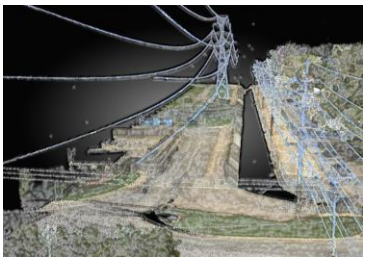
IPUMSU

MICHIGAN STATE UNIVERSITY | INSTITUTE OF PUBLIC UTILITIES Regulatory Research and Education

517.355.1876 | 517.355.1854 fax | ipu.msu.edu | ipu@msu.edu

IPU Grid School 2017



Engineering, Economics, Regulation, and Transformation of the Supply Chain for Power

March 27-30, 2017 | Kellogg Center, MSU

About Grid School

IPU Grid School is designed to improve regulatory capacity for grid-related policy development and decision-making at all government levels in support of innovation, efficiency, and environmental goals. Grid School is open to the public and private sectors, including economic and environmental regulators. The program provides an intensive, interdisciplinary, and interactive educational and professional networking experience. Grid School is objective and rigorous, taught by knowledgeable and independent experts. This program considers the integral role of electricity grids in the energy supply chain and is designed to be responsive to new mandates and infrastructure investments associated with federal and states policies. IPU Grid School is sponsored by the Institute of Public Utilities in collaboration with MSU's College of Engineering and Argonne National Laboratory.

IPU Grid School is **open to everyone** and designed for members of the federal and state regulatory policy community, including commissioners and staff members of the public utility commissions, energy and environmental agency staff, legislative staff, consumer advocates, utility personnel (public and private), engineers, planners, investors, analysts, consultants, attorneys, and others interested in learning about the electricity grid. Attendees receive a certificate of participation and credit toward a Certificate of Continuing Regulatory Education (currently available only to public-sector and nonprofit employees). IPU also can help arrange continuing education credits (for engineers, accountants, attorneys, and others).

Topics Covered

- Fundamentals of power systems and grid infrastructure
- Fundamentals of electricity markets and economics
- Intersection of wholesale and retail markets
- Grid integration for variable energy resources
- Resource modeling, planning, and mapping
- Energy storage and emerging technologies
- Integrated resource planning policy and practices
- Demand-side energy resources and their evaluation
- Distributed energy resources and their impacts
- Rate design and net metering
- Natural gas trends and role in the power sector
- Interdependency, security, resiliency, and big data
- Emerging utility and regulatory models
- Future of electricity and grids

IPU also offers a Sunday preconference program on **Introduction to Public Utility Regulation and Ratemaking** (1:00 to 6:00 pm).

For program details and registration information, please visit www.ipu.msu.edu.
For accommodations, please visit https://kelloggcenter.com.

IPUMSU

MICHIGAN STATE UNIVERSITY | INSTITUTE OF PUBLIC UTILITIES Regulatory Research and Education

517.355.1876 | 517.355.1854 fax | ipu.msu.edu | ipu@msu.edu

IPU Grid School 2017

March 27-30, 2017 | Kellogg Center, MSU

Program Agenda

Sunday	Room 105
1:00-6:00 pm 270 min.	**Introduction to Public Utility Regulation and Ratemaking** [Beecher] Optional preconference educational program (separate registration required)

Monday	Lincoln Room
7:00-8:00 am	**Registration & Continental Breakfast *(provided each morning)***
8:00-8:15 am	**Welcome to Grid School!** [Beecher].
8:15-10:00 am 105 min.	**Fundamentals of Power Systems and Grid Infrastructure 1** [Mitra]. Characteristics of electrical power. Supergrids, transmission, distribution grids, and microgrids. Infrastructure components, interconnection, interoperability, and balancing.
10:00-10:15 am	Networking Break
10:15-12:00 pm 105 min.	**Fundamentals of Electricity Markets and Economics 1** [Rose]. Wholesale market structure, operation, economics, and pricing. Role of private, nonprofit, and public power. Federal, state, and local governance of generation, transmission, and distribution. FERC regulation and key rulings. Fragmentation and coordination.
12:00-1:15 pm	Lunch at Brody Hall (on your own)
1:15-3:00 pm 105 min.	**Fundamentals of Power Systems and Grid Infrastructure 2** [Mitra]. Congestion, abnormalities, and vulnerabilities. NERC and other standards for quality, reliability, and security. Supply-side capacity, efficiency, and expansion. Grid modernization and intelligence. Smart-grid capabilities.
3:00-3:15 pm	Networking Break
3:15-5:00 pm 105 min.	**Fundamentals of Electricity Markets and Economics 2** [Rose]. Energy, capacity, and ancillary services markets. Regional transmission organizations (RTOs). Distribution system organizations (DSOs). Retail markets. Transactive energy.
5:00-5:30	**Bonus: State Oversight of the RTOs** [Paslawski].

5:30-7:00	Welcome Reception

Tuesday	Lincoln Room
8:15-10:00 am 105 min.	**Intersection of Wholesale and Retail Markets** [Rose]. Market behavior and monitoring. Environmental regulation. PURPA and avoided cost. Wholesale price signals. Renewable Energy Certificate (REC) markets. Demand response.
10:00-10:15 am	Networking Break
10:15-12:00 pm 105 min.	**Grid Integration for Variable Energy Resources** [Veselka].Engineering properties and efficiency of energy resource alternatives. Costs and benefits of renewable resources. Locational marginal pricing (LMP).
12:00-1:15 pm	Lunch at Brody Hall (on your own)
1:15-2:15 pm 60 min.	**Grid Integration for Variable Energy Resources** [Veselka]. Case studies
2:15-2:45 pm	Networking Break
2:45-4:00 pm 75 min.	**Resource Modeling, Planning, and Mapping** [Koritarov]. Methodological evolution and accepted practices in planning and forecasting. Modeling generation capacity expansion investment decisions. Regional planning, management, and coordination. Energy Zones Mapping Tool.
4:00-4:15 pm	Networking Break
4:15-5:00 45 min.	**Energy Storage Technologies** [Koritarov]. Centralized and distributed energy storage. Pumped storage. Fuel cells. Electric vehicles. Emerging technologies.
5:00-5:30	**Bonus: Renewable Portfolio Standards** [Barbose].

Wednesday	Lincoln Room
8:15-10:00 am 105 min.	**Integrated Resource Planning** [Wilson]. Regulatory requirements, practices, and processes. Resource and grid neutrality. IRP modeling methods.
10:00-10:15 am	Networking Break
10:15-12:00 pm 105 min.	**Demand-side Energy Resources** [Levin]. Energy efficiency technologies Dynamic pricing and demand response. Data security and privacy. Aggregation, bidding, and dispatching. Behavioral issues. Program evaluation.
12:00-1:15 pm	Lunch at Brody Hall (on your own)
1:15-3:00 pm 105 min.	**Distributed Energy Resources** [Barbose]. Trends in electricity revenues, expenditures, and prices. Rate design and net metering. Grid defection. Impacts on grids, utilities, and customers.
3:00-3:15 pm	Networking Break

3:15-5:00 pm 105 min.	**Natural Gas Trends and Role in the Power Sector** [Dismukes]. Interaction o gas and electricity markets. Gas in the generation portfolio. Resource interdependency.
5:00-5:30 30 min.	**Bonus 1: Overview of International Case Studies** [Levin]. **Bonus 2: Integrated Resource Planning in Michigan** [Proudfoot].

Thursday	Lincoln Room
8:15-10:00 am 105 min.	**Infrastructure Interdependency and Cyber-security** [Ten]. Transmission and distribution grid vulnerabilities. Cyber-security assessment and protection. Recovery and resilience. Utilities and big data.
10:00-10:15 am	Networking Break
10:15-Noon 105 min.	**Roundtable on the Future of Electricity Grids: Evolution or Extinction?** [Beecher, et al.] Regulatory compact. Social value of networks. Disruptive change and uncertainty. Myth and reality of the death spiral. Incentives for grid modernization. Paradigms and prudence. Competing energy goals and futures.
Noon	Adjourn

Accessing program materials
Navigate to the attendee materials link on the IPU program web page and enter the program password: _____.

Submitting questions during the program
Program attendees are encouraged to ask questions at any time. To submit questions to the speakers from your phone, tablet, or computer, visit www.sli.do and enter event code #_____. Downloading the sli.do app is optional.

MICHIGAN STATE UNIVERSITY

Argonne NATIONAL LABORATORY

IPUMSU

MICHIGAN STATE UNIVERSITY | INSTITUTE OF PUBLIC UTILITIES Regulatory Research and Education

517.355.1876 | 517.355.1854 fax | ipu.msu.edu | ipu@msu.edu

IPU Grid School 2017

March 27-30, 2017 | Kellogg Center, MSU

Links to Program Evaluation Forms

Sunday
http://survey.constantcontact.com/survey/a07edza3z4mj0o7dfj9/start

Monday
http://survey.constantcontact.com/survey/a07edza5h5gj0o7kbe8/start

Tuesday
http://survey.constantcontact.com/survey/a07edza9n6zj0o88718/start

Wednesday
http://survey.constantcontact.com/survey/a07edzacn2bj0o8niy3/start

Thursday
http://survey.constantcontact.com/survey/a07edzafg69j0o92mxf/start

Overall Program Evaluation
http://survey.constantcontact.com/survey/a07edxlh8zpj083ecdk/start

IPUMSU

MICHIGAN STATE UNIVERSITY | INSTITUTE OF PUBLIC UTILITIES Regulatory Research and Education

517.355.1876 | 517.355.1854 fax | ipu.msu.edu | ipu@msu.edu

IPU Grid School 2017

March 27-30, 2017 | Kellogg Center, MSU

Program Faculty

Galen BARBOSE (glbarbose@lbl.gov)
Energy/Environmental Policy Research Scientist/Engineer, Electricity Markets & Policy Group, Lawrence Berkeley National Laboratory
MS, Energy and Resources Group, U.C. Berkeley.
eta.lbl.gov/people/Galen-Barbose

Janice BEECHER (beecher@msu.edu)
Professor and Director
Institute of Public Utilities, Michigan State University
Ph.D., Political Science, Northwestern University
www.linkedin.com/in/janice-beecher-33a61810/

David DISMUKES (dismukes@lsu.edu)
Professor and Executive Director
Center for Energy Studies, Louisiana State University
Ph.D., Economics, Florida State University
www.enrg.lsu.edu/staff/dismukes

Vladimir KORITAROV (koritarov@anl.gov)
Deputy Director, Center for Energy, Environmental, and Economic Systems Analysis, Argonne National Laboratory
School of Electrical Engineering, University of Belgrade
www.linkedin.com/in/koritarov

Todd LEVIN (tlevin@anl.gov)
Energy Systems Engineer, Center for Energy, Environmental and Economic Systems Analysis, Argonne National Laboratory
Ph.D., Industrial Engineering, Georgia Institute of Technology.
www.anl.gov/energy-systems/person/todd-levin

Joydeep MITRA (mitraj@msu.edu)
Associate Professor
Electrical and Computer Engineering, Michigan State University
Ph.D., Electrical Engineering, Texas A&M
www.egr.msu.edu/~mitraj/profile.html

Tanya PASLAWSKI (tanya@misostates.org)
Executive Director
Organization of MISO States
JD, Michigan State University College of Law
www.misostates.org/index.php/about-us-2/staff

Paul PROUDFOOT (proudfootp@michigan.gov)
Director, Electric Reliability Division
Michigan Public Service Commission
B.S., Packaging, Michigan State University
www.linkedin.com/in/paul-proudfoot-5749502b/

Kenneth ROSE (ken@kenrose.us)
Independent Consultant
Senior Fellow, Institute of Public Utilities, Michigan State University
Ph.D., Economics, University of Illinois at Chicago
www.linkedin.com/in/ken-rose-738a4365/http://www.kenrose.us/id1.html

Chee-Wooi TEN (ten@mtu-.edu)
Associate Professor, Electrical and Computer Engineering
Michigan Technical University
PhD, Electrical Engineering, University College Dublin
hwww.mtu.edu/ece/department/faculty/full-time/ten/

Thomas VESELKA (tdveselka@anl.gov)
Principal Computational Engineer
Argonne National Laboratory
M.S., Synoptic Meteorology, Northern Illinois University
www.anl.gov/energy-systems/person/thomas-veselka

Rachel WILSON (rwilson@synapse-energy.com)
Senior Associate
Synapse Energy Economics, Inc.
M.E.M., Yale School of Forestry and Environmental Studies
www.synapse-energy.com/our-team/rachel-wilson