

The EnergyVille 2023 Symposium on Microgrids

By Nikos Hatziaargyriou¹, Maria Brucoli, Johan Driesen, Mihaela Albu, Goncalo Mendes, and Radu Plamanescu

THE 17TH ANNUAL SYMPOSIUM on Microgrids was held in Genk, Belgium, on 18–19 September 2023 at the EnergyVille, Thor Park 8310 3600, Genk. The symposium belongs to the series of the symposiums that rotate each year around three regions: Europe and Africa, The Americas, and Asia and Oceania. The purpose of the symposiums is to exchange information internationally, yet informally, on the current state of research on microgrids and to identify key technical, economic, and policy issues that should be addressed by future work. The prior 16 symposiums have been at the following locations: 1) Berkeley, USA, 17 June 2005; 2) Montreal, Canada, 23 June 2006; 3) Nagoya, Japan, 6 April 2007; 4) Kythnos Island, Greece, 2 June 2008; 5) San Diego, USA, 17–18 September 2009; 6) Vancouver, Canada, 21–22 July 2010; 7) Jeju Island, South Korea, 26–27 2011 May; 8) Evora, Portugal, 3–4 September 2012; 9) Santiago, Chile, 11–12 September 2013; 10) Tianjin, China, 13–14 November 2014; 11) Aalborg, Denmark, 27–28 August 2015; 12) Niagara-on-the-Lake, Canada, 20–21 October 2016; 13) Newcastle, Australia, 28–30 November 2017; 14) Bucharest,

Romania, 2–6 September 2018; 15) Fort Collins, USA, 10–11 August 2019; 16) Singapore, 1–2 November 2022. All have been highly productive and enjoyable.

The goal of the EnergyVille 2023 Symposium was to continue the exchange of results from microgrid research, demonstration, and deployment worldwide with emphasis on recent results and areas of potential international cooperation. As before, each region has invited eminent speakers to present their work, and there was the usual additional session on remote applications and posters on display. The emphasis was on current microgrid demonstrations, although fundamental research and policy presentations were also welcome. Attendance is by invitation only, and usually about half of the attendees are from the host region while the other half is approximately evenly split between the remaining regions.

The EnergyVille Symposium was attended by 98 attendees from 33 countries (Figure 1). As in all these years, the organizers took the responsibility to host the main symposium without any registration fee. There were two full days of presentations on 19–20 September 2023 at the EnergyVille, Thor Park, Genk, Belgium, the official venue for the symposium (Figure 2).

Although technical talks were the core of the two days of intensive

work, the conference included various social events so that participants could engage in fruitful and enjoyable discussions in a warm and friendly environment. A welcome reception arranged for the afternoon before the first day of the official meeting was followed by a banquet dinner on the second day, hosted at C Mine, a previous mine complex that is used today as a creative hotspot and an industrial museum. (Figures 3 and 4). The location for the dinner was the perfect opportunity for the delegates to explore switchgear dating back to the First World War (Figures 5–7), while reflecting on the current challenges around the energy transition. On the third day, a technical tour on the actual microgrid demonstration sites and research facilities of the EnergyVille Center was organized. Special mention goes to the technical visit to Th!nk E Living Lab.

The technical part of the conference (Figure 8) was opened by the Conference Chair Johan Driesen (Katholieke Universiteit KU Leuven and EnergyVille) who gave the welcome speech and Maria Brucoli (SSE Energy Solutions, U.K.) who presented the history of the Microgrids Symposia series. The symposium was opened by Gerrit-Jan Schaeffer, the Director of EnergyVille. EnergyVille is a collaboration between the Belgian research partners KU Leuven, VITO,



Figure 1. The EnergyVille Symposium attendees.

imec, and UHasselt in the fields of sustainable energy and intelligent energy systems. It develops technology and knowledge to support public and private stakeholders in the transition to an energy-efficient, decarbonized, and sustainable urban environment. Its activities are clustered in eight interdisciplinary domains: solar energy, battery storage, power electronics, power-to-molecules, thermal systems, electrical networks, energy for buildings and districts, and energy strategies and markets. It is located in the industry-oriented ecosystem of Thor Park (Genk, Belgium). Genk itself is a young city that cleverly developed on the foundations of its rich mining past that combines its industrial image with the title of greenest city in Flanders.

On the inaugural day, Marija Ilic from the Massachusetts Institute of Technology, Cambridge, USA, delivered a compelling Keynote Speech

titled “Cyber-secure dynamic monitoring and decision systems (DyMonDS) for emerging microgrids” (Figure 9). Her presentation centered on addressing the multifaceted challenges and opportunities within microgrid

technology, business landscapes, and societal implications. With a global perspective, Ilic highlighted noteworthy microgrid installations worldwide, offering valuable insights from these experiences, lessons learned,



Figure 2. Thor Park, Genk, Belgium, the official venue for the EnergyVille Symposium.



Figure 3. Old coal mine shaft at C Mine, Genk.



Figure 4. Johan Driesen, the EnergyVille Symposium Chair, and Maria Brucoli, the International Steering Committee Chair speaking at the symposium banquet.

and how these innovations could integrate into the broader spectrum of modern power systems' technological advancements.

Europe Session 1, chaired by Nikos Hatziaargyriou (National Technical University of Athens, Greece) and Maria Brucoli (SSE Energy Solutions, U.K.) included three presentations. A presentation from Yanbo Wang (Aalborg University, Denmark) entitled "DC microgrid technology toward green e-transportation" focused on the role of microgrid-based solutions for green e-transportation. Examples included a dc microgrid-based vehicle-to-grid (V2G), dc microgrid-based metro traction power system, and a dc microgrid-based hybrid metro traction solution. It was followed by Katja Sirviö (VTT Technical Research Center of Finland) presenting "Dynamic energy landscapes: VTT's leading role in unlocking innovation and powering tomorrow," which included VTT's vision of microgrids as modular "web-of-cells" concept. It regards microgrids as enablers of energy communities, local energy markets, and sector integration providing a modular approach from building to city level. Jan Cappelle (KU Leuven and EnergyVille) presented "Agri-PV: Combining food and electricity production," highlighting their great benefits, and providing successful real-life examples.

The Asia Session chaired by Meiqin Mao (Hefei University of Technology, China) and Dongjun Won, (Inha University, South Korea) included three presentations. Yukitoki Tsukamoto (Mitsubishi Electric Corporation) provided several real installations and introduced a digital solution that combines distributed resource energy management system and an energy exchange and trading system. The presentation of Wei Feng (Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China) was entitled "Flow battery and its

application in microgrids and demand response.” It presented the technical characteristics, current state of developments, and further needs of improvement of vanadium flow batteries, zinc-based flow batteries, organic aqueous flow batteries, and emerging multielectron transfer aqueous batteries. Hyeonjun Yoo from KERI (South Korea) outlined the pivotal issues arising from the proliferation of inverter-based resources (IBRs) in his presentation on “Grid-forming (GFM) inverter-based distributed control for microgrids.” His emphasis centered on addressing the challenges posed by the growing presence of IBRs. Yoo’s primary research goals revolved around the development of GFM-based virtual inertia control technology to enhance frequency stability and enable distributed operation without relying on a central energy management system.

Prof. Trevor Gaunt (University of Cape Town, South Africa) delivered the keynote speech of the second day on microgrids and electrification in South Africa. He gave an overview of past and current microgrids projects including agricultural projects identifying failures and “seeds of hope.” He described current power deficits in South Africa, with adverse effects on power poverty and economic development, and explained the general power theory. He finally underlined the difference in planning and operation of microgrids in Africa compared with developed regions.

The isolated systems session was chaired by Alexandre Prieur (CanmetENERGY, Natural Resources Canada) and Jorge Ortiz (Trama TecnAmbiental (TTA), Spain). The first speaker was Michael Ross (Yukon University, Canada) on “Lessons learned in Old Crow post-commissioning.” The Old Crow community, residing within the Arctic Circle and belonging to the Vuntut Gwitchin First Nation, stands committed to harmonizing their lifestyle

with nature and the environment. The Old Crow microgrid is an innovative project which includes solar panels, batteries, diesel engines, and a microgrid controller. The project is the most expansive solar initiative within the Yukon, marking a significant milestone in the region’s renewable energy landscape. The second speaker was Oscar Aitchison (Okra Solar) on mesh grids on redesigning

electricity networks from the ground up. He developed the idea of a mesh grid as a bottom-up electrification of individual buildings, leading to a fully decentralized grid and their current development in multiple locations in Africa with dispersed population providing economic and reliability advantages. Yanni Luo (Sungrow, EMEA) spoke on “Empowering microgrids: Sungrow’s ESS solutions”

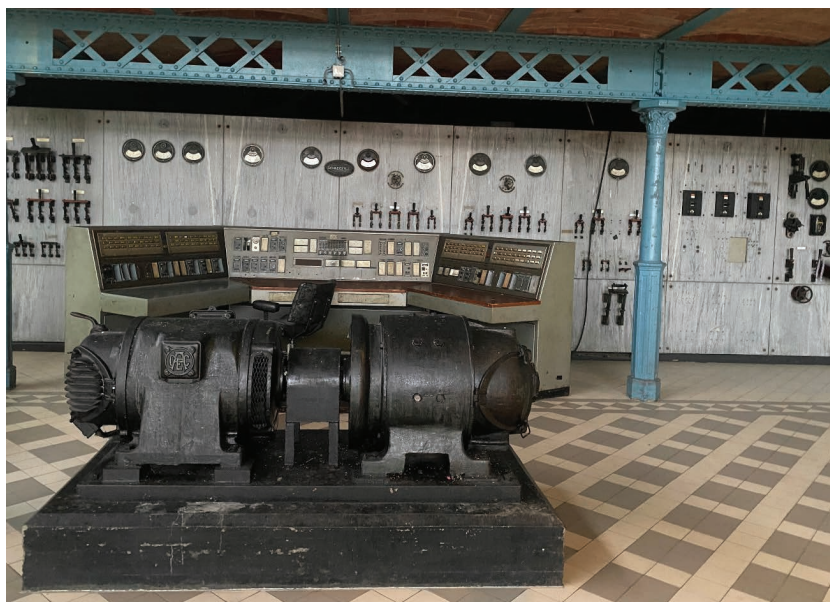


Figure 5. Old switch room at the C Mine industrial museum, Genk.



Figure 6. Details of measurement equipment at the C Mine industrial museum, Genk.



Figure 7. Details of switchgear cabinets at the C Mine industrial museum, Genk.

describing smart energy solutions for the microgrid power station with advanced control capabilities including black start solutions and several successful application cases.

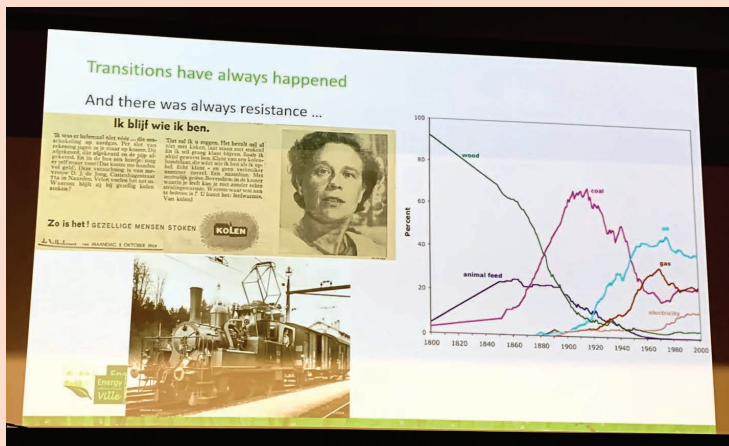
The Europe Session 2—EU Projects was chaired by Maria Brucoli (SEE Energy Solutions). Nikos Hatziaargyriou (NTUA) presented the “Project RE-Empowered: Renewable energy empowering European and Indian communities.” RE-Empowered develops a complete set of solutions for local energy systems that will be demonstrated in four pilot sites: two European and two Indian, complementary in terms of size, organizational, and technical maturity. These are the Bornholm Island (Denmark),

Kythnos Island (Greece), Keonjhar (India), Isolated Villages, Ghoramara Island (India), where residents live without electricity in very poor conditions, suffering severe cyclonic storms every 5–10 years. Massimo Cresta (ASM Terni SpA, Italy) described the progress in the HYPER-RIDE—Hybrid AC/DC microgrid project. He focused on the Italian Pilot ASM Terni characterized by an already very high and increasing component of self-generated energy from renewable energy sources. The objectives are to validate LV ac/dc and dc/dc converters in a real distribution grid context demonstrating the potential offered by a more modular, smart hybrid ac–dc decentralized operation of the MV/LV electricity grid. Johan Driesen (KUL and EnergyVille) presented “Microgrids for EV charging” focusing on the advantages of low-voltage direct current (LVDC) technology’s role in commercial buildings and districts to facilitate the integration of on-site renewable generation and energy storage. He identified the key technical challenges and described the LVDC test facility (+/- 500-V bipolar dc) in EnergyVille including its extension to dc electric vehicle (EV) charging and the role of microgrids in the charging of eTrucks. Laurens Mackay, (DC Opportunities) presentation “DC microgrids opportunities” focused on the benefits and challenges around technology development and application for dc microgrids and dc distribution grids. Real-life applications include examples for rural electrification, dc/dc V2G EV charging and dc for public lighting.

The Americas Session was chaired by Guillermo Andres Jimenez Estevez (University of Los Andes, Colombia) and Jim Cale (Colorado State University, USA). The first presentation by the chairs together with Alexandre Prieur (Renewable Energy Integration CanmetENERGY Natural Resources Canada) was a “Microgrids overview in the Americas.” Jim Cale



(a)



(b)

Figure 8. (a) Welcome presentations. (b) Genk energy transition.

reported that in the United States, microgrids installations have surpassed 575 with a total capacity of 7,000 MW operating in 2022 with 3,000 MW more in construction, while the national renewable asset microgrid capacity is expected to grow 3.5 times, bringing the total to 32,470 MW by 2030. During the past six years, 21 states have proposed and enacted 53 microgrid-related bills largely for grid reliability and resilience. These often arise following an extreme weather event or prolonged outage. Alexandre Prieur explained that in Canada the microgrid main driver is the renewable generation integration to main grid (i.e., Net Zero community and distributed energy resource integration) aiming to reduce diesel dependence. He presented federal funding programs for isolated communities and presented a number of successful relevant projects. Guillermo Jiménez Estévez presented the status of microgrids in Latin America, including laboratories and test systems. Fourteen microgrids projects starting in 2008 of various sizes are in operation, while research on Nexus WEF, Agrivoltaics, and SPP is actively ongoing.

Fabio Andrade from the University of Puerto Rico-Mayagüez delivered a presentation titled “Resilient microgrid pilots.” He presented the Microgrid Laboratory at the university, shedding light on ongoing research initiatives and collaborative projects. Andrade highlighted the catastrophic impact of Hurricanes Fiona and Maria and their profound effects on Puerto Rico. He elaborated on the operational and ongoing pilot microgrid initiatives in the region, emphasizing their critical role in the aftermath of such disasters. These initiatives notably encompass community engagement spanning across 19 municipalities, showcasing the pivotal role of microgrids in bolstering resilience within these communities. Luiz A. S. Ribeiro [Federal University of Maranhão (UFMA/



Figure 9. Marija Ilic keynote speech.

Brazil) and Technical University of Denmark (DTU)] presented the “Medium voltage microgrid for Alcântara Launch Center” in the context of the Brazilian strategic plan to increase the rocket launches, including private company launches. He described the on-grid, off-grid operation modes, blackstart, and the transition from on-grid to off-grid and vice versa focusing on the scheduled off-grid operation for safety during rocket launches. Ali Mehrizi-Sani [Virginia Tech (VT), USA] presented the “Microgrids for military installations: A technology review.” He underlined the need for resilience and focused on 5G deployment for electrical grid applications, as a microgrid utilizing renewables, and the advantages of 5G control, including cost savings, green energy utilization, grid efficiency and security, resiliency, and reliability. He also described the VT 5GPG Testbed.

The Poster Session was organized and chaired by Mihaela Albu (Technical University for Science and Technology Politehnica of Bucharest, Romania) and Hiroshi Asano (Central Research Institute of Electric Power Industry (CRIEPI), Japan). Seventeen posters were put on display, with many of them raising high interest among participants. Following a dedicated session with a 3-min pitch from the presenter of each poster,

four posters were selected from the participants to receive the “Best Poster Prize”:

- 1) Saehwan Lim (KERI Distributed Power System Research Center, Korea), presenter of “Real time hardware validation of optimal conservation voltage reduction strategy with measurement based load estimation,” authors: Saehwan Lim, Hyeong-Jun Yoo, Jin-Oh Lee, Gyeong-Hun Kim.
- 2) Luiz A. S. Ribeiro (Federal University of Maranhão, Brazil, and Technical University of Denmark, Denmark), presenter of “Microgrid for Alcântara Launch Center in Brazil,” authors: Hércules A. Oliveira, Luiza Higino S. Santos, Luiz A. S. Ribeiro, José G. de Matos, and Mehdi Savaghebi.
- 3) Gunnar Kaestle (T.U. Clausthal, Germany), presenter of “Self-regulation of dispatchable loads for resilient microgrid supply with electric vehicles,” authors: Gunnar Kaestle, Haoyuan Wang, Tomi Engel.
- 4) Guillermo Jiménez-Estévez (Universidad de los Andes, Colombia), presenter of “Analysis of energy alternatives under the water-energy-food nexus approach,” authors: Andrea Cusva-García, Guillermo Jiménez-Estévez, Rocío Sierra, Nicanor Quijano.

The International Microgrid Symposium is made possible through the work of the International Steering Committee (ISC). The authors of this article would like to thank: “The Americas” ISC members: Brian Miller, Jim Cale, Farid Katiraei, Chris Marnay, Guillermo Jiminez, Alexandre Prieur

and Michael Ross; the “Asia and Oceania” ISC members: Ryoichi Hara, Dongjun Won, Shigeru Bando, Saad Sayeef, Meiqin Mao, Alex Chong, Pierluigi Mancarella, Lingwei Zheng, Yuko Hirase, Raymond Chang, Jin-Hong Jeon, and Wei Feng; “Europe and Africa” ISC members: Josep Guerrero,

Xavier Vallve, Roger Salent, and Yajuan Guan. The next Symposium will be organized in Puerto Rico in 2024.

All presentations and posters of the 2023 EnergyVille and the previous Microgrids Symposia can be downloaded from <https://microgrid-symposiums.org/>.

EnergyVille 2023 Symposium on Microgrids

18-20 September 2023, Genk - Belgium



“Plain Talk About the Electric Power Industry”

PLAIN TALK ABOUT THE Electric Power Industry” is a three-day series of courses targeting power-industry professionals who are not engineers but who need more understanding of the technical side of the industry in which they work. New engineers or

engineers new to the power industry also take these courses. The first day consists of an overview of the electric power industry, and days two and three provide more detail on distribution systems and transmission systems, respectively. Students can take one, two, or all three courses. The schedule for 2024 is as follows:

- 6–8 May 2024, Anaheim, CA, USA (colocated with the 2024

IEEE PES T&D Conference and Exposition)

- 23–25 July 2024, Seattle, WA, USA (colocated with the 2024 IEEE PES General Meeting).

If you would like to develop a new course for the “Plain Talk” series, please contact LaToya Gourdine at l.gourdine@ieee.org.

