UTILITY OF THE FUTURE
An MIT Energy Initiative response to an industry in transition

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Aim, tools and contributors
The future of the provision of electricity services

- Examine new options for the provision of electricity services from DERs and ICTs
- Focus on the USA & Europe over the next decade & beyond
- Policy and regulatory recommendations to facilitate an efficient utilization of ALL resources, whether centralized or decentralized
The modeling tools
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Scope & key recommendations
Part 1: Understanding distributed energy resources (DERs) and the new ways of providing electricity services

“L’avenir, tu n’as point à le prévoir mais à le permettre”
Citadelle, Antoine de Saint-Exupéry, 1948

“The future, you do not have to foresee it, but to enable it”
Is the future distributed?
The future is integrated
A framework for an evolving electricity sector
Part 2: A framework for an efficient and evolving power system

4. A Comprehensive and Efficient System of Prices and Regulated Charges for Electricity Services
5. The Future of the Regulated Network Utility Business Model
6. Restructuring Revisited: Electricity Industry Structure in a More Distributed Future
7. The Re-Evolution of Short- and Long-Term Electricity Market Design
1. Cost-reflective prices and charges
Part 2: Understanding distributed energy resources (DERs) and the new ways of providing electricity services

CREATE A COMPREHENSIVE & EFFICIENT SYSTEM OF PRICES & CHARGES

The only way to put all resources (centralized & distributed) on a level playing field and achieve efficient operation and planning
Prices and charges

- Based on the individual injection & withdrawal profiles
  - Symmetrical
  - Avoiding going behind the meter
Optimize the granularity of price signals with respect to both time and location

Spatial granularity

- Distribution nodal LMPs (DLMPs, real & reactive)
- Intermediate DLMPs (substation/zonal/other)
- Wholesale LMPs + distribution losses
- Wholesale nodal LMPs
- Wholesale zonal LMPs

Temporal granularity

- Time-of-use pricing
- Critical peak pricing
- Day-ahead hourly price
- Real-time spot price

The MIT Utility of the Future Study
Forward-looking peak-coincident network capacity charges

- Energy charge
- Network capacity charge

The MIT Utility of the Future Study
... and scarcity-coincident generation capacity charges
Allocate residual network and policy costs without distorting efficient incentives.
Address distributional concerns without sacrificing efficient incentives

Efficient pricing would unwind cross-subsidies and result in greater variability in charges

- Lump-sum bill credits or surcharges can restore desired cross-subsidies if desired
- Lump-sum pre-payments or hedging arrangements can address monthly bill variability
- Means-tested low-income assistance can replace implicit subsidy due to volumetric charges
2. Improved network regulation
Part 2: Understanding distributed energy resources (DERs) and the new ways of providing electricity services

ENHANCE DISTRIBUTION REGULATION

To enable the development of more efficient & innovative distribution utility business models
State of the art regulatory tools to reduce information asymmetry & manage uncertainty

**Incentive-compatible menu of contracts**
- to induce accurate utility forecasts and minimize strategy behavior

**Engineering-based reference network models**
- to equip regulators for forward-looking benchmarks and analyze uncertainty scenarios

**Automatic adjustment mechanisms**
- to account for forecast errors

3. Revisit industry structure
Part 2: Understanding distributed energy resources (DERs) and the new ways of providing electricity services

RETHINK INDUSTRY STRUCTURE TO MINIMIZE CONFLICTS OF INTEREST

Responsibilities and independence of network providers, system operators and market platforms through unbundling and strict regulatory oversight
Carefully assign responsibility to minimize potential conflicts of interest
4. Update electricity markets
Part 2: Understanding distributed energy resources (DERs) and the new ways of providing electricity services

IMPROVE WHOLESALE MARKET DESIGN TO BETTER INTEGRATE DERS

Reward **flexibility** improving bidding formats, time granularity and reserves pricing and evolve RES support mechanisms for a level playing field for all technologies
Enable new resources to play in existing and emerging markets

Update wholesale market rules (such as bidding formats) to reflect the operational constraints of new resources

Implement liquidity-oriented solutions to mitigate existing entry barriers
Minimize the interference of support mechanisms for clean technologies in electricity markets

Auctioned capacity-based subsidies complemented with ex-post compensations defined for reference benchmark plants
Part 3: Insights on the Economics of DERs and the Competition between Centralized and DERs
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Average locational value per MWh

- Energy: distr.
- CVR
- Distr. deferral
- Gen. deferral
- Total

Average locational value per MWh: 84.7
Part 3: Insights on the Economics of DERs and the Competition between Centralized and DERs

Average locational value per MWh

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<td>Average locational</td>
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Part 3: Insights on the Economics of DERs and the Competition between Centralized and DERs

CAREFULLY EVALUATE THE ECONOMIC OPPORTUNITIES AND COSTS OF DERs

Better utilization of existing assets hold great potential for cost savings. Economies of scale still matter. The distributed deployment of resources is not always cost-effective.
Part 4: A Policy and Regulatory Toolkit for the Future Power System

PROACTIVE POLICY & REGULATORY REFORMS
Networks, markets, end-user prices and charges, industry structure, cybersecurity...
Robust to the uncertain changes underway

TO FACILITATE EFFICIENCY IN THE FUTURE
Technology agnostic (centralized or decentralized, renewable or conventional, ... )
IN SUMMARY, WHAT THE STUDY PROPOSES

• can be gradually implemented with existing technology and reasonable regulatory measures
• sets a level playing field for competition of centralized and distributed resources
• enabling an efficient outcome regardless of the future development of technologies or policy objectives
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