Budapest community microgrids

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Marija Ilic -- a senior research scientist at the Laboratory for Information and Decision Systems, affiliate of the MIT Institute for Data, Systems, and Society, senior staff in MIT Lincoln Laboratory''s Energy Systems Group, and Carnegie Mellon University professor emerita -- is a researcher on a mission: making electric energy systems future-ready.

Since the earliest days of streetcars and public utilities, electric power systems have had a fairly standard structure: for a given area, a few large generation plants produce and distribute electricity to customers. It is a one-directional structure, with the energy plants being the only source of power for many end users.

To explore this question, Ilic has developed a new way to model complex power systems.

Using this simpler concept to manage the complexities and limitations of electric power systems, Ilic is taking a non-traditional approach: She models the systems using information about energy, power, and ramp rate (the rate at which power can increase over time) for each part of the system -- distributing decision-making calculations into smaller operational chunks. Doing this streamlines the model but retains information about the system''s physical and temporal structure. "That''s the minimal information you need to exchange. It''s simple and technology-agnostic, but we don''t teach systems that way."

She believes regulatory organizations such as the Federal Energy Regulatory Commission and North American Energy Reliability Corporation should have standard protocols for such information exchanges, just as internet protocols govern how data is exchanged on the internet. "If you were to [use a standard set of] specifications like: what is your capacity, how much does it vary over time, how much energy do you need and within what power range -- the system operator could integrate different sources in a much simpler way than we are doing now."

Another important aspect of Ilic''s work is that her models lend themselves to controlling the system with a layer of sensor and communications technologies. This uses a framework she developed called Dynamic Monitoring and Decision Systems framework, or DyMonDS. The data-enabled decision-making concept has been tested using real data from Portugal''s Azores Islands, and since applied to real-world challenges. After so many years it appears that her new modeling approach fittingly supports DyMonDS design, including systematic use of many theoretical concepts used by the LIDS community in their research.

Although this is one of Ilic''s most recent projects, her work on DyMonDS can be traced back four decades, to when she was a student at the University of Belgrade in the former country of Yugoslavia, which sent her to the United States to learn how to use computers to prevent blackouts.

Ilic first arrived at MIT in 1987 to work with the late professor Fred Schweppe on connecting electricity technologies with electricity markets. She stayed on as a senior research scientist until 2002, when she moved to Carnegie Mellon University (CMU) to lead the multidisciplinary Electric Energy Systems Group there. In 2018, after her consulting work for Lincoln Lab ramped up, she retired from CMU to move back to the familiar environs of Cambridge, Massachusetts. CMU"s loss has been MIT"s gain: In fall 2019, Ilic taught a course in modeling, simulation, and control of electric energy systems, applying her work on streamlined models that use pared-down information.

Addressing the evolving needs of electric power systems has not been a "hot" topic, historically. Traditional power systems are often seen by the academic community as legacy technology with no fundamentally new developments. And yet when new software and systems are developed to help integrate distributed energy generation and storage, commercial systems operators regard them as untested and disruptive. "I"ve always been a bit on the sidelines from mainstream power and electrical engineering because I"m interested in some of these things," she remarks.

However, Ilic"s work is becoming increasingly urgent. Much of today"s power system is physically very old and will need to be retired and replaced over the next decade. This presents an opportunity for innovation: the next generation of electric energy systems could be built to integrate renewable and distributed energy resources at scale -- addressing the pressing challenge of climate change and making way for further progress.

"That"s why I"m still working, even though I should be retired." She smiles. "It supports the evolution of the system to something better."

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