessment, measurements and monitoring, meteorological forecasting, now-casting, analysis of ground station and satellite data. | *Abstracts which deal with all PV relevant solar radiation science and tools are placed here.* |
| **4.2 Engineering Design and Installation of PV Systems**<br>Planning, plant optimization tools, cost analyses, advanced installation criteria, construction and safety issues. | *This is the topic for the design, engineering and commercialisation of entire PV systems. Work which focuses on how a system Interacts with the grid is dealt with in subtopics 4.6 (grid interface) and 5.6 (grid integration).* |
| **4.3 Operation, Performance and Maintenance of PV Systems**<br>Monitoring, predictive and corrective maintenance, system failure analysis, system reliability, operational safety. | *Papers which describe the operational experience of systems in use are placed here. Of particular interest are maintenance related cost analyses as well as methods for predicting technical lifetimes. Work which focuses on how a system Interacts with the grid is dealt with in subtopics 4.6 (grid interface) and 5.6 (grid integration).* |
| **4.4 PV and Buildings**<br>Design, and architectural aspects of BIPV and BAPV; zero energy buildings; PV products for buildings; building, environment, safety and other regulatory aspects. | *This subtopic will collect all presentations describing how PV systems are placed on or are integrated into buildings, covering both functional and aesthetic aspects. All types of buildings are considered - residential, office, commercial, and industrial. Related ancillary equipment is also considered and how the whole system is integrated and performs, e.g., electric and thermal performance, heat pumps, integrated mounting structures, multi-functionality.* |
| **4.5 Infrastructure-integrated PV (I2PV) and Nature-inclusive PV (eco-PV); Vehicle Integrated PV (VIPV)**<br>Design, implementation and performance of PV in infrastructures, on water, in dual use agriculture (Agri-PV) and in nature; Vehicle integrated PV. | *This subtopic will collect all presentations describing how PV systems are placed on or are integrated into infrastructure, but also in nature and the environment which surrounds us. PV integrated into vehicles (VIPV) is also covered here.* |
| **4.6 Power Electronics and Electrical Grid Interface**<br>Power electronics for advanced grid functionality, measurement and control; simulation tools and testing methods; communication protocols, data driven methods; grid optimization at high PV penetration. | *This subtopic covers recent developments in power electronics, measurement, modelling and control focusing on the interface between a PV plant and the electrical grid. The subtopic addresses relevant developments, including from digitalisation, for a reliable, secure and optimized grid operation at high PV penetration. This also covers concepts such as advanced inverter functionality, voltage and frequency regulation, power quality and stability, islanded operation, or micro-grids. ICT integration including (cyber) security is also included.* |
| **4.7 Concentrators, TPV**<br>Design and measurement of concentrator solar cells, assemblies and CPV modules. Optical systems, mounting structures and trackers; Thermal Photovoltaic Conversion (TPV). | *Papers focusing on the device (cell) level may be more relevant to topic 1 or topic 2, in particular subtopic 2.4 for III-V based cells.* |
| **4.8 PV for Space Applications**<br>Photovoltaic cells and systems for space photovoltaics, and their in-flight performance. | *Papers focusing on the device (cell) level may be more relevant to topic 1 or topic 2, in particular subtopic 2.4 for III-V based cells.* |

# TOPIC 5

## Energy Transition – Integration, Storage, Sustainability, Policy, Economics, Energy Poverty, Society

*This Topic covers the wide range of multidisciplinary efforts required to ensure the rapid deployment of PV technologies on a massive and global scale as a key element of the energy and the broader ecological transition.*

*As such it covers a range of essential aspects:*

- *integration of PV generated electricity into the electrical grid and the wider energy system, including storage and sector coupling;*
- *analysing and ensuring that PV is implemented sustainably and ecologically in all dimensions;*
- *financing, market development and policy making;*
- *addressing and ensuring societal acceptance of the role of PV in a just energy transition.*

### 5.1 Energy System Integration; Storage

Energy management including modelling of integrated supply-demand systems, digital monitoring, control, forecast and dispatch involving various energy sources and users, including heat pumps, electromobility and others; Technology and engineering of storage systems and their integration; Direct applications of PV generated electricity, e.g., desalination, P2X.

*This subtopic comprises the systemic approach to integrate PV generated electricity, in ever increasing amounts, into the wider energy system, including balancing supply and demand. Experience from other renewable sources and grid operators are welcome. Hybrid systems with auxiliary generators, such as biomass CHP are included here. PV solutions to meet the needs of increased electromobility are highly relevant.*

*The wide spectrum of storage systems is also addressed: Technology and engineering of storage systems for PV electricity: accumulators, supercapacitors, Redox flow, CAES, flywheels, storage in heat/cold, pumped hydro, seasonal storage including sizing, operation and performance of such storage to improve the overall service of the PV System. We consider papers which describe the technical relation and interaction between PV generation and storage/conversion, aimed to optimise the "dispatchability" and functionality of PV driven electricity systems, covering the full range of size from the local, to regional and continental. The time scale covers the full range from grid stabilisation to seasonal storage.*

*Industrial applications in which PV generated electricity is converted directly into a useful product or service, including conversion of PV electricity into other energy carriers are also included here, e.g., PV-to-gas/fuels including hydrogen production (P2X); Water desalination, sterilization and upgrading; PV process heat and other novel applications in industrial processes.*

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| **5.2 Sustainability, Environment, and Circularity of PV**<br>Safety and environmental issues; life-cycle analysis (LCA) of modules and systems, CO2 footprint, water use, sustainability of materials, customised products and sustainable design, product regulation concepts, recycling and waste management, decommissioning, raw material availability, resource efficiency and material flows, PV in the circular economy, urban and spatial planning. | *As a renewable energy solution PV must also address concerns about its environmental impact. This topic specifically calls for papers from experts in environmental science and engineering, health and safety, and also socio-economists dealing with the circular economy and LCA.* |
| **5.3 Modelling and Scenarios for Renewables, Policy, Global Challenges**<br>Modelling and scenario analysis; interplay with other renewable energy systems; Policies for R&D, innovation and deployment; role of policy, trade barriers, regulatory frameworks for grid integration; education, training and job creation; Upscaling of PV and deployment at TW scale. | *This is the subtopic for policymakers, researchers, energy-law experts, media communicators, but also teachers and communicators. The more global aspects solicit papers from large, often collaborative efforts to analyse the role of PV in a larger context, often related to energy modelling or scenario analysis. Projecting PV towards 2030, 2050 and comparing the calculations are typical subjects in this subtopic, as well as the relation of PV to greater policy efforts in the worlds regions, or international agreements, including UN Sustainable Development Goals and IPPC.* |
| **5.4 Costs, Economics, Finance and Markets**<br>Cost models and cost reduction, soft and area related costs; competitiveness, economics of, and business models for PV and storage/conversion (P2X); PPAs, financing and investment; market development and segmentation; market design for PV as dispatchable power and electricity market participation and integration; utility scale development, prosumer aspects and digitalisation. | *In this subtopic we address market analysts, project developers and business experts from finance, and investment and utilities. It covers the more non-technical aspects of installing and dispatching PV electricity, new scenarios and the market conditions required to make them happen as well as analysis of present market development and trends.* |
| **5.5 Regional Experiences; Combatting Energy Poverty**<br>PV roll-out in developing and emerging economies, business models and finance, scenarios, roadmaps and experiences at local and regional scale of PV implementations; approaches to employ PV to alleviate poverty and energy poverty, barriers to PV deployment and solutions to overcome those | *This subtopic is intended to provide opportunities to share scenarios and experiences at local and regional scale of PV implementations, especially those from regions that often have less visibility. Sharing of lessons learned at local, municipal or regional level is a key aim. Discussions and examples of the role that PV can play in the alleviation of poverty in general, and energy poverty in particular, in different regions of the world are welcome.* |
| **5.6 Societal Challenges; Citizens' Participation, Awareness**<br>PV impacts on society, awareness and social acceptance of the energy transition, barriers perceived by society, roles of citizens and examples addressing these, role of behaviour, cooperatives enabling PV deployment, trade-offs between different societal goals. | *This subtopic addresses SSH scientists and looks at societal challenges around the ongoing energy and ecological transition, and how to ensure the implementation of climate change mitigation and adaptation policies in a rapid and fair manner. Citizen's participation is essential at the local and global scale and methods and studies to help achieve this are relevant here.* |

# ABSTRACT SUBMISSION

Authors wishing to contribute to the Conference Programme of the WCPEC-8, 26-30 September 2022, Milan, Italy, should submit an abstract at the latest by **4 February 2022**.

Authors are invited to carefully read the topic descriptions and select the topic and subtopic which most closely matches the key novelty of their work. The subtopic descriptions are brief and non-exhaustive, while at the same time self-explanatory so that locating the correct area is straightforward.

Abstracts must be written using the template MS Word document. You can download it in the User Area during the submission process.

Abstracts (in the format of 1 page for the Summary of the Abstract + up to 3 explanatory pages) shall be written in English and include short sections addressing:

- Summary of the Abstract
- Applicable topic and sub-topic number
- Aim and approach used
- Scientific innovation and relevance
- Results or preliminary results and conclusions

Authors also need to provide using the abstract submission platform:

- Applicable topic and sub-topic number (e.g. 1.2)
- Full paper title
- Preferred type of presentation (this preference may not be offered depending on the outcome of the review process)
- Full name, affiliation, address and e-mail of the author responsible for the submission for the correspondence
- For all other authors: full name, affiliation and e-mail (all other authors will be notified by e-mail after abstract submission)

The total length should not be more than four A4 pages.

Kindly also note that in case you apply for “Journal Publication” in order to ensure a sufficiently detailed evaluation, only abstracts with a minimum of 3-4 pages are eligible. Please ensure that this requirement is respected.

Detailed instructions on how to prepare and submit your abstract are given in the “Abstract Submission Guidelines”. Please read these instructions carefully.

**For questions concerning abstracts, please contact:**

EU PVSEC Programme Secretariat

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# IMPORTANT KEYDATES

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|---|---|
| **4 February 2022** | Deadline for submission of abstracts |
| **February – End-April 2022** | Abstracts review and evaluation by the Scientific Committee |
| **End-April 2022** | Notifications of authors |
| **Beginning of September** | Submission of manuscript for the Conference Proceedings |

**CLICK HERE TO SUBMIT YOUR ABSTRACT**

Visit the Author's Workstation for more detailed information.

## INSTITUTIONAL SUPPORT

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## COORDINATION OF THE TECHNICAL PROGRAMME

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