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Highlights from MIT Utility of the Future Report

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Utility of the Future: Technology, Regulatory/Policy, Business Models

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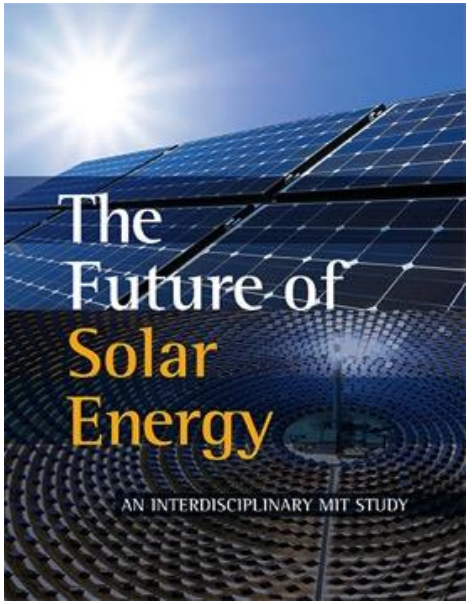
MIT Energy Initiative

Linking Science, Innovation, and Policy to Transform the World's Energy Systems

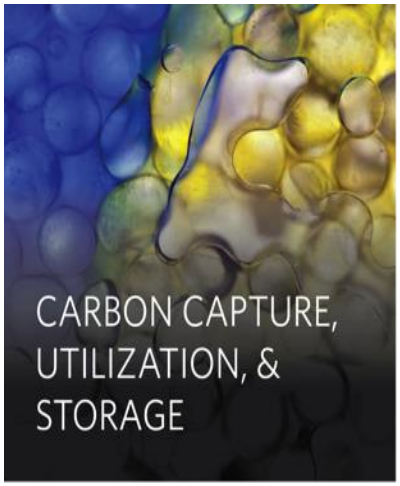
MIT has spun out over **60 energy start-ups** since MITEI's inception

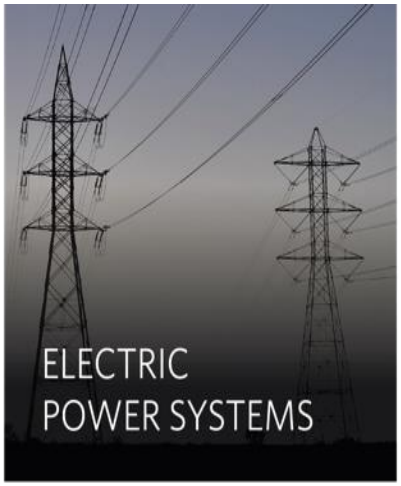
- 2006 Launch
- Interdisciplinary: Engineering, Science, Economic, Management
- Energy production, delivery, use… and environmental

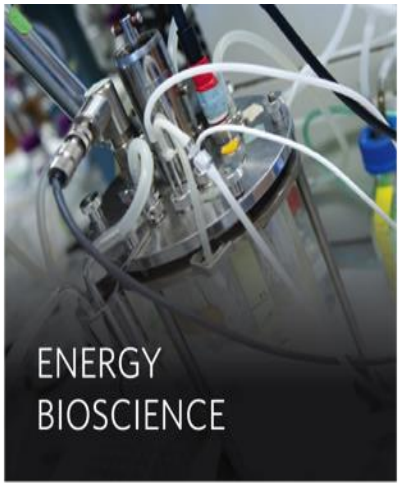
Over 30% of MIT faculty engaged

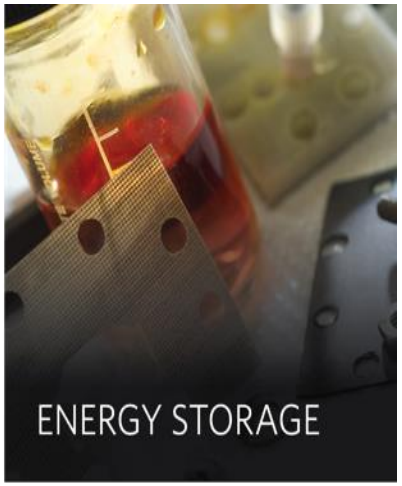


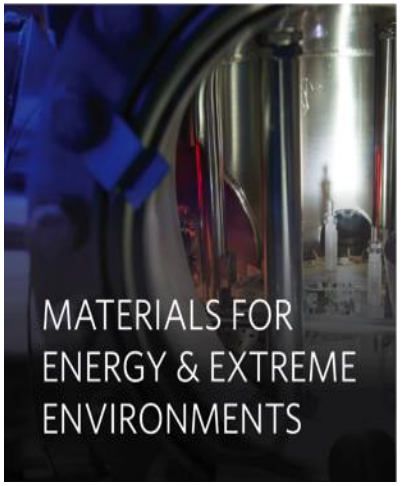
MIT Energy Initiative's
LOW-CARBON ENERGY CENTERS

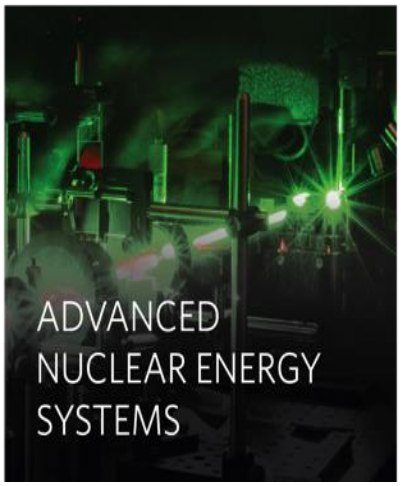


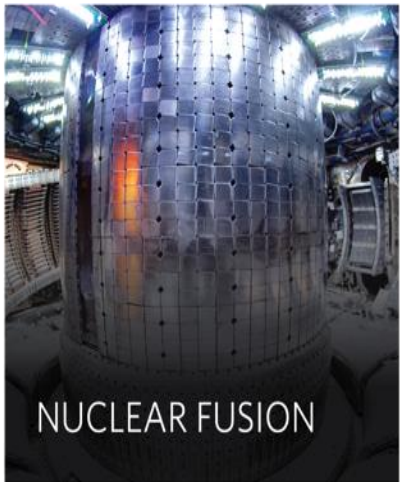


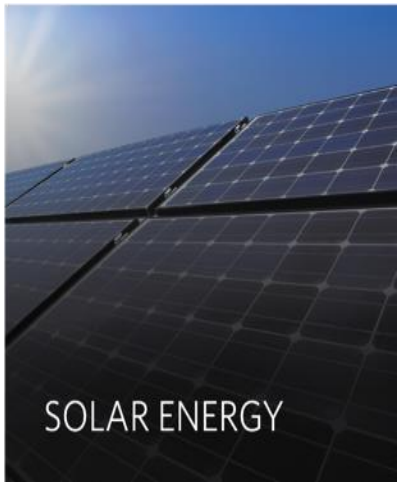


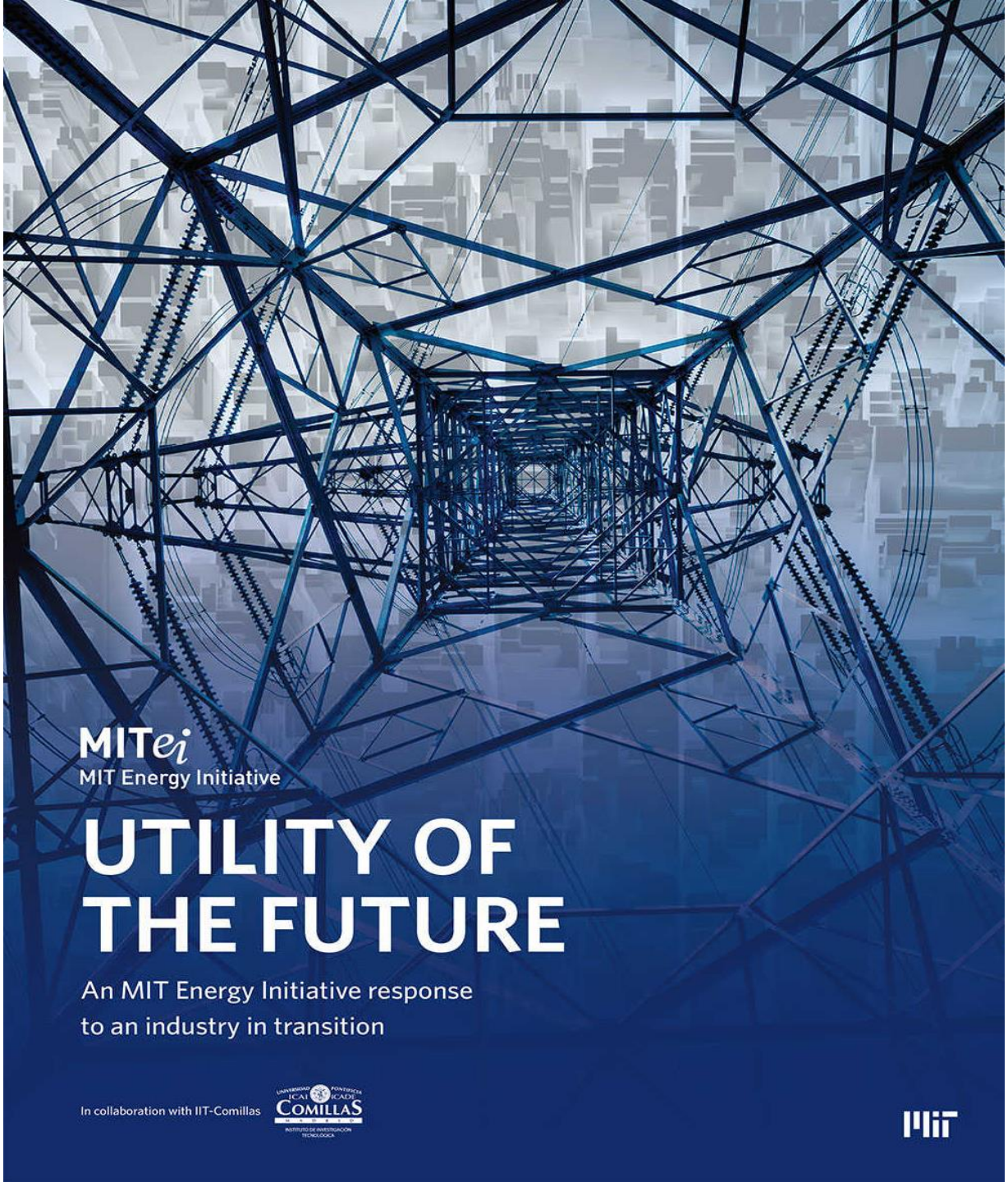










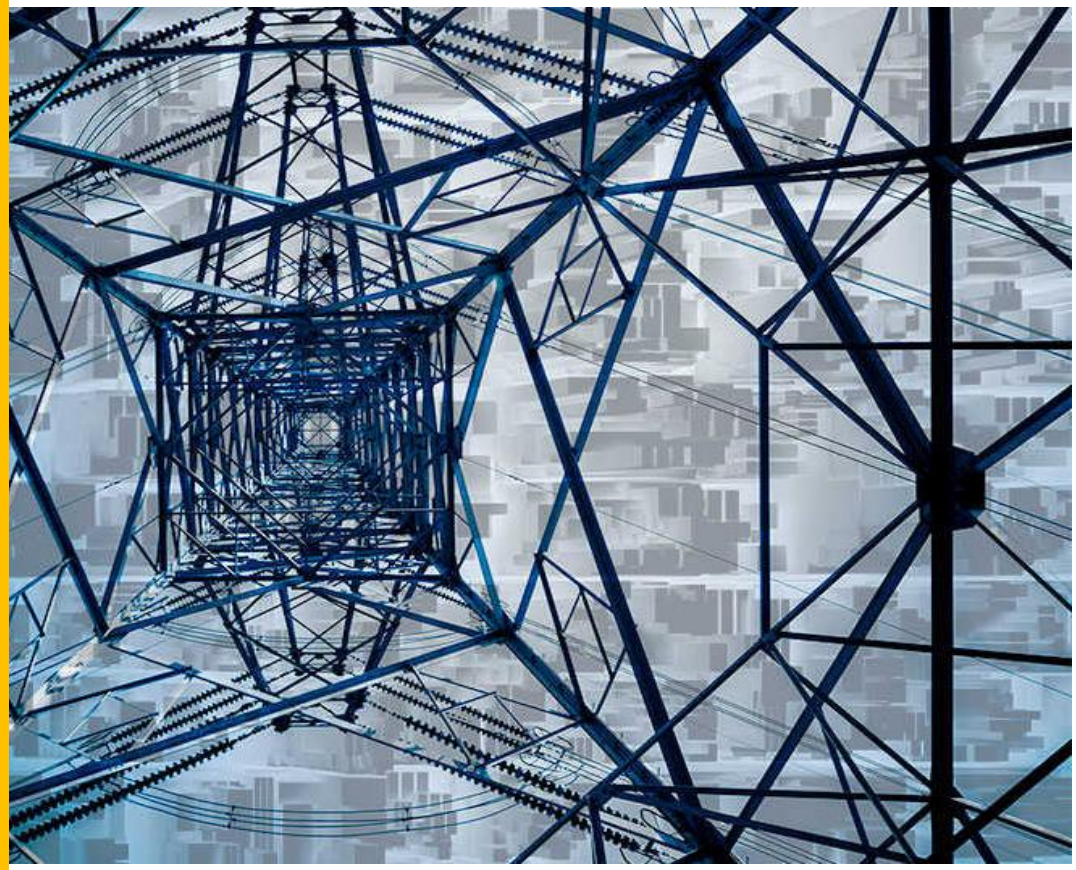


How Distributed Energy Resources (DERs) may change the provision of electricity services

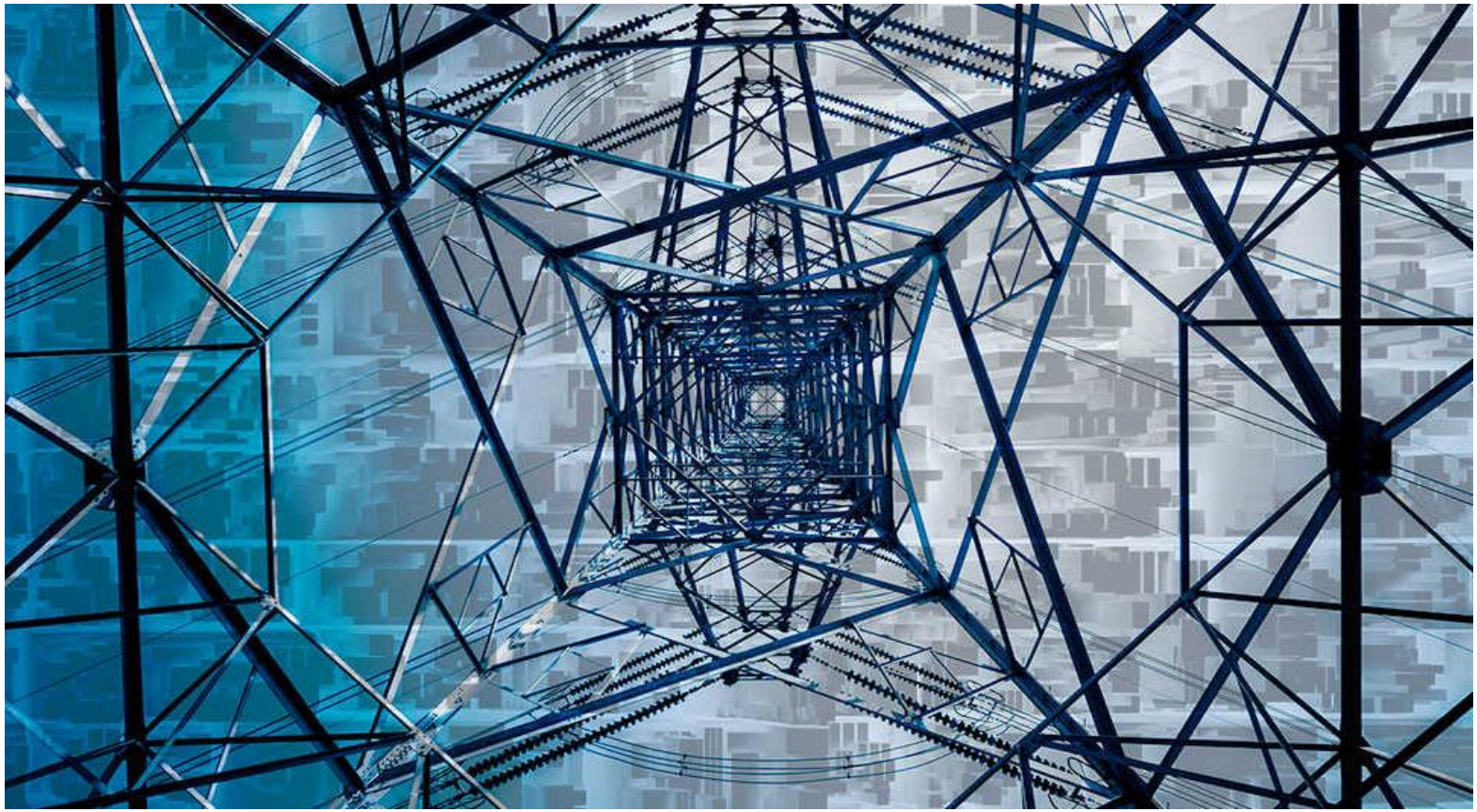
Multiple Technologies for Energy Generation

- **Coal/Gas**
- **Solar**
- **Wind**
- **Advanced Nuclear**
- **Fusion**

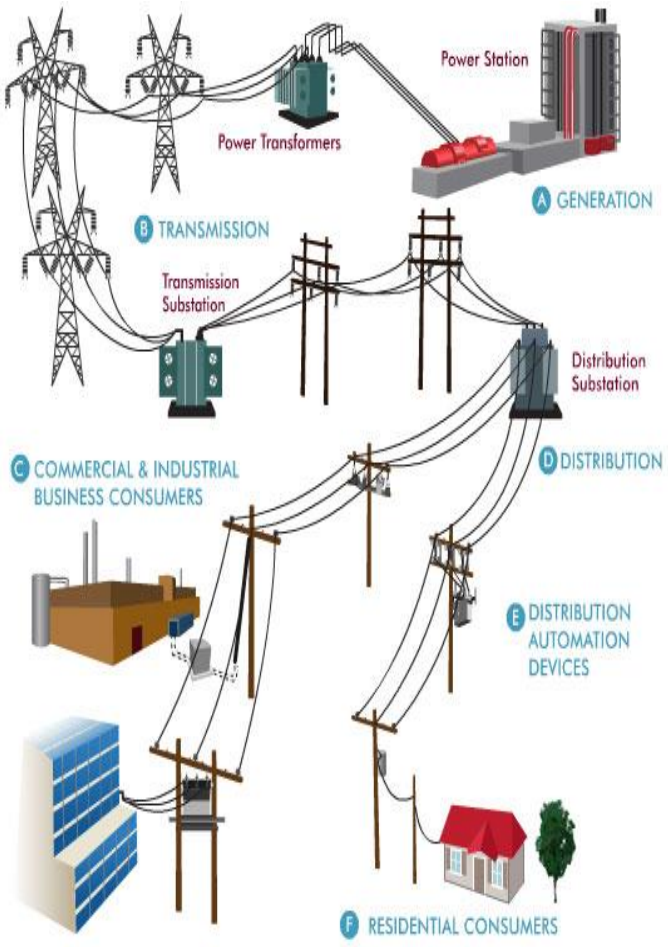
… and Energy Storage

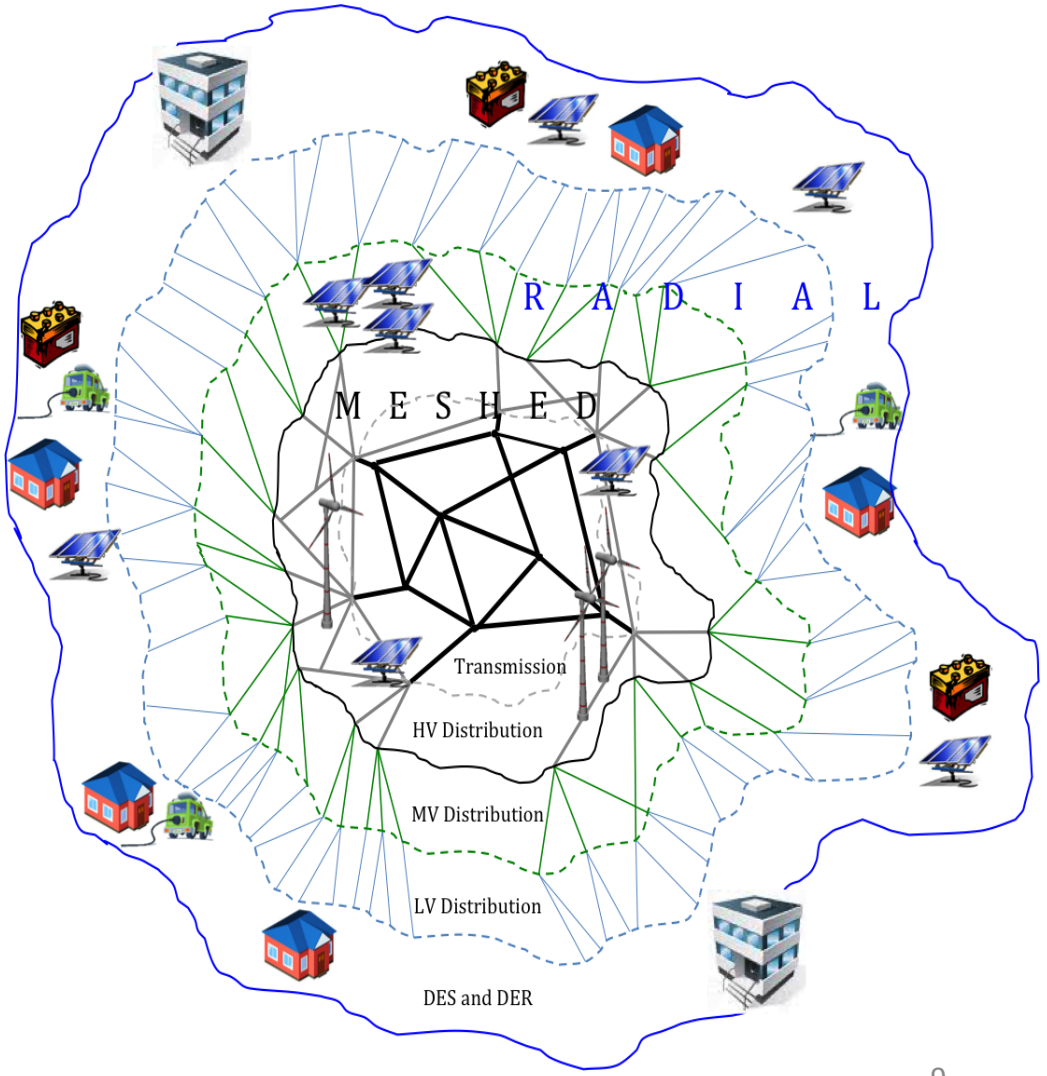


Policy/Regulatory: Need for Locational Marginal Pricing for energy services as part of efficient system

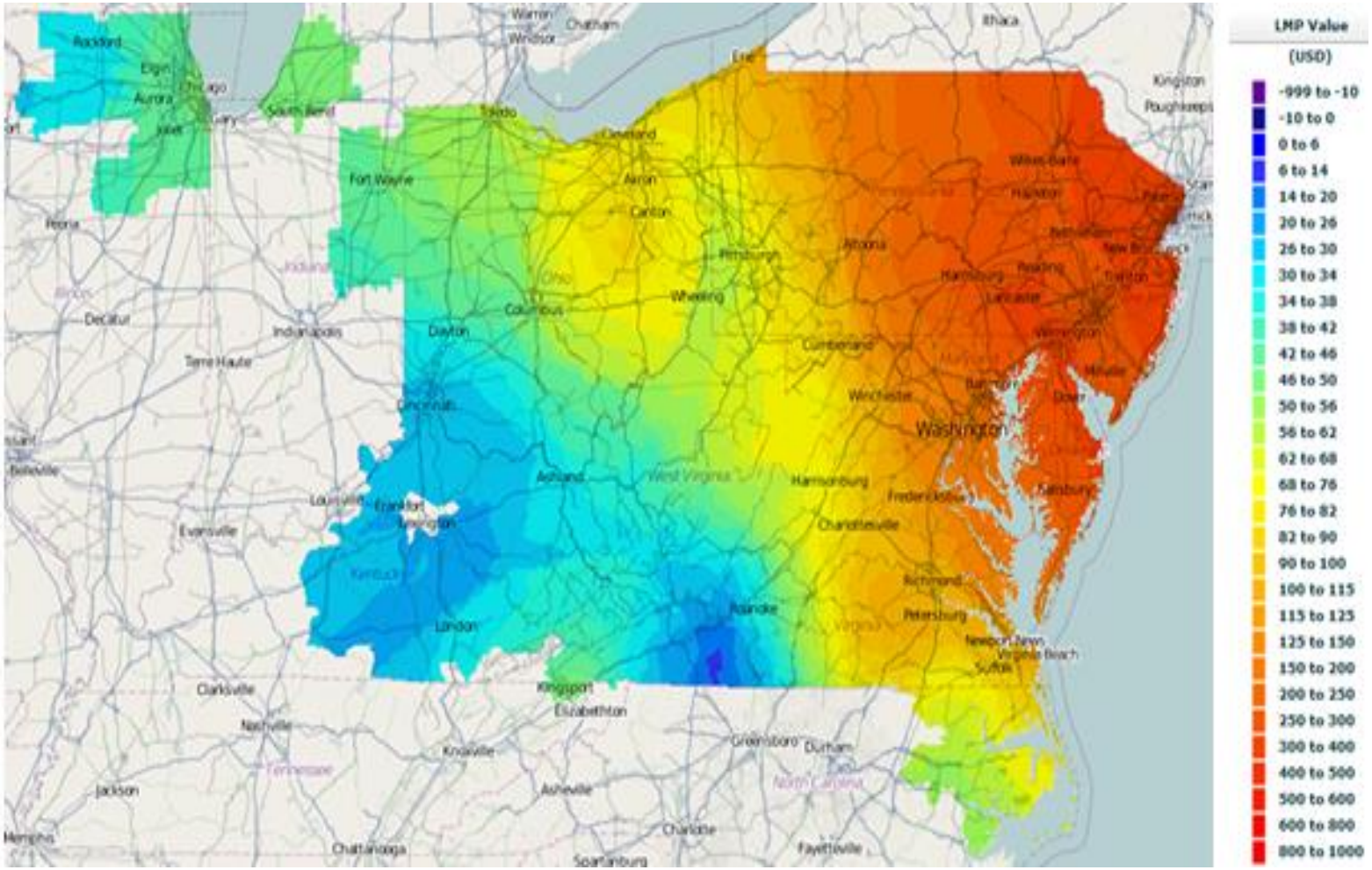


Electrical grid is complex and decentralized; Regulations need to be more sophisticated



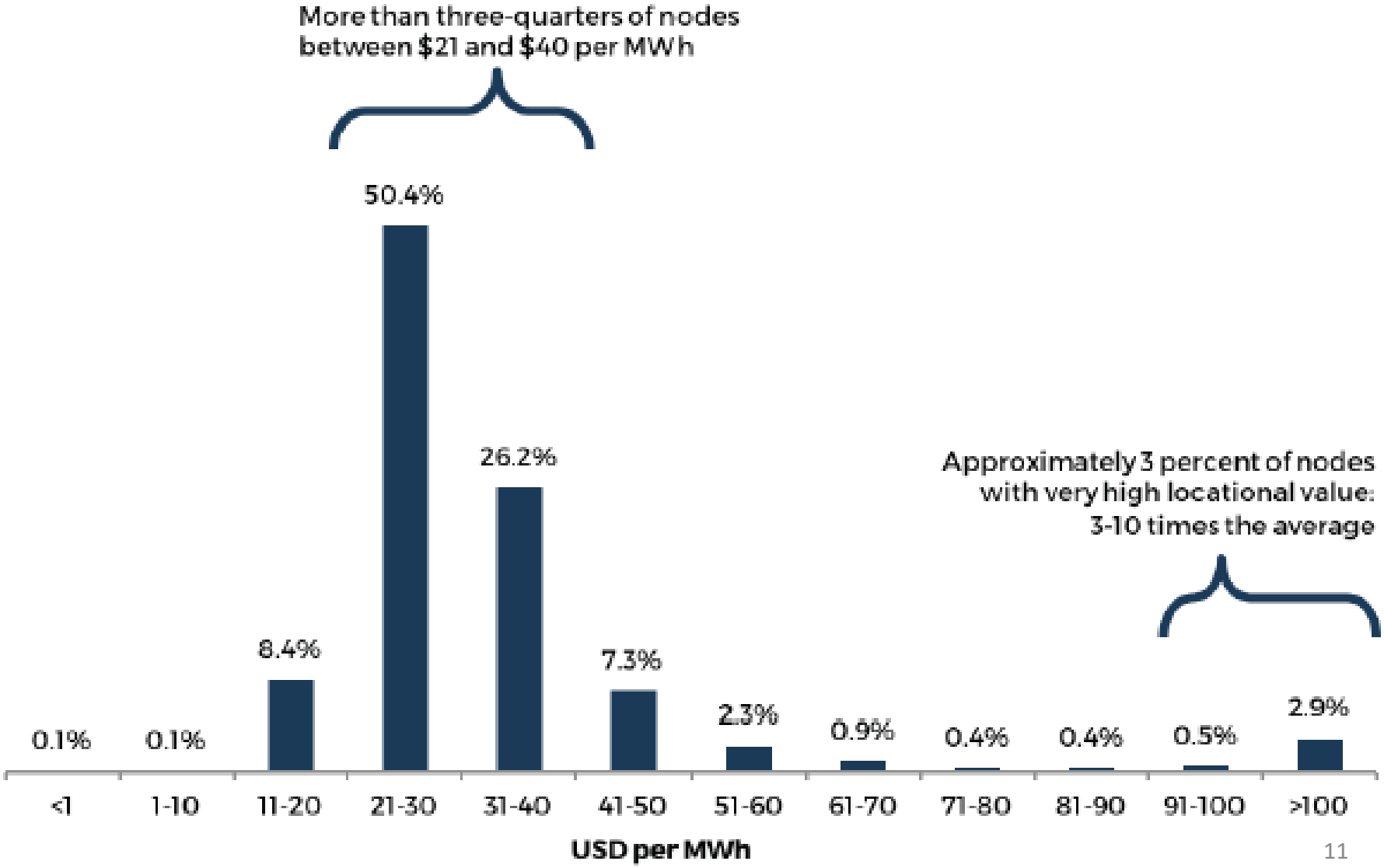


Energy prices at transmission level may vary significantly if there are binding network constraints

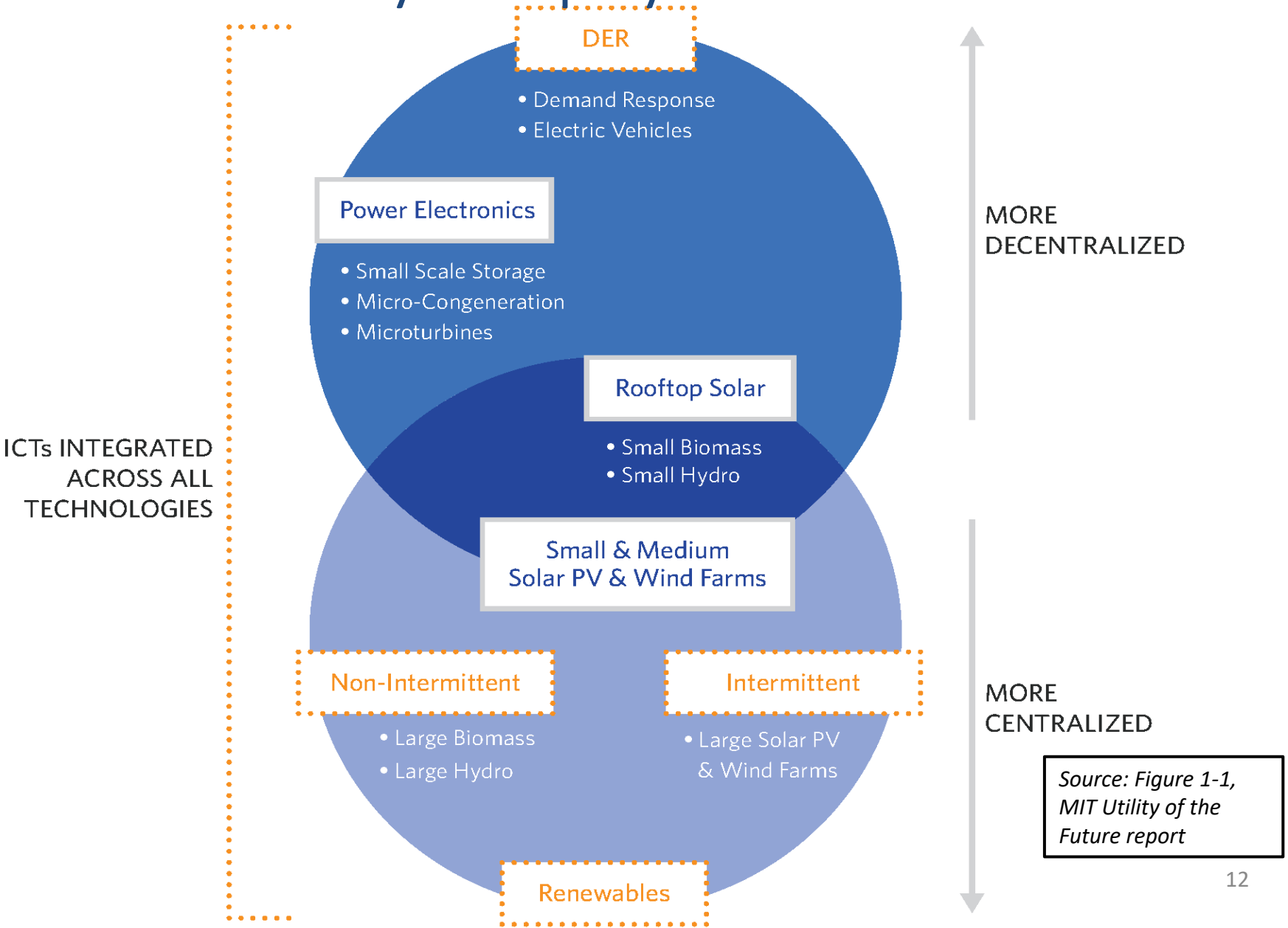


Wholesale Location Marginal Pricing variation across more than 11,000 PJM (Pennsylvania, New Jersey, Maryland Independent Systems Operator) nodes on July 19, 2015 at 4:05 pm

Average Nodal Locational Marginal Prices in single region can vary widely *($ per Megawatt-hour; 2015, PJM)*



Taxonomy showing Distributed and Renewable Energy Resources can vary in deployment

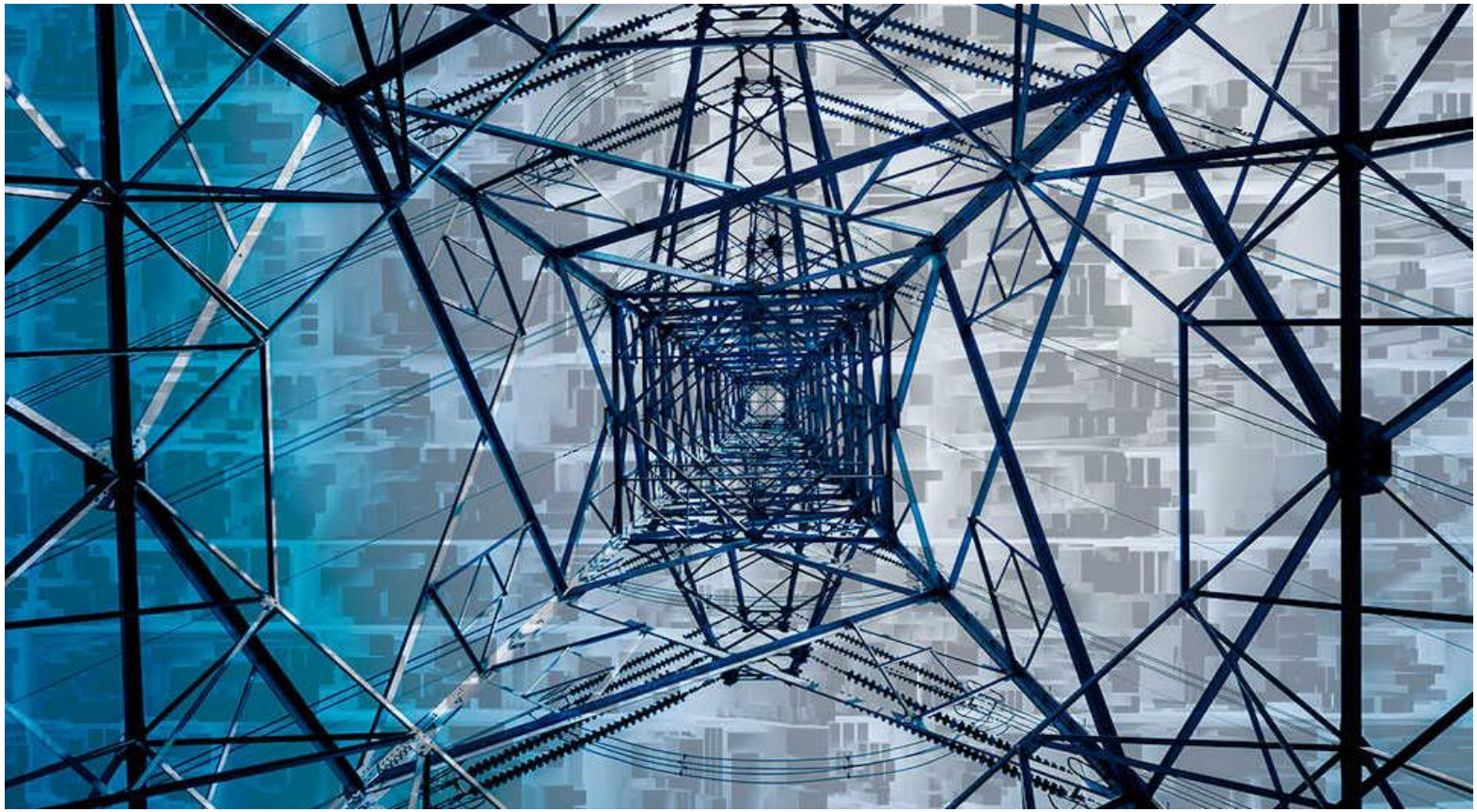


Source: Figure 1-1, MIT Utility of the Future report

Locational Benefits of Distributed Energy Resources

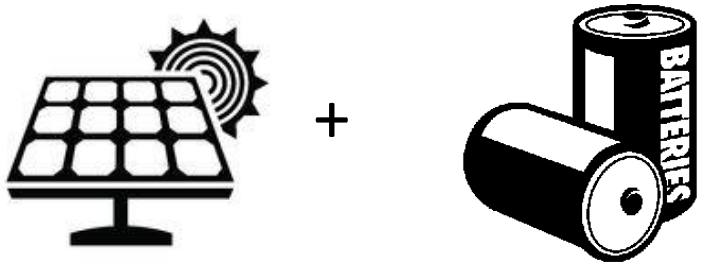
	Service	Network benefits from decentralization
Energy Related Services	Electric energy	None
	Primary operating reserves	None
	Secondary and tertiary operating reserves	None
	System restoration	**Locational**
	Firm capacity	None
Network Related Services	Network connection	None
	Voltage control	**Locational**
	Power Quality	**Locational**
	Network constraint management	**Locational (Primary driver)**
	Energy loss reduction	**Locational**

Policy/Regulatory: Actions Necessary



Distributed Energy Resources can be supported by Energy Storage and Demand Response

- Technologies can complement each other



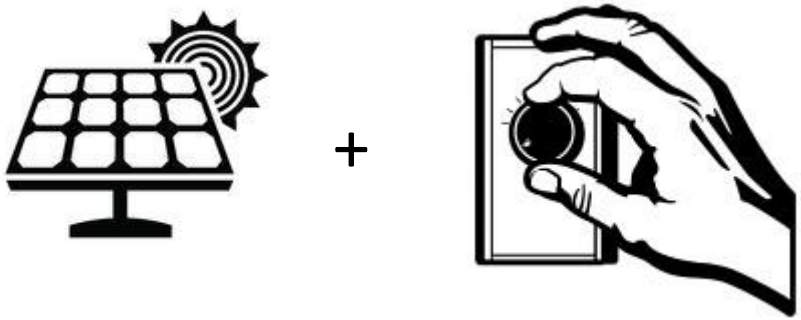
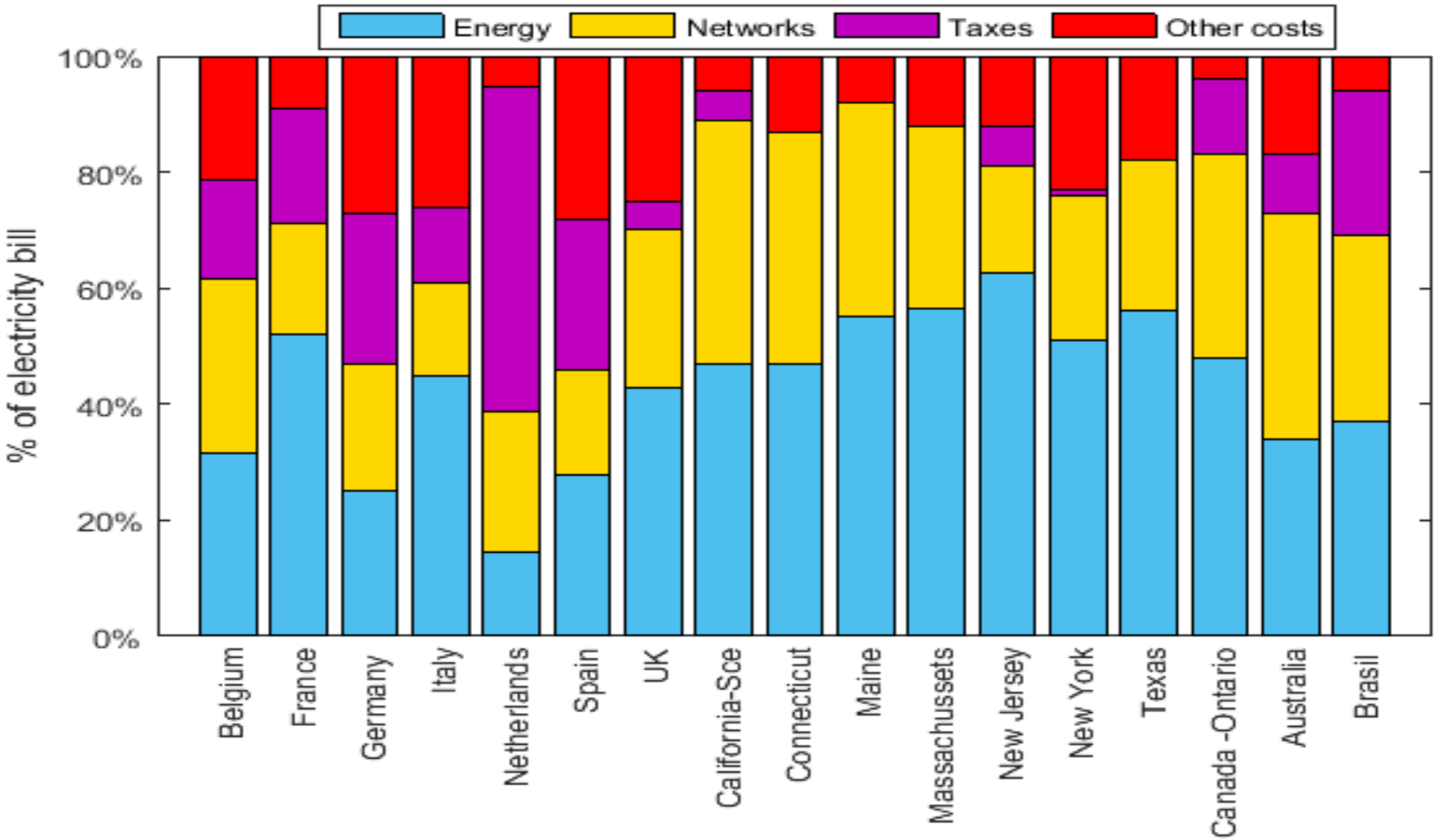


Image source: Shutterstock

Remove inefficient barriers

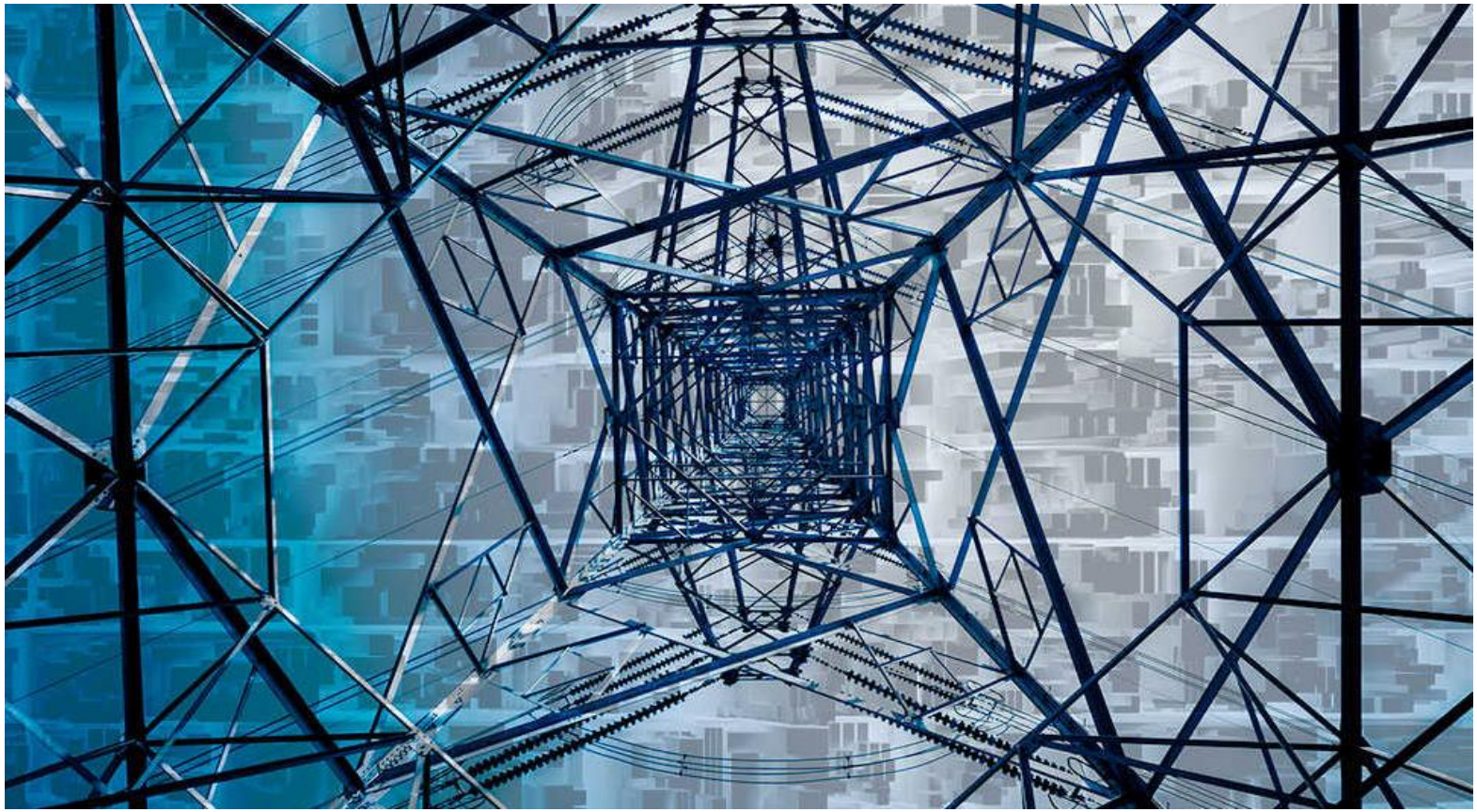
- Get signals & response capabilities **closer to real time**
- **Enhance market liquidity & transparency** using more centralized & discrete market mechanisms
- **Adapt auction rules** to incorporate new operational constraints of new resources
- **Align reserves & energy markets** & establish the flexibility requirements for participation
- Allow **DERs to participate in long-term capacity markets**
- **Minimize interference of support mechanisms** for clean technologies in electricity markets

Policy costs & residual network costs should not be recovered with volumetric charges ($/kWh). Recommend a fixed annual charge distributed in monthly installments.

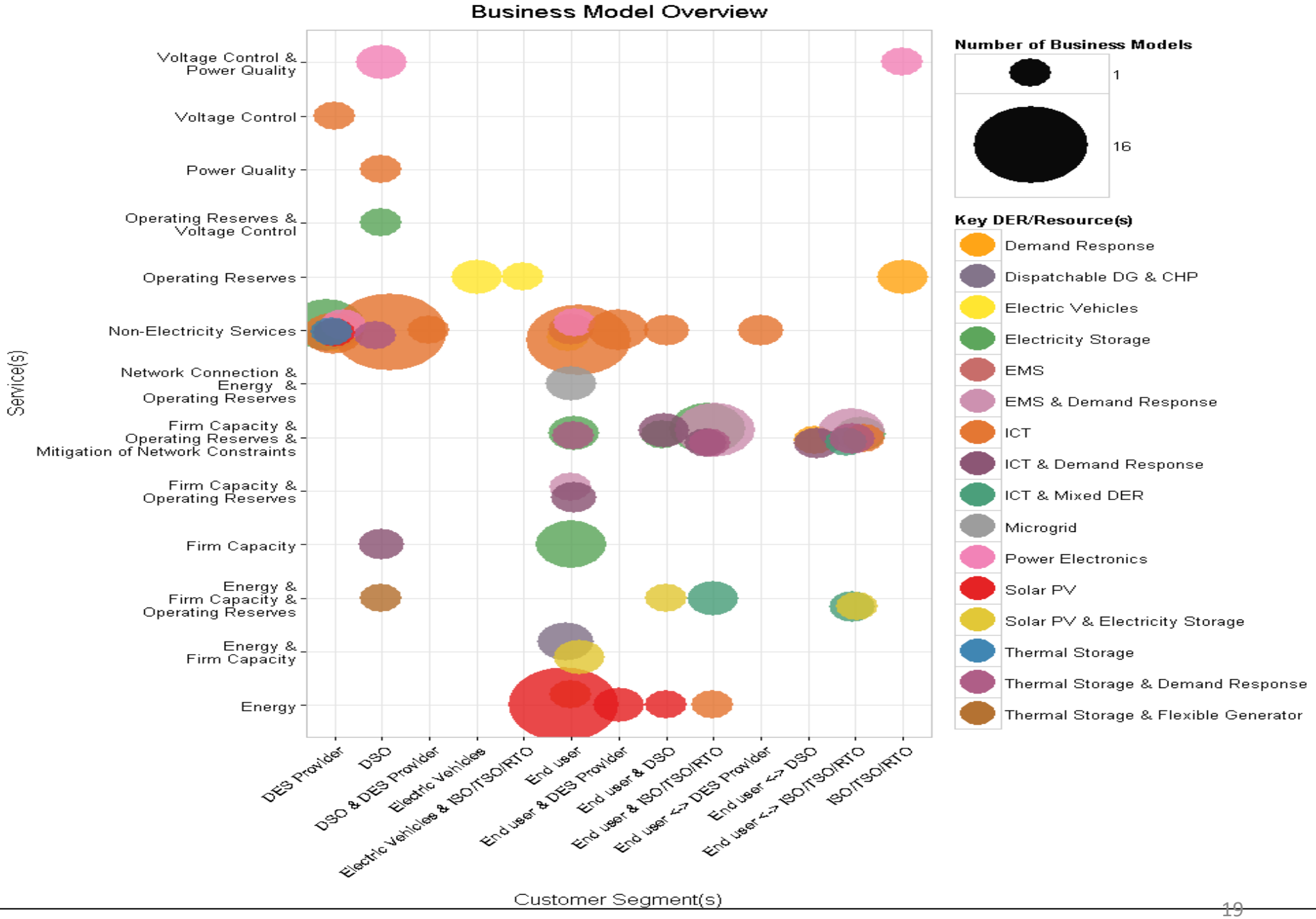


Breakdown of residential electricity bills in different jurisdictions in 2014-2015

Business Models



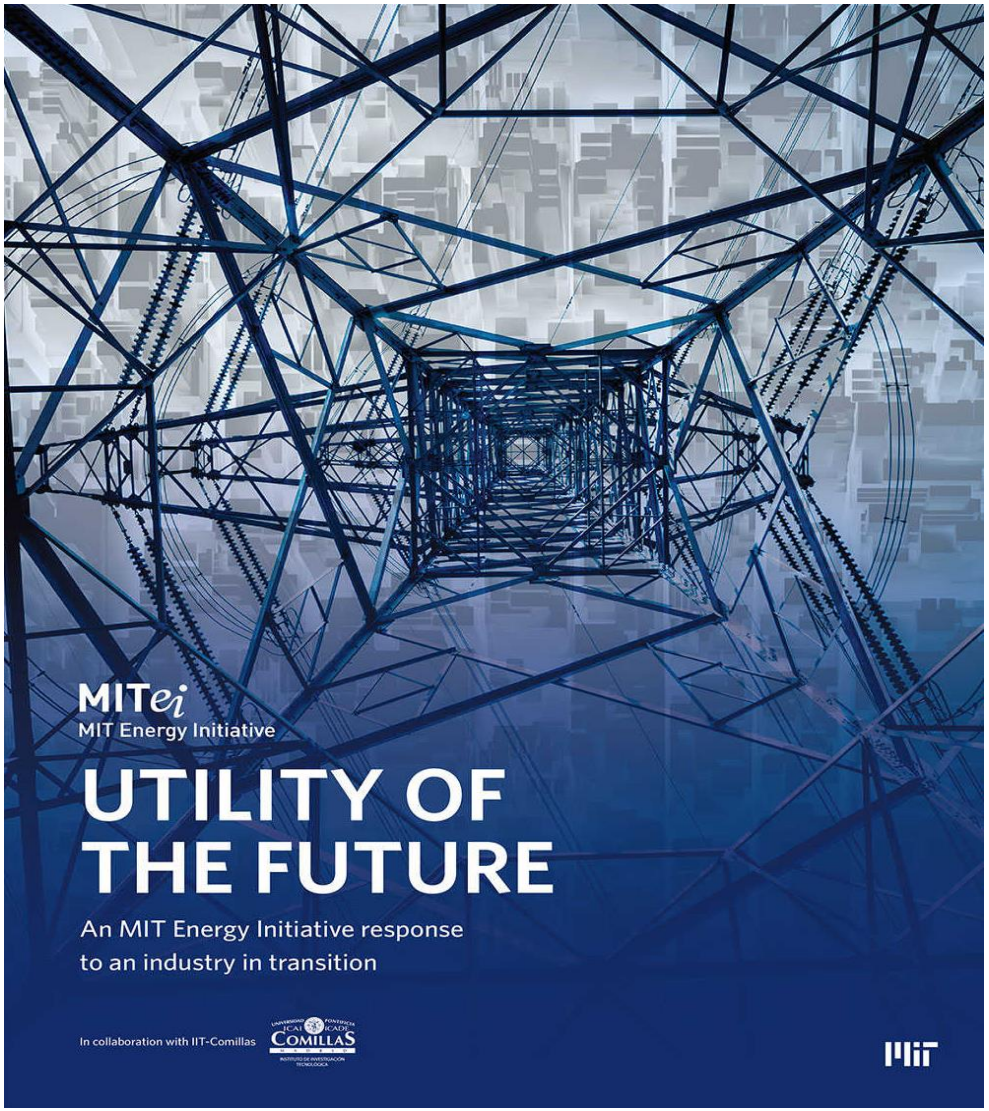
Business Models from MIT study



For more info: MIT energy reports

http://energy.mit.edu/research/utility-future-study/

Or browse “MITEI utility of the future”



One of series of MIT Future of Energy Studies:

Most recent: Nuclear (September 2018)

http://energy.mit.edu

Also low-carbon energy centers

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