The Electric Power Systems Center aims to facilitate worldwide electrification in an economically efficient yet equitable, secure, and low-carbon manner that helps to pave the way for the power system for the future.

The electric power sector is undergoing a seismic transformation. Major forces including the drive toward greater de-carbonization, increased decentralization, and digitization are reshaping the provision of electricity services. With these dynamics comes a host of opportunities and a range of challenges for stakeholders across the value chain.

The Electric Power Systems (EPS) Center, one of the MIT Energy Initiative’s Low-Carbon Energy Centers, has been established to accelerate an efficient transition toward a decarbonized power sector by leveraging and integrating MIT’s broad-ranging expertise.

Through quantitative analysis and member-focused research, the Center studies the impacts and system level implications of emerging technologies, evolving business models, and regulatory and policy dynamics that are shaping the future of the sector. The Center examines both pragmatic and disruptive solutions ranging from development of new modeling tools to breakthrough digital, software, and hardware technologies. It is also developing a comprehensive framework that expands upon MIT’s interdisciplinary and integrative modeling capabilities and techno-economic analysis to help guide and inform members on an ongoing basis through this transition.

“Understanding and shaping this transition requires a broad range of expertise in topics ranging from economics, power system regulation, and political science to sensors, control systems, and digital signal processing — areas of expertise that are central to the Electric Power Systems Center.”

— Professor Christopher Knittel
Co-Director, Electric Power Systems Center
Goals and approach

The Electric Power Systems Center applies the broad analysis and research capabilities of MIT faculty from across the Institute’s five schools and engages with EPS Center members to help them navigate the complex transition to tomorrow’s power system and support data-driven decision-making at the strategic, operational, and regulatory levels across the power sector. To incorporate the breadth of relevant perspectives, membership includes traditional utilities, OEMs, digital service providers, system integrators, new energy service providers, NGOs, and regulatory and policy makers, among others.

Analysis and core competencies

Today’s power system is highly complex, spanning 12 orders of magnitude from long-term planning to real-time system operation. To function, it depends on the precise integration of hardware, operational coordination, and market and regulatory structures. Increasing deployment of distributed energy resources such as solar, storage, wind, and demand response, along with growing cyber threats concomitant with digitization, are further challenging the reliable planning and operations of the power system.

Addressing these challenges in an effective and efficient manner requires a multidisciplinary approach. MIT is uniquely positioned to meet the challenges within the electric power sector given its breadth of capabilities across a wide range of technical, social, and economic disciplines relevant to the power sector. These include:

- Power system policy markets and regulatory design
- Climate and carbon impact modeling
- Technical and economic power system modeling
- Customer engagement, behavioral economics, and business model evolution
- Digitization and its impact on power systems
- Power electronics and power systems technology
- Application of machine learning and artificial intelligence
- Cybersecurity for the evolving power sector
- Enabling universal energy access in emerging economies
Key Electric Power Systems Center focus areas include:

- Markets and regulation
- Digitally enabled business models, customer engagement, cyber security
- Electrification of new sectors (mobility/transportation, the built environment)
- Hardware, sensor, communications, and control enablement
- Power system modeling and simulation

Computational methods and modeling tools

The Center develops state-of-the-art computational methods for power system modeling, simulation, and planning. Proprietary models core to the Center’s capabilities include:

- **GenX**: Wide area electricity resource capacity planning with distributed energy resources
- **Reference Network Model**: Wide area electricity resource capacity planning with distributed energy resources
- **D-Sim**: Distribution network power flow, locational pricing, and operational simulation with distributed energy resources
- **DR DRE**: End-user demand response and distributed resource economic decision model
- **SESAME**: High resolution energy systems technology assessment

To learn more about these modeling tools, visit: [epscenter.mit.edu/modeling-tools](https://epscenter.mit.edu/modeling-tools)

Example projects

The goals of these projects are to explore new areas that can advance the electric power system.

- System impacts of power sector decarbonization: Wind, solar integration, and the role for energy storage
- Maintaining system reliability on the path toward decarbonization
- Challenges to wholesale markets created by intermittent zero marginal cost generation at scale and public policies to encourage it
- The power system in transition: Insights on the spatio-temporal value of US renewable production
- Systems-level sustainability analysis of the electric power system
- A multilayered power system model for future-proof interoperability

“Quantitative analysis and modeling is key to understanding and guiding the transformations in the power sector.”

— Dr. Francis O’Sullivan
Co-Director, Electric Power Systems Center
Interested in joining us?

Membership benefits

- Semi-annual workshops
- Unpublished proprietary analysis and research presented via member-only webinars and at workshops
- Insights from techno-economic analysis and decision support tools
- Member participation in formulating collaborative research programs with the faculty committee
- Access to a curated web-based library of relevant academic research with links to all MIT Center for Energy and Environment Policy Research (CEEPR) working papers
- Opportunities to develop important connections with MIT researchers, rising talent, and the MIT/Boston-area startup ecosystem

The Electric Power Systems Center is building on over a decade of thought leadership in the energy sector with quantitative analyses that shape and inform policy, technology development, and future research.

Find these studies and more at: energy.mit.edu/studies

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