CALL FOR PAPERS

THE 53rd IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE

June 08-13, 2025
Montreal, Canada

Call for Papers

On behalf of the Technical Program Committee, I would like to invite you to submit an abstract on your latest achievements in photovoltaic (PV) research, development, applications, and impact to the 53rd IEEE Photovoltaic Specialists Conference (PVSC 53). PVSC 53 continues the conference's longstanding tradition of covering the full spectrum of PV knowledge and innovation, from the basic science and engineering of materials, devices, and systems, to the examination of policy and markets and critical issues of social impact. PVSC is a highly interactive and inclusive venue for everyone, from seasoned PV experts to entry-level professionals to students alike. The conference provides a unique opportunity to meet, share, and discuss PV-related developments in a timely and influential forum.

While full papers are encouraged, publication of a conference proceeding will be optional, with short abstracts otherwise acting as the publication of record. Authors will have the option of contributing their evaluation abstract or an edited (and longer, if desired) conference proceeding by the **May 30, 2025** publication deadline. Exceptional abstract submissions may be recommended and encouraged to submit a full manuscript for peer-review to IEEE Journal of Photovoltaics.

New this year: Poster presenters will have the option to include a maximum 3-minute video that will be available for asynchronous viewing by conference registrants.

To have your paper considered for presentation at PVSC 53, please submit:

1. An evaluation abstract (3 pages maximum for technical committee review), using the current version of the MS Word template provided on the conference website;
2. A short abstract of 300 words or less for display on the PVSC 53 website and default publication in the PVSC proceedings.

Abstract submission is available via the PVSC 53 website. Please make use of (or exactly follow the formatting of) the **current version** of the MS Word template when preparing your submission. Technical evaluation abstracts will be thoroughly reviewed to decide acceptance and determine oral versus poster presentation format. **The deadline for abstract submission is January 17, 2025,** at midnight Pacific Standard Time (UTC - 8 hours). Contributing authors will be notified of the acceptance status of their papers by March 21, 2025, after which they **must confirm** their ability and willingness to present their work at the conference. Invitation letters for visa applications are issued upon request after registration to the conference.

I look forward to welcoming you at the 53rd IEEE Photovoltaic Specialists Conference in Montreal, Canada!

Stephanie Tomasulo
Technical Program Chair
2025 53rd IEEE PVSC

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Tyler Grassman
Ohio State University
USA

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The Netherlands

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First Solar ETC
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Area 3 Chair
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USA

Area 8 Chair
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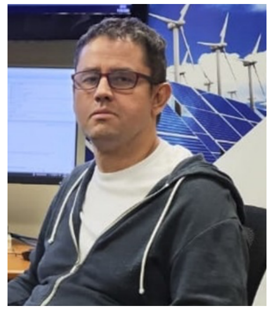

Area 9 Chair
Nelson Diaz
Universidad Distrital F.J.C
Colombia

Area 10 Chair
Adam R. Jensen
Technical University of Denmark
Denmark

Area 11 Chair
Jacob Cordell
National Renewable Energy Laboratory
USA

Area 1: Fundamentals and New Concepts for Future Technologies

Area Chair: Rebecca Saive, University of Twente, Netherlands
Co-Chair: Ian Sellers, University of Buffalo, USA

Sub-Area 1.1: Fundamental Conversion Mechanisms
Sub-Area 1.2: Novel Materials and Devices
Sub-Area 1.3: Advanced Light Management and Spectral Shaping

Area Description
Paradigm shifts in solar cell technology are invariably preceded by breakthroughs arising from basic scientific research. Area 1 comprises fundamental research and novel device concepts that will provide a platform for the development of future photovoltaic technologies. Papers are sought describing research in basic physical, chemical, and optical phenomena, studies of new materials and innovative device designs, as well as photon management methods. Subjects of particular interest include, but are not limited to, new materials for all parts of the photovoltaic device, advances in the understanding of basic PV architectures and phenomena, nanostructures, approaches for advanced optical management, new synthesis processes, and/or unconventional conversion mechanisms.

Sub-Area 1.1: Fundamental Conversion Mechanisms

Sub-Area Chair: Daniel Suchet, IPVF Ecole Polytechnique, France
This sub-area explores novel paradigms for solar energy conversion through both experimental and theoretical approaches. Research should focus on innovative physics, modeling, and early demonstrations of advanced conversion mechanisms. Topics of interest include:

- Multiple exciton generation and molecular singlet-fission
- Hot-carrier effects and protocols
- Intermediate band concepts and band alignment engineering
- Thermophotovoltaics, thermophotonics, and/or thermoradiative concepts
- Solar fuel generation and alternative energy storage mechanisms
- Fundamental thermodynamic studies related to solar energy

Sub-Area 1.2: Novel Materials and Devices

Sub-Area Chair: Joeson Wong, University of Chicago, USA
This sub-area focuses on the development of new absorber materials and device architectures. Abstracts submitted to this sub-area should focus on topics that are at such an early stage of development or involve such unconventional material systems that they fall outside the scope of other areas, emphasizing fundamental research and novel concepts not yet explored in mainstream photovoltaics. Topics covered include:

- 2-dimensional materials and devices, nanowires, and quantum dots
- Earth-abundant absorber materials and perovskite-inspired materials
- Carrier-selective contacts and transparent conducting materials
- Tandem and multijunction solar cells with unconventional materials
- Advanced growth, synthesis, and thin-film deposition techniques
- Cost-reduction strategies and material reusability

Sub-Area 1.3: Advanced Light Management and Spectral Shaping

Sub-Area Chair: Phoebe Pearce, University of New South Wales, Australia

This sub-area addresses novel concepts to maximize light harvesting and photon energy utilization in solar cells. Key topics in this sub-area include:

- Anti-reflection coatings and spectrum splitting
- Textured light-trapping surfaces and interfaces
- Luminescent systems for up/down conversion and quantum cutting
- Photonic and plasmonic structures
- Photon recycling and angular restriction techniques

Area 2: Chalcogenide Thin Film Solar Cells

Area Chair: *Deborah McGott, First Solar ETC, Sweden*
Co-Chairs: *Aaron Arehart, Ohio State University, USA*

Sub-Area 2.1: Absorber Preparation and Material Properties
Sub-Area 2.2: Contacts, Windows, Interfaces, and Substrates
Sub-Area 2.3: Cell and Module Characterization – Analysis, Theory, and Modeling
Sub-Area 2.4: Chalcogenides for Tomorrow and Beyond – Tandems, Recyclability, and Future Innovations

Area Description
Chalcogenide thin film solar cells have demonstrated remarkable progress over recent years both in record conversion efficiency (> 23%) and manufacturing volume (over ten gigawatts per year). Combining low-cost, fast production with reliable field operation, chalcogenide thin film solar cells have helped reduce the cost of PV-generated electricity. Area 2 brings the chalcogenide thin film community together to present and discuss progress, challenges, and future research directions for CdTe, CuZnSnS, and CIGS and other chalcogenide photovoltaic materials and devices. The aim is to improve fundamental understanding, address performance loss at the cell and module level, and accelerate production. Topics range from fundamental and applied material science, computational/analytical results and in-depth characterization, to device fabrication, manufacturing challenges, and future innovations.

Sub-Area 2.1: Absorber Preparation and Material Properties

Sub-Area Chair: Lorelle Mansfield, National Renewable Energy Laboratory, USA
Sub-area 2.1 captures progress in thin film fabrication, material properties, and their relationship with device performance. Topics include experiment, theory, and some characterization of:

- Morphology, phase coexistence, and microstructure
- Extended, point, and other bulk defects
- Transport properties
- Doping and bulk passivation
- Compositional gradients and homogeneity
- Influence of growth substrate, grain boundaries, and post-deposition treatments

Sub-Area 2.2: Contacts, Windows, Interfaces, and Substrates

Sub-Area Chair: Alexander Goldstone, Sivananthan Laboratories, USA
Sub-area 2.2 advances understanding of contacts, buffer and window layers, interfaces, and growth substrates/superstrates and their effect on device performance. Please note some overlap with subareas 1.2 and 4.2. Topics include experiment, theory, and some characterization of:

- Novel contact materials, carrier selective contacts
- Transparent conductors, moisture barriers, new or improved growth substrates
- Interface passivation strategies (chemical, field-effect)
- Light management techniques
- Cell scribing and interconnection in modules

Sub-Area 2.3: Cell and Module Characterization – Analysis, Theory, and Modeling

Sub-Area Chair: Abasi Abudulimu, University of Toledo, USA

Sub-Area 2.3 complements topics addressed in sub-area 2.1 and 2.2 through research discussion aimed at measurement, analysis, theory, and modelling of cells and modules. Please note some overlap with Area 5. Topics include:

- Novel and established characterization methods
- Device analysis that yields insight into internal operation
- 1D, 2D, and 3D modelling of current devices and studies which guide progress
- In-situ and in-line metrology, statistical data analysis, machine learning

Sub-Area 2.4: Chalcogenides for Tomorrow and Beyond – Tandems, Recyclability, and Future Innovations

Sub-Area Chair: Chris Ferekides, University of South Florida, USA

Sub-area 2.4 provides a launchpad for discussion on next generation chalcogenide-based photovoltaics. Please note some overlap with Area 1. This area solicits contributions for experimental and theoretical research that brings existing or projected technologies together for:

- Tandem and multijunction device applications
- New module and system architectures
- Modules and material recyclability and sustainability (e.g., longer panel lifetimes, use of earth abundant materials, reduced carbon emissions)
- Supply chain and feedstocks
- Novel applications (e.g., lightweight/flexible, space, building-integrated, low dimensional)

Area 3: III-V Photovoltaic Devices and Space Solar Power

Area Chair: Pilar Espinet-González, The Aerospace Corporation, USA

Co-Chair: Romain Cariou, CEA-Liten, France

Sub-Area 3.1: III-V Photovoltaic Cells
Sub-Area 3.2: III-V Cost Reduction Strategies & Terrestrial Applications
Sub-Area 3.3: Space Photovoltaic Modules, Systems, and Flight Experience
Sub-Area 3.4: Alternatives to III-V for Space Applications
Sub-Area 3.5: Photonic Power Converters

Area Description

Area 3 focuses on two main subjects: III-V photovoltaic devices and space power systems. III-V solar cells offer unparalleled photovoltaic conversion efficiency, an expansive palette of material properties, high absorption coefficients, resilience in extreme environments, as well as compatibility with a wide-range of growth and fabrication strategies. These attributes make III-Vs well-suited for a multitude of both terrestrial and space power applications. Area 3 addresses all aspects of III-V materials, photovoltaic device design, growth, fabrication, and systems for applications including concentrator photovoltaics (CPV), autonomous vehicle power, commercial solar electric vehicles, laser power beaming receivers, dismounted soldier power, consumer electronics, thermophotovoltaics, solar fuels generation, and biomedical energy harvesters. Area 3 also covers systems for space power including flight experience and emerging material system alternatives to III-Vs.

Sub-Area 3.1: III-V Photovoltaic Cells

Sub-Area Chair: Stephanie Essig, University of Stuttgart, Germany

Sub-Area 3.1 concentrates on all aspects of III-V photovoltaic development up to the device level. Topics of interest include, but are not limited to:

- Epitaxial growth
- Materials design, development and characterization
- Device-level modeling and characterization in single and multijunction devices including hybrid tandem/multijunctions with a focus on the III-V development
- Novel processing strategies (excluding low-cost strategies (see Area 3.2))
- Reliability and environmental effects testing from materials-to-device level

Sub-Area 3.2: III-V Cost Reduction Strategies & Terrestrial Applications

Sub-Area Chair: Aaron Ptak, National Renewable Energy Laboratory, USA

Topics of interest in this Sub-Area concern all aspects of cost reduction strategies for III-V photovoltaics at the materials, device, or module level. This Sub-Area also includes all terrestrial applications and systems that involve III-V photovoltaics. Topics of interest include:

- Substrate reuse
- Direct monolithic growth of III-Vs on low-cost templates
- High-throughput epitaxial growth and enhanced growth precursor utilization efficiency
- Low-cost device, array and module fabrication strategies
- Terrestrial conventional CPV and micro-CPV

- Transportation applications
- Underwater photovoltaics
- Unmanned aerial vehicles (UAVs)
- Solar fuels

Sub-Area 3.3 III-V Space Photovoltaic Modules, Systems, and Flight Experience

Sub-Area Chair: Stephen Polly, Rochester Institute of Technology, USA

This Sub-Area includes all module- and systems-level development for space applications based on III-V photovoltaic devices, as well as on-orbit reliability and performance. Key topics include:

- Integration of space solar cells onto rigid or flexible backplanes
- Stabilization against damage from UV radiation, high energy particles, electrostatic discharge, and other space hazards
- Interactions with electric propulsion subsystems
- Micro-CPV for the space environment
- Flight experience and reliability studies
- Strategies to improve AM0 calibration of solar cells and panels

Sub-Area 3.4: Alternatives to III-V for Space Applications

Sub-Area Chair: Ahmad Kirmani, Rochester Institute of Technology, USA

This Sub-Area solicits papers regarding all aspects of photovoltaic materials, structures, devices, or systems based on alternatives to III-Vs (e.g. perovskites, silicon, chalcogenides, etc.) for the space environment. Topics of interest include:

- Novel AM0 cell and module designs
- Materials design for interlayers and interfaces to enhance stability
- Environmental effects on alternative materials
- Reliability
- Testing standards
- Flight experience

Sub-Area 3.5: Photonic Power Converters

Sub-Area Chair: Emily Kessler-Lewis, Air Force Research Laboratory, USA

Sub-Area 3.5 seeks abstracts concerning all aspects of photonic energy conversion involving primary light sources other than the sun. Topics of interest include:

- Single and multijunction laser power converters
- Module- and system-level laser power beaming
- III-V devices for thermophotovoltaics (TPV)
- Ambient light harvesting
- Implantable and biomedical systems and applications

Area 4: Silicon Photovoltaic Materials and Devices

Area Chair: *Ujjwal Das, University of Delaware*
Co-Chair: *Bertrand Paviet-Salomon, CSEM*

Sub-Area 4.1: Silicon Feedstock & Wafering, Thin Silicon & Advanced Light Management
Sub-Area 4.2: Passivated, Carrier-Selective, and Heterojunction Contacts
Sub-Area 4.3: New Material Integration with Silicon for PV Applications
Sub-Area 4.4: Metallization, Interconnection, Module Integration, and Recycling/Sustainability and Novel PV Integrations
Sub-Area 4.5: Device Physics, Modelling, New/Enhanced Characterization Techniques

Area Description

Silicon remains dominant in photovoltaic technology with market share exceeding 90%, while technologically continuing to develop and scientifically entering the realm of innovative integrations. Commercial cell efficiencies exceeding 24%, module costs below $0.3/W are becoming routine as manufacturers transition to TOPCon and SHJ structures. The emergence of bifacial, IBC, and shingled cells has broadened the module flavors, while new applications in BIPV, VIPV, Floating PV is expected to bring unforeseen innovation. The dawn of silicon-based tandems and multi-junctions are anticipated to yield an era of 30% plus efficiencies as the new norm. This area addresses advancements in silicon materials, device designs, innovative integrations, materials recycling, sustainability, and new industrial trends, opportunities, challenges & roadmaps, shaping the future of silicon photovoltaics.

Sub-Area 4.1: Silicon Feedstock & Wafering; Thin Silicon & Advanced Light Management

Sub-Area Chair: Young Woo Ok, Georgia Institute of Technology, USA

Sub-area 4.1 focuses on advancement in silicon wafer production, thin silicon growth methods, defect engineering, and their impact on device performance and integration. Topics include:

- Silicon purification, crystallization, doping, wafering
- Thin silicon materials deposition/growth methods
- Mechanical and electrical characterization of resulting wafers/foils
- Surface engineering, light management – topics related to novel surface engineering like plasmonic, spectral shaping may be organized with Area 1

Sub-Area 4.2: Passivated, Carrier-Selective, and Heterojunction Contacts

Sub area Chair: Delfina Munoz, CEA-INES, France

Sub-area 4.2 focuses on development in contacting methods to simultaneously passivate defects and extract charge carriers i.e., maintain high quasi-Fermi-level splitting and thus high open circuit voltage and selectively extract charge carriers of one type. Specific topics are:

- Fabrication, characterization, commercialization, and device physics of passivated and carrier-selective contacts
- Contacts employing amorphous silicon, tunnel oxides, polysilicon

- Strategies with partial surface coverage such as the areas below the metal fingers, bifacial, and interdigitated back contact design
- Cell-level degradation and reliability studies of passivated contact structures – topics related to module-level degradation may be organized with Area 8

Sub-Area 4.3: New Materials Integration to Silicon PV

Sub area Chair: Di Yan, University of Melbourne, Australia

Sub-area 4.3 focuses on new materials integration to Si with other PV thin films, and microelectronics-inspired materials and/or processes for junction formation and surface defect passivation. Topics include:

- Integration of new materials with Si such as, emerging nitrides, oxides, alkaline/alkaline-earth metal compounds, rare-earth compounds, chalcogenides, organics, nanomaterials, 2-D materials
- Methods for Si exfoliation, deposition
- Characterization and modeling of new materials, interfaces, and devices
- Tandem/multijunctions device – topics related to tandems where the focus is the non-Si top cell may be organized with the corresponding Areas 2, 3, and 6

Sub-Area 4.4: Metallization, Interconnection, Module Integration, and Mass production and Recycling/Sustainability

Sub area Chair: Thien Truong, National Renewable Energy Laboratory, USA

Sub-area 4.4 covers the electrode metallization processes and characterization, materials recycling, sustainability, and novel module construct and integration for various applications. Please note some overlap on sustainability with Area 11. Topics include:

- Electrode deposition/formation processes including evaporation, printing, plating, multi-wire bonding, laser assisted process, selective doping
- Contact materials to eliminate/reduce indium and silver consumption
- Interconnection for advanced cell structures like back contact cells and Si-based tandems
- Recent achievements, challenges, and roadmaps in silicon PV mass production
- Life cycle assessment, materials recycling, sustainability

Sub-Area 4.5: Device Physics, Modelling, New/Enhanced Characterization Techniques

Sub area Chair: Paul Procel Moya, TU Delft, Netherlands

Sub-area 4.5 is aimed to understand modelling phenomena in Si-based solar cells and new interpretations of device physics that guides the Si PV performance closer to the radiative limit. Topics include:

- Device physics, multi-dimensional models, computational simulations
- Numerical analysis
- New characterization techniques

Area 5: Characterization Methods

Area-Chair: *Ziv Hameiri, University of New South Wales, Australia*
Co-Chairs: *André Augusto, Dalarna University, Sweden*

Sub-Area 5.1: In-situ and In-Line Metrology, Data Analysis, and Machine Learning
Sub-Area 5.2: Characterization Instruments and Techniques
Sub-Area 5.3: Characterization of Photovoltaic Materials and Cells
Sub-Area 5.4: Characterization of Photovoltaic Modules and Systems

Area Description

Measurement is the backbone of research development, process optimization, process control, quality assurance, and field monitoring. This area focuses on the continuous development and adaptation of characterization techniques throughout the PV value chain. It also emphasizes the data interpretation, analysis, statistical inference, and machine learning that relate measured information to the material/device properties, process conditions, experimental guidance and other practical consequences, making them useful.

Sub-Area 5.1: In-situ and In-Line Metrology, Data Analysis, and Machine Learning

Sub-Area Chair: Shuai Nie, The University of New South Wales, Australia

Findings related to

- In-situ monitoring (e.g. thickness determination during thin film deposition, optical emission spectroscopy)
- High sampling rate inline metrology (e.g. electroluminescence or photoluminescence imaging, wafer resistivity)
- Analysis of high-volume data combining multiple pieces of information that are relevant to PV manufacturing or field monitoring contexts - the novelty may be related to the measurement technique itself, its modification to capture data at high throughput, or new insights on high-volume data obtained by statistical analysis/model-based analysis/machine learning.

Sub-Area 5.2: Characterization Instruments and Techniques

Sub-Area Chair: Muqing Liu, Yangtze Institute for Solar Technology, China

Measurement techniques that elucidate the material, functional, optical or electrical properties of PV materials and devices (cells or modules) are of interest. Topics may include methods based on:

- Interferometry, spectroscopy, and microscopy,
- Imaging,
- Electrical probing and scanning probes

Reports that focus on the measurement principles, arrangement or routines and how they relate practically to PV processing and performance, are preferred. Development of operando measurements is also welcome in this Sub-Area.

Sub-Area 5.3: Characterization of Photovoltaic Materials and Cells

Sub-Area Chair: Sarah Wieghold, Argonne National Laboratory, USA

Findings related to the measurement, interpretation and analysis of PV materials cells Examples of topics that would fit into this area include studies on:

- Materials - Defect states, material composition, electrons and ion transport, interface properties
- Cells - Device transients, instability and degradation in cell performance, and the impact of defects and operating conditions on cell-level electrical characteristics

Sub-Area 5.4: Characterization of Photovoltaic Modules and Systems

Sub-Area Chair: Gisele Alves dos Reis Benatto, Technical University of Denmark, Denmark

This sub-area encompasses the characterization of complete modules and systems relevant to field performance including but not limited to:

- Large area characterization - photoluminescence, electroluminescence, ultraviolet (UV) fluorescence, infrared (IR) thermography, and current-voltage traces
- Cell level characterization (directly connected to module-level characteristics) - laser beam induced current (LBIC), external quantum efficiency (EQE), angular resolved reflectance, or microscopy – note: emphasis is on studies related to module efficiency, cell-to-module losses, and module power under real operating conditions.

Studies on durability and accelerated testing should be submitted to Sub-Area 8.1 or 8.2.

Area 6: Perovskite and Organic Materials and Solar Cells

Area-Chair: *Nakita K. Noel, University of Oxford, England*
Co-Chairs: *Laura T. Schelhas, National Renewable Energy Laboratory, USA*

Sub-Area 6.1: Advances in Materials Development
Sub-Area 6.2: Stability and Reliability of Solar Cells and Modules
Sub-Area 6.3: Advanced Perovskites and Organic Tandem/Multijunction Solar Cells
Sub-Area 6.4: Scalable Deposition Techniques and In-line Metrologies

Area Description

In the vast world of emerging materials for photovoltaic applications, halide perovskites currently lead the pack. With power conversion efficiencies exceeding 26% for single-junction devices, 33.9% and 29% for perovskite-silicon tandems and all-perovskite tandems respectively, these materials hold significant promise. In recent years organic solar cells have also experienced a renaissance with the advent of non-fullerene acceptors, having achieved certified efficiencies of 29%. However, in order to deliver on the abundance of promise these technologies hold, their impressive efficiencies need to be balanced with long-term operational stability, and importantly these characteristics need to be translated to much larger areas than the typical lab-scale device. Area 6 provides a platform for researchers in the field to present their latest results in the area of halide perovskite and organic photovoltaic devices. Topics in this area will range from materials development and advances in scalable deposition techniques and large area processing, to multijunction devices and the stability and reliability of lab scale devices and modules.

Sub-Area 6.1: Advances in Material Development

Sub-Area Chair: Artem Musiienko, Helmholtz-Zentrum Berlin, Germany
Sub-area 6.1 focuses on advances in material development for perovskite and organic photovoltaics. This includes:

- Interface passivation
- New transport and interlayer materials
- Compositional engineering
- Doping strategies

Sub-Area 6.2: Stability and Reliability Solar Cells and Modules

Sub-Area Chair: Sona Ulicna, EPFL, Switzerland
Sub-area 6.2 focuses on developments critical to commercialising emerging PV technologies-operational stability. Topics include

- Outdoor testing
- Accelerated stress testing
- Post-mortem failure analysis
- Packaging and module design

Sub-Area 6.3: Advanced Perovskites and Organic Tandem/Multijunction Solar Cells

Sub-Area Chair: Junke Wang, University of Oxford, England

Sub-area 6.3 focuses on approaches to delivering high-performance tandem architectures containing one or more perovskite/organic layers. This includes (but is not limited to):

- Perovskite/Si tandems
- All-perovskite tandems
- Perovskite/Organic tandems
- Perovskite/CIGS tandems

Sub-Area 6.4: Scalable Deposition Techniques and In-line Metrologies

Sub-Area Chair: Le Chen, First Solar, USA

Sub-area 6.4 focuses on scalable techniques for the large-area coating of halide perovskites and organic semiconductors, as well as the development and use of in-line metrology used for the characterization of the same. Topics include:

- Blade-coating
- Ink-jet printing
- Spray-coating
- In-line characterization techniques

Area 7: PV Modules, Manufacturing, Systems and Applications

Area Chair: Nicholas Rolston, Arizona State University, USA
Co-Chairs: Chiara Barretta, Polymer Competence Center Leoben GmbH, Austria

Sub-Area 7.1: New Materials and Production Technologies
Sub-Area 7.2: New Applications for PV
Sub-Area 7.3: System Design Optimization, Power Electronics, and Batteries
Sub-Area 7.4: Modeling and Predicting Energy Yield and Performance

Area Description
This area is dedicated to exploring the latest advancements and breakthroughs in PV module manufacturing and production, novel application and integration; system designs and optimization, especially integrated power electronics, energy storage solutions; energy yield prediction; and novel performance analysis strategies assisted by big data analytics and deep learning applications.

Sub-Area 7.1: New Materials and Production Technologies

Sub-Area Chair: Mathilde Fievez, Beyond Silicon, USA

In Sub-Area 7.1, abstracts are invited for innovations in module construction that have been largely responsible for significant increases in efficiency, annual yield, and the corresponding decreases in the levelized cost of energy (LCOE) for photovoltaic electricity generation. Topics include:

- New materials for backsheets, encapsulants, glass, or interconnects
- New techniques for module assembly to reduce cost, increase efficiency, or enhance reliability
- New designs for bifacial applications
- Module adjustments and optimization for extreme environments
- Novel module electrical configurations

Sub-Area 7.2: New Applications for PV

Sub-Area Chair: Sarah Kurtz, University of California-Merced, USA

In Sub-Area 7.2, abstracts are invited describing new areas of applications for PV spanning a wide range of applications to account for up-and-coming areas and especially those that enable multifunctionality for PV devices. These include:

- New applications for PV including but not limited to agrivoltaics, building integrated PV, floatovoltaics, and non-traditional applications
- Recent advances in building integrated or applied PV systems (BIPV or BAPV), off-grid PV systems, hybrid systems, mini/micro-grids, DC end-use systems, mobility and transportations systems, infrastructure-integrated PV, agrivoltaics, floating solar, “wearable” PV, and other non-traditional PV applications

Sub-Area 7.3: System Design Optimization, Power Electronics, and Batteries

Sub-Area Chair: Patrizio Manganiello, IMEC, Belgium

Sub-Area 7.3 spans a broad range of topics that includes new concepts for complete photovoltaic systems, methods of system optimization, field results, full life-cycle analysis of system components, in addition to power converters and energy storage technologies. Topics include:

- System design and optimization
- Inclusion of power electronics, and energy storage solutions that enhance the performance and grid integration of PV systems
- Grid-tied and off-grid system designs, power converter technologies, maximum power point tracking, and energy storage integration
- Improving system efficiency, reliability, and grid stability, contributing to the overall growth and sustainability of solar energy systems

Sub-Area 7.4: Modeling and Predicting Energy Yield and Performance

Sub-Area Chair: Bill McMahon, National Renewable Energy Laboratory, USA

Sub-Area 7.4 focuses on PV methods of module modelling and the prediction of produced energy. Abstracts relating to mechanical, thermal, and electrical modelling of PV modules and systems including methods for determining parameters for these models are also welcome. This covers the following topics:

- Modeling and predicting the energy yield of PV systems
- Meteorological data integration, climate-specific models, and uncertainty analysis
- Developing reliable methods for assessing PV system performance (e.g., capacity tests, O&M), facilitating optimal system design, and increasing overall energy output
- Potential of big data analytics and deep learning technique for PV performance analysis
- Significance of data-driven insights in ensuring long-term performance and reliability of PV modules and systems

Area 8: Module and System Reliability

Area Chair: Laura Bruckman, Case Western Reserve University, USA
Co-Chair: Kristopher O. Davis, University of Central Florida, USA

Sub-Area 8.1: Accelerated Testing of PV Materials, Modules, and System Components
Sub-Area 8.2: PV Reliability and Durability Observations from the Field
Sub-Area 8.3: Data-Centric Approaches to Promote PV Module and System Reliability

Area Description

The long-term performance, reliability, and durability of PV modules and systems are all critical to the continued growth of the PV sector. PV modules and systems are often deployed in harsh weather conditions and the expected lifetimes are extending to 30-40 years. The industry is both risk averse, requiring all new technologies across the supply chain to prove their robustness in extensive testing before field deployment, and rapidly adopting new technologies faster than they can be field tested. Area 8 takes a holistic approach considering the performance, reliability, and durability of all types of PV systems and the constituent components (e.g., modules, power electronics, energy storage, and other balance of system components) and materials that make up these components. Topics in this area will cover accelerated testing, testing and observations from the field, and measurement and analysis methods that support reliability and durability research. Reliability and durability studies of both mature and emerging types of PV modules and system components will be covered in this area.

Sub-Area 8.1: Accelerated Testing of PV Materials, Modules, and System Components

Sub-Area Chair: Archana Sinha, Kiwa PVEL, USA

PV modules and system components are exposed to a wide range of stresses, such as high temperatures, temperature fluctuations, humidity, ultraviolet light, electrical bias, and various mechanical stresses. Submissions in Sub-Area 8.1 should explore the development, validation, and implementation of accelerated testing as a means of enhancing PV module and system reliability and durability. Submissions covering the following topics are encouraged:

- Accelerated testing methods for PV materials, modules, and system components and findings from these tests
- Validation of accelerated testing approaches using field-based results
- Modeling, simulation, measurement, and analysis methods that support accelerated testing research
- Accelerated testing studies that provide insights into degradation mechanisms and failure modes, linking them to specific external stressors
- Results from both well-established technologies and commercially relevant emerging technologies, including c-Si, CdTe, perovskites, and tandem modules

Sub-Area 8.2: PV Reliability and Durability Observations from the Field
Sub-Area Chair: Sub-Area Chair: Jaya Mallineni, SOLV Energy, USA

Observations from the field are invaluable in efforts to improve the reliability and durability of PV systems and the materials, modules, and other components that make up these systems. Sub-Area 8.2 focuses on these observations, as well as the tools and methods needed to more effectively study the performance, reliability, and durability of PV systems operating in the field. Submissions covering the following topics are encouraged.

- Observations and reports related to the performance, reliability, and durability of PV systems operating in the field, including findings related to the materials, modules, and other components that make up these systems
- Modeling, simulation, measurement, and analysis methods that support field testing and performance monitoring
- Studies demonstrating effective solutions and corrective actions for maximizing energy when confronted with performance, reliability, and durability issues in the field
- Field observations and reports proving insights into degradation mechanisms and failure modes, linking them to specific design choices, materials, and manufacturing processes
- Results from both well-established technologies and commercially relevant emerging technologies, including c-Si, CdTe, perovskites, and tandem modules

Sub Area 8.3: Data-Centric Approaches to Promote PV Module and System Reliability

Sub-Area Chair: Erika Barcelos, Case Western Reserve University, USA

With the rapid development and adoption of new materials and technological innovations currently occurring across the entire PV sector, the industry and R&D community will need to be vigilant in efforts to ensure reliability and durability are not compromised. Sub-Area 8.3 will cover the sharing of data, knowledge, and analytical tools could help in these efforts, as well as the application of AI tools to promote PV module and system reliability/durability. Submissions covering the following topics are encouraged:

- Open datasets related to PV module and system reliability and durability
- Frameworks to curate data, knowledge, and information related to PV module and system reliability and durability
- Open-source modeling and analysis tools related to PV module and system reliability and durability
- Initiatives to promote the sharing of data, code, and knowledge related to PV module and system reliability and durability

Area 9: Power Electronics and Grid Integration

Area Chair: *Nelson Diaz, Universidad Distrital F.J.C, Bogotá, Colombia*
Co-Chair: *Juan Sebastián Gómez Quintero Universidad Andrés Bello, Chile*

Sub-Area 9.1: Power Converter Design, Modelling, Reliability, and Control
Sub-Area 9.2: Ancillary Services and Grid Support Functionalities
Sub-Area 9.3: Microgrids and Distribution System Operation and Control

Area Description

As photovoltaic (PV) installations become increasingly widespread, the demand for power electronic converters designed to interconnect solar panels to the grid will continue to rise. Moreover, the rapid integration of massive levels of distributed PV penetration poses new challenges for managing grid operations. At the component level, advanced inverter functionality and energy storage will enhance grid stability by enabling rapid response to control and stabilize the grid during rapidly changing phenomena. Furthermore, the development of advanced topologies and controls will further improve converter performance and reduce system costs. At the system level, optimization and management of distributed PV and other grid resources will continue to support the integration of large amounts of renewable energy and enable more advanced grid services and support functions. The evolving nature of power distribution systems will motivate new methods for microgrid and distribution grid operations, requiring proactive management of variable generation resources. Therefore, the power electronics and power systems community is encouraged to submit contributions that address the full range of scientific and technical aspects related to PV grid integration.

Sub-Area 9.1: Power Converter Design, Modelling, Reliability, and Control

Sub-Area Chair: Sergio Fernández Rojas, Delta Electronics, USA

Sub-Area 9.1 focuses on new converter designs and control for DC-DC and inverter-based applications for PV power. Additionally, contributions related to modeling and reliability analysis of power grids with high penetration of inverter-based PV power are welcome. Topics include:

- Design, modelling and control of power electronics for PV converters
- Novel circuit designs, magnetics, wide bandgap semiconductor materials, and other innovative approaches to component-level converter design
- Advanced power electronics control at the level of individual converters, multi-converter-based microgrids, power systems, and large-scale PV power plants
- The reliability of power converters and the impact of PV converters on the reliability of power grids

Sub-Area 9.2: Ancillary Services and Grid Support Functionalities

Sub-Area Chair: Medhi Savaghebi, DTU, Denmark

Sub-Area 9.2 focuses on advanced control functionalities performed by inverter-based PV power systems, providing ancillary services to support power grid operation. Topics include:

- Synthetic (virtual) inertia
- Voltage and frequency regulation.
- Reactive power provision
- Fault current provision to maintain power system protection
- Ramp rate limiting, or power smoothing to prevent frequency events
- Harmonic mitigation, and operation of PV converters as active power filters to improve power quality
- Ancillary services provided by PV converters in microgrid environments

Sub-Area 9.3: Microgrids and Distribution System Operation and Control

Sub-Area Chair: Andrés Cortés Borray, ib vogt GmbH, Germany

Sub-Area 9.3 focuses on highlighting the challenges and successful applications of integrating PV power units into microgrids. Topics include:

- Impact of systems that include significant amount of PV converters on the reliability of power grids.
- Challenges of integrating PV into microgrids and distribution systems.
- PV sizing and placement, dispatching, and other pertinent issues for the operation in Microgrids based on PV converters
- Coordinated operation and Management of microgrids based on PV converters

Area 10: Solar Resource Assessment and Forecasting

Area Chair: *Adam R. Jensen, Technical University of Denmark (DTU), Denmark*
Co-Chairs: *Sophie Pelland, Natural Resources Canada – CanmetENERGY, Canada*

Sub-Area 10.1: Solar and Meteorological Measurement and Modeling
Sub-Area 10.2: Forecasting of Solar Irradiance and PV Power

Area Description
Solar resource measurement, modeling, and forecasting are essential for operating PV systems, and for predicting and evaluating their performance. In particular, uncertainties related to the solar resource contribute significantly to uncertainties in PV yield and economic viability. This research area covers technologies and methods to measure, model, and forecast solar irradiance with a particular focus on applications in the PV sector.

Sub-Area 10.1: Solar and Meteorological Measurement and Modeling

Sub-Area Chair: Javier Lopez-Lorenze, DNV, Norway

Accurately measuring and modeling the available solar resource is essential for technical and economic planning of PV systems and for evaluating the performance of existing systems. This sub-area covers topics related to reducing the uncertainties in PV performance modeling and monitoring, including:

- Radiometer design (thermal offsets, spectral measurements, etc.)
- Radiation models (clear sky models, decomposition, transposition, etc.)
- Solar resource assessment methodologies (satellite models, reanalysis models, etc.)
- Variability and uncertainty quantifications
- Measurements for bifacial systems (rear-side irradiance and albedo)
- Ancillary measurements such as soiling, temperature, precipitation, and snow

Sub-Area 10.2: Forecasting of Solar Irradiance and PV Power

Sub-Area Chair: Marc Perez, Clean Power Research, USA

As PV generation increases, the role of solar irradiance and PV power forecasting becomes ever more important to successfully integrate renewable energy into the grid. This sub-area covers the latest improvements in forecast modeling at various time and spatial scales, including:

- Short-term forecasting (all-sky imagers, data-driven forecasts, etc.)
- Probabilistic and ensemble forecasting
- Regional forecasting and upscaling
- Reducing uncertainty using statistical methods, e.g., blended forecasts
- Quantifying forecast uncertainty
- Comparison and benchmarking of forecasts

Area 11: PV Deployment, Policy and Sustainability

Area Chair: *Jacob Cordell, NREL, USA*
Co-Chairs: *Annick Anctil, Michigan State University, USA*

Sub-Area 11.1: Economics, Policy, and Energy Justice
Sub Area 11.2: Environmental Sustainability
Sub Area 11.3: User Behavior, Education in Institutes of Learning, and Workforce Development
Sub Area 11.4: The Role of Photovoltaics in the Transition to a 100% Renewable Energy Supply

Area Description

The PV Deployment, Policy and Sustainability area provides an opportunity to discuss aspects required to ensure the long-term success of the PV industry. This includes discussions on four themes focusing on 1) economics, policy, and energy justice, 2) environmental sustainability, 3) social interventions, and 4) the interplay of these topics toward 100% renewable energy generation. Recognizing the importance of student engagement for sustained growth in the industry, we encourage students to submit papers focusing on outreach and education efforts in educational institutes.

Sub-Area 11.1: Economics, Policy, and Energy Justice

Sub-Area Chair: Keiichiro Sakurai, AIST, Japan
This sub-area focuses on the economics and policy developments critical to expanding PV deployment and/or energy justice including:

- Overcoming barriers in PV deployment and providing equitable and affordable access to solar energy
- Policy impacts, market drivers, and financial considerations
- Unique case studies of interest to conference participants also welcomed

Sub Area 11.2: Environmental Sustainability

Sub-Area Chair: Ilke Celik, Portland State University, USA
This sub-area seeks submissions with a broad, systems-level perspective on the sustainability of PV throughout the life cycle.

- Topics of interest include discussions on current and future PV technologies through life-cycle assessment, material supply, manufacturing, and end-of-life management
- Results from simulations, surveys, and focus group discussions on these topics are welcomed

Sub Area 11.3: User Behavior, Education in Institutes of Learning, and Workforce Development

Sub-Area Chair: Dwarak Ravikumar, Arizona State University, USA
This sub-area focuses on increasing solar PV adoption through understanding user behavior and developing a skilled workforce for the solar PV industry. These areas of research focus on early engagement of students and workforce development. Existing results are highly encouraged for abstract submission and topics of interest include studies on:

- Influencing user behavior
- Encouraging adoption
- Early engagement of students at all levels (e.g., high school, vocational training, technical school and university)
- Innovative solar education and workforce development

Sub Area 11.4: The Role of Photovoltaics in the Transition to a 100% Renewable Energy Supply

Sub-Area Chair: Heather Mirletz, National Renewable Energy Laboratory, USA

In countries accounting for 82% of the global electricity generation, photovoltaics and wind are already the cheapest source of electricity. It took 66 years to install 1 TW of solar photovoltaic systems. However, the second TW will be installed in roughly three years only and an annual TW market will be reality before the end of the decade. This has a significant impact not only for the electricity system, but for our global energy supply as well. We especially encourage contributions from students and aim to cover diverse regions and approaches. Abstracts should address:

- Which technologies and concepts are available and most beneficial in addressing the challenges of the energy transition
- Topics relevant to the role of photovoltaics in this transition