



Delft University of Technology

Welcome from the IEEE PES ISGT Europe 2020 General Chairs

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DOI

[10.1109/ISGT-Europe47291.2020.9248939](https://doi.org/10.1109/ISGT-Europe47291.2020.9248939)

Publication date

2020

Document Version

Final published version

Published in

IEEE PES Innovative Smart Grid Technologies Conference Europe

Citation (APA)

Lukszo, Z., & Palensky, P. (2020). Welcome from the IEEE PES ISGT Europe 2020 General Chairs. *IEEE PES Innovative Smart Grid Technologies Conference Europe, 2020-October*, 4-4. Article 9248939. <https://doi.org/10.1109/ISGT-Europe47291.2020.9248939>

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Delft, The Netherlands

26-28 October, 2020

IEEE Catalog Number: CFP20SGT-ART

ISBN: 978-1-7281-7100-5

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Proceedings of
2020 IEEE PES Innovative Smart Grid Technologies Europe (ISGT-Europe)
26-28 October, 2020

Sponsor:

IEEE Power & Energy Society

IEEE Catalog Number: CFP20SGT-ART

ISBN: 978-1-7281-7100-5

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Welcome from the IEEE PES ISGT Europe 2020 General Chairs

On behalf of the Organizing Committee we are very pleased to welcome you to the 10th IEEE PES Innovative Smart Grid Technologies Europe (ISGT-Europe) Conference organized by the Delft University of Technology, the Netherlands, which for more than 175 years has been one of the most prestigious public institutions both at an international and national level in education, research, technological transfer and services in all sectors of engineering.

The IEEE-PES ISGT-Europe 2020 conference will stress the need for viewing the role of smart grids in future energy systems as part of the designing, managing and operating qualitatively new complex socio-technical systems. From a technical perspective, solutions to the limited ability to predict stochastic generation and demand can be found in novel technologies such as integrated communications, advanced sensing & measurement technologies, advanced control methods, improved interfaces and decision support. From an economic and regulatory perspective, the challenge is to innovate and deploy new technologies within new business models and market designs, so that the objectives to contribute significantly to a sustainable world will be met.

This is the first ISGT conference that is conducted in a virtual fashion. This is a challenge but also an opportunity. Although we would have preferred to welcome the ISGT community in the beautiful city of the Hague located in South-Holland, we are happy to host you virtually this time.

We kept the classical format of a conference with regards to timing and content, and tried to replicate the interactive elements such as discussions or social interaction with on-line tools. Conferences are - besides learning the newest trends and developments - for meeting peers and networking after all. A clearly positive aspect of virtual conferences such as this one are reduced costs, both in conference organization (and in attendee fees 😊) and travel. Still, we hope that we will meet soon again face to face and enjoy a few days together.

We would like to thank all the conference sponsors and everyone that supported us in setting this IEEE PES ISGT-Europe 2020 up, from IEEE PES, the Technical Review Committee to the local team at TU Delft and wish everyone a fruitful and engaging conference.

We look forward to meeting you virtually at the 10th IEEE PES Innovative Smart Grid Technologies Europe (ISGT-Europe) Conference.



Zofia Lukszo

General Chair
Faculty of Technology, Policy
and Management
Delft University of Technology



Peter Palensky

General Co-Chair
Faculty of Electrical Engineering,
Mathematics & Computer Science
Delft University of Technology

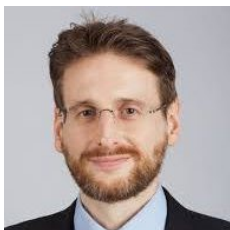
Welcome from the IEEE PES ISGT Europe 2020 Program Chairs

First of all, we would like to thank all authors for contributing so actively to the research presented at this conference. The quality of the ISGT-Europe 2020 program is primarily the result of your own work as an author! ISGT-Europe is a highly recognized annual conference spanning several fields with an exceptional balance between the theory and applications of smart grid technologies.

We also want to offer a special thank to the organizers of panel sessions who play a key role in highlighting special topics of importance and inspiring new research directions in a coherent manner. A total of 334 papers were submitted this year, out of which 246 papers were accepted. The program features 8 panel sessions, three keynote presentations, and 41 regular sessions forming 7 parallel tracks over three days. Regular sessions are organized this year in an interactive online fashion due to the virtual format of the conference. While the online format certainly presents limitations to the most valuable aspect of the conference: in-person interaction among participants, we hope that the online sessions will give rise to interesting discussions and interactions even in a virtual environment. Afterall, this new format has been the norm for most meetings in research, academia, and industry during the past 6 months.

Authors of contributed papers in the conference program come from 47 different countries, spread over five continents, with 32% having an affiliation outside Europe. This makes ISGT-Europe 2020 a truly international event with global representation! It was a great pleasure to work with an outstanding International Program Committee, who volunteered and worked hard so many hours during the Spring period auditing all papers and reviews. Their timely actions were essential to manage the submissions, make acceptance decisions, and assemble the conference program. Our numerous reviewers also must be thanked as well as they ultimately ensure the quality and fairness in the selection of papers.

Finally, we would like to thank Yilin Huang for organizing the online social program, Joep van der Weijden for helping to finalize the panel sessions and the conference website, and the people at QiqoChat (Lucas Cioffi, Joey Isip) for their constant and creative support in setting up the online conference platform and enabling the virtual program format. We hope that you will all find this year's ISGT-Europe program rich, attractive, and inspiring. We wish you a productive and enjoyable 2020 IEEE PES Innovative Smart Grid Technologies Europe conference!



Tamas Keviczky

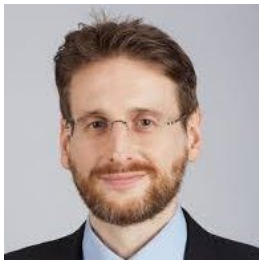
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IEEE PES ISGT Europe 2020 Keynote Presentations

Title: Smart Electricity and Hydrogen symbiosis for a Sustainable energy system

Speaker: Ad van Wijk, Special advisor to Hydrogen Europe, EU commission

Time and Location: Monday, October 26, 2020, 9:00-10:00, Online live stream 1 (MoKK)



Abstract. A global sustainable energy system can be realised with predominantly solar and wind as energy source, converted into electricity via solar panels and wind turbines. Where possible, useful and cost effective, the electricity produced is directly used. However, lowest cost solar and wind electricity can be produced far away from the demand, requiring conversion to hydrogen by electrolysis for cheap transport and storage. The lower electricity production cost and cheaper transport and storage cost will compensate for extra energy conversion losses and costs.

The hydrogen can be transported in large quantities worldwide by ship or by pipelines and stored in the underground in salt caverns. Volumes and capacities for hydrogen transport and storage are orders of magnitude larger than for electricity. Today, the conversion process to convert hydrogen in heat, electricity or mechanical power is via combustion. However, in future electrochemical conversion via fuel cells will become more important. Fuel cells for mobility, in buildings for power and heat, and for electricity balancing. In the end electrochemical conversion using electrolyzers and fuel cells together with heat pump technology will fully replace combustion technologies. A smart integration of electricity and hydrogen systems using electrochemical conversion and heat pump technology can deliver energy demand in all sectors, clean, reliable and affordable. Electricity and hydrogen will be the carbon-free symbiotic energy carriers and smart grids needs to integrate both.

Biography. Ad van Wijk is part-time Professor Future Energy Systems at TU Delft, the Netherlands. He is guest professor at KWR Water Research Institute to develop and implement the research program Energy and Water. He is special advisor to Hydrogen Europe to develop European hydrogen policies with the EU commission. He holds several advisory and supervisory board positions. Van Wijk has studied physics and did his Ph-D on Wind Energy and Electricity Production at Utrecht University in the Netherlands. He worked as a Researcher and Associate Professor, between 1983 and 1997 in the Department of Science, Technology and Society at Utrecht University. In 1984, van Wijk founded the company Ecofys, which eventually grew into Econcern. Econcern developed many new sustainable energy products, services and projects. Examples include the offshore wind farm Princess, several multi-MW solar farms, a solar cell manufacturing plant and a bio-methanol plant in the Netherlands. Since 2011 van Wijk is appointed as professor Future Energy Systems at TU Delft. He does research on hydrogen energy systems and fuel cell cars and has realized “the Green Village” at the TU Delft campus. Van Wijk achieved many important prizes for excellent entrepreneurship. Amongst others he was Dutch entrepreneur of the year in 2007 and Dutch top-executive in 2008. In 2018 van Wijk was honored by KWR, by appointing him Honorary Fellow. Van Wijk has published many books, scientific articles and reports. Amongst others ‘How to boil an egg’, ‘Our Car as Power Plant’, and ‘Hydrogen, the bridge between Africa and Europe’.

Title: The Cognitive Grid Enterprise - How to achieve to a smarter grid operation by augmenting humans with AI and machine learning

Speaker: Leo Dijkstra, Comms Leader IBM Services Benelux

Time and Location: Tuesday, October 27, 2020, 9:00-10:00, Online live stream 1 (TuKK)



Abstract. The term smart grid has been around for well over a decade, yet AI and machine learning are now enabling humans to make smarter decisions in managing the power grid. Augmenting humans with digital enhanced cognitive functions such as sight, touch and hearing, all workflows are being re-imagined to increase grid capacity, worker safety and customer experience: How can a machine learning 'grid model' help TSO-operators spot the risks and grid operating limits? How can vegetation growth models, satellite images and accurate weather prediction send crews out to the right place and time to cut tree branches before interfering with power lines? And how can visual recognition, augmented reality and speech recognition help field workers do their jobs safely, efficiently and with a higher job satisfaction? These elements come together in what IBM calls 'The Cognitive Enterprise', or in this case 'The Cognitive Grid Enterprise'.

Biography. Leo Dijkstra has a 20 year background in transforming E&U markets: from the opening of commercial flexible power markets for TSO's in 2001, through unbundling of the sector and the introduction of national DSO/TSO data hubs to facilitate free choice of supplier for business and residential customers, to the definition of market models and standards for the emerging market of electric vehicle charging (e.g. OCPP and interoperability standards). Leo currently leads IBM's Benelux Energy, Environment & Utilities business and works on integrating DER's in all aspects of the energy system with a number of clients.

Title: Digitizing the electric power grid – the future is now

Speaker: Alex Apostolov, Principal Engineer OMICRON electronics

Time and Location: Wednesday, October 28, 2020, 9:00-10:00, Online live stream 1 (WeKK)



Abstract. The electric power utilities are transitioning towards a Smart Grid as a result of the changes in the industry driven by the developments of computer and communication technologies, as well as the increasing penetration of renewable distributed energy resources. The presentation describes the characteristics of the smart grid and the need for digitization in order to meet the requirements of the different applications. It briefly introduces the key components of the IEC 61850 standard and the extensions that are developed to cover the requirements of different domains outside of the substation. It describes the non-conventional sensors that are becoming key components of the digital substations and looks at different architectures, such as distributed, centralized or hybrid systems. Engineering of the digital substations based on the IEC 61850 SCL (system configuration language) is later described. The benefits of the digital grid and its impact on the maintenance and testing of the electric power system are described at the end of the presentation.

Biography. Alexander Apostolov received MS degree in Electrical Engineering, MS in Applied Mathematics and Ph.D. from the Technical University in Sofia, Bulgaria. He has 45 years' experience in power systems protection, automation, control and communications. He is presently Principal Engineer for OMICRON electronics in Los Angeles, CA. He is IEEE Fellow and Member of the IEEE PES Power Systems Relaying and Control (PSRC) Committee and the Power System Communications and Cybersecurity (PSCC) Committee. He is past Chairman of the Relay Communications Subcommittee and serves on many IEEE PES Working groups. He is member of IEC TC57 working groups 10, 17, 18 and 19. He is Convenor of CIGRE WG B5.69 "Experience gained and Recommendations for Implementation of Process Bus in Protection, Automation and Control Systems (PACS)" and member of several other CIGRE B5 working groups. He is Distinguished Member of CIGR and IEEE Distinguished Lecturer. He holds four patents and has authored and presented more than 500 technical papers. He is Editor-in-Chief of PAC World.

IEEE PES ISGT Europe 2020 Panel Sessions

Title: Coordination of flexible energy prosumers in integrated urban energy systems

Moderator: Simon Tindemans (Delft University of Technology)

Speakers: Ning Zhang (Tsinghua University), Goran Strbac (Imperial College), Yi Ding (Zhejiang University), Longjian Piao (Delft University of Technology)

Time and Location: Monday, October 26, 2020, 10:30-12:15, Online live stream 1 (MoAMP1)

Abstract: Urban environments are characterized by a high density of energy consumption, and tight constraints on local development (including network infrastructure). The implication is that while initiating the energy transition in urban environments cannot be postponed, the transition pathways must continuously adapt to local conditions and future developments. Against this background, it is essential to unlock the flexibility offered by energy consumers in close proximity, and across different energy vectors, making use of the additional flexibility offered by local sources of energy (prosumers) and the proliferation of IoT-enabled devices. This session brings together panelists that address this challenge from technical, regulatory and socio-economic perspectives. They will present and discuss the potential benefits of unlocking prosumer flexibility, and how these can be achieved in ways that are feasible, fair and resilient.

Title: Localization in Electricity Markets: Moving down to the Distribution Grids

Moderator: Koen Kok (TNO)

Speakers: Koen Kok (TU Eindhoven), Bert Claessens (Centrica Business Solutions), George Trienekens (TenneT)

Time and Location: Monday, October 26, 2020, 10:30-12:15, Online live stream 2 (MoAMP2)

Abstract: Local markets for electricity are gaining interest from academic and industrial researchers alike. At the level of the transmission networks and wholesale electricity markets, locational aspects have been included in the market clearing procedure for decades now. Currently, one of the energy transition challenges is to develop local market mechanisms for the distribution level of the electricity system. These mechanisms should be (1) fair, transparent and posing the right incentives to all stakeholders, (2) scalable, robust, increasing resiliency, and (3) connecting to the wholesale markets such that local and global stakes are balanced. Throughout Europe, there are multiple initiatives investigating the technical and commercial feasibility of local market mechanisms. In this panel, we will seek discussion between researchers and experts from academics and industry to identify open questions and set the R&D agenda, based on a common understanding of the current state of the art.

Title: Digital Twin

Moderator: Christian Heuer (Siemens AG, Germany)

Speakers: Susana Almeida de Graaff (TenneT, Netherlands), Trevor Hardy (PNNL, USA), Jeff Mocha (OEC, Canada), Peter Palensky (Delft University of Technology), Zubran Solaiman (Bentley Systems, UK)

Time and Location: Monday, October 26, 2020, 18:00-19:45, Online live stream 1 (MoPMP1)

Abstract: The term "digital twin" is hot: An established method in avionics or automotive industry now enters new sectors, power systems being one of them. A digital twin represents some real (cyber/physical/social) system in a digital fashion. It can represent the past (forensics, analytics), the present (dashboard), or the future (predictive controls or maintenance, scenario optimization). Depending on the depth of the used models, it can give insights into hidden dynamics, risks, and optima. There are many situations and locations in the power system where digital twins can help: as decision support in the control room, embedded in a substation controller, as a planning tool, or on markets. This panel invites a group of experts, both from research and practice to confront the audience with the bare facts on digital twins in order to discuss their use and limits for power systems and smart grids. The panelists will pitch their propositions as thesis and antithesis, the audience will vote on that. After an interactive discussion with the audience, the vote is repeated, assessed, and summarized.

Title: Evolution of power systems to smart grids - EMPOWER project paradigm

Moderator: Lenos Hadjidemetriou (University of Cyprus)

Speakers: Andreas Stavrou (Electricity Authority of Cyprus), Rogiros Tapakis (Transmission System Operator Cyprus), Mihaela Albu (Politehnica University of Bucharest), Markos Asprou (University of Cyprus)

Time and Location: Tuesday, October 27, 2020, 10:30-12:15, Online live stream 1 (TuAMP1)

Abstract: In this panel, the lessons learned so far from the EMPOWER project will be discussed by speakers that forms a blend of academia and industry. In particular, this panel will discuss the benefits of the application of a key technology such as the synchronized measurement technology to a real power system in the view of the challenges that the islanded nature of the Cyprus power system pose. Several other aspects such as the real time applications that the synchronized measurement technology enables as well as the potential of storage in an islanded power system will also be discussed.

Title: Increasing the Flexibility of the European Power System: Four Large Scale Demonstrators on the Transmission Grid from the OSMOSE H2020 Project

Moderator: Christoph Weber (University of Duisburg-Essen)

Speakers: Guillaume Denis (RTE), Alberto Escalera Blasco (REE), Miran Kavrecic (HSE), Luca Orru (TERNA)

Time and Location: Tuesday, October 27, 2020, 10:30-12:15, Online live stream 2 (TuAMP2)

Abstract: Flexibility can be defined as the ability of the power system to adapt to variations of the demand, the generation and the grid. New challenges are arising like the increasing penetration of RES but new solutions are also emerging like smarter controls or large scale storage. The OSMOSE H2020 project (2018-2021) aims at enhancing the flexibility of the European power system especially through four large scale demonstrators lead by Transmission System operators: RTE, REE, TERNA and ELES. These demonstrations covers various innovations on flexibility services and providers: grid forming, multi-services by hybrid storage, near real-time cross border exchanges, smart zonal energy management system. Each demo will present in 15 minutes its objectives and current status. A roundtable will be the occasion to discuss with the audience the following questions:

- How could these demos be replicated and extended in Europe, for what benefits? Are there barriers to overcome?
- How could the transmission grid be even more flexible and accelerate the energy transition?

Title: Flexibility Options for ~100% Renewable Energy Systems: Demand Response and Sector Coupling

Moderator: Germán Morales-España (TNO)

Speakers: Germán Morales-España (TNO), Niina Helistö (VTT), Dimitrios Papadaskalopoulos (Imperial College), Jos Sijm (TNO), Juha Kiviluoma (VTT)

Time and Location: Wednesday, October 28, 2020, 10:30-12:15, Online live stream 1 (WeAMP1)

Abstract: For large-scale integration of renewable energy, power systems must provide abundant flexibility to accommodate high shares of variable and uncertain renewable resources. Electrification is also becoming the most promising option to bring renewable energy to other sectors, thus greatly increasing (unconventional) electric demand, which poses new challenges and opportunities to the power system. In this panel session, we present different flexibility sources, their modelling and economic challenges for optimal planning and operation of power systems. These flexibility options include demand response, storage, and flexible sector coupling, e.g., power2gas (H2), power2mobility (EVs), and power2heat.

Title: Ancillary Services Provided by Power-Electronics Interfaced Distributed Renewable Energy Sources Connected in Distribution Grids

Moderator: Charis Demoulias (Aristotle University of Thessaloniki)

Speakers: José M. Maza-Ortega (University of Seville), Juan Manuel Mauricio (University of Seville), Milos Cvetkovic (Delft University of Technology), Hermann De Meer (University of Passau), Kyriaki-Nefeli Malamaki (Aristotle University of Thessaloniki)

Time and Location: Wednesday, October 28, 2020, 10:30-12:15, Online live stream 2 (WeAMP2)

Abstract: Although power-electronics interfaced Distributed Renewable Energy Sources (PEI-DRES) are highly proliferated at distribution systems, their intermittent and inertia-less nature still prohibits the overall decommission of bulk synchronous generators (SGs), whose inherent properties are the basis of robust and stable transmission systems. Towards this direction, the increased controllability of PEI-DRES should be exploited so as they can provide Ancillary Services (AS) similarly to SGs. This panel session will provide a further insight on this topic through the ongoing research in the H2020 EU project EASY-RES.

Title: Real-Time Simulation and HIL Testing: Validating Technologies for a Smarter, More Sustainable Grid

Moderator: Kati Sidwall (RTDS Technologies Inc.)

Speakers: Kati Sidwall (RTDS Technologies Inc.), Urban Rudež (University of Ljubljana), Rajne Ilievska (University of Ljubljana), Jose Rueda (Delft University of Technology), Panos Kotsampopoulos (National Technical University of Athens)

Time and Location: Wednesday, October 28, 2020, 18:00-19:45, Online live stream 1 (WePMP1)

Abstract: Real-time simulation and hardware-in-the-loop (HIL) testing has been used in the power industry for over twenty-five years. Originally developed as a solution for flexibly testing the control and protection associated with HVDC projects, the application of the technology is now widespread and varied, and today real-time simulators are used particularly effectively in the smart grid technologies space. The devices associated with and required by smart grids have the potential to interact with each other and with existing technologies, and given the fast-acting nature of modern control and protection systems, the tools required to study them in detail must be capable of representing subcycle phenomena. Real-time simulators offer an electromagnetic transient representation of the power system along with the ability to connect devices in a closed-loop with the simulated network for flexible, controlled, and safe testing prior to deployment. This panel session highlights recent exciting projects from real-time simulator users validating and de-risking enabling technologies for a smarter, more sustainable grid.

IEEE PES ISGT Europe 2020 Online Social Event

As an online social event, a pub quiz will be organized among teams composed of the conference participants. The topic of the pub quiz is smart grid technologies and trivia.

Time and Location: Tuesday, October 27, 2020, 18:00-19:45, Online live stream 1 (TuPMP1)

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Sciences (AS), Civil Engineering and Geosciences (CEG), Electrical Engineering, Mathematics and Computer Science (EEMCS), Mechanical, Maritime and Materials Science (3ME) and Technology, Policy and Management (TPM) are included. About forty research groups and more than three hundred faculty members are connected to and actively involved in DCSE and its activities.

<https://www.tudelft.nl/en/tu-delft-institute-for-computational-science-and-engineering/>



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