

Integrated Power, Public Transit, Hydrogen, and Natural Gas Systems: A New Low-Carbon Approach using Energy Storage and Smart Grid Technologies

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Speaker:

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Abstract:

With the ever-increasing trend in the penetration of renewables into energy systems and wide adoption of fast charging stations to power electric vehicles and public transit networks, a new paradigm shift of the way energy is produced, traded, distributed, and utilized is created. Although such a shift is unparalleled, it is accompanied with serious integration challenges. In this presentation, examples of these challenges in power distribution systems such as voltage and reactive power control, reverse power flow, feeders' congestion, and energy management are briefly highlighted. An integrated power-transit simulation model is introduced to quantify the possible implications of adopting electric buses on power grids. A novel multi-agent control scheme is introduced to mitigate voltage and reactive power challenges in smart distribution systems and microgrids. While utility scale battery energy storage is envisioned as an effective mean to address most of the integration challenges; newly emerging technologies for power-to-gas (PtG) conversion are now offering alternative solutions to the problem. The proliferation of PtG facilities can lead to the deployment of integrated renewable-based natural gas and power systems in the near future. In this regard, new optimization algorithms are introduced in this presentation to schedule the operation of integrated power, hydrogen, and gas distribution networks and quantify the techno-economic benefits of the proposed integrated system.

Bio:

Dr. Farag received the B.Sc. (with honors) and the M.Sc. degrees in Electrical Engineering from Assiut University, Egypt, in 2004 and 2007, respectively, and the PhD degree in Electrical and Computer Engineering from University of Waterloo, in 2013. Dr. Farag is a registered professional engineer in Ontario and a member of Cigre international workgroup C6.28 for standardization of microgrids. He joined the Department of Electrical Engineering and Computer Science at York University in 2013 as an assistant professor, where he has been promoted to the rank of associate professor before joining KFUPM. His main research interests are in the areas of power distribution networks, integration of distributed energy resources, electric mobility, modeling,

analysis, and design of microgrids and hydrogen energy systems, and applications of multi-agent technologies in smart grids.