Grid Modernization

The Distribution System as a Platform Technology

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Overview of My Talk

• This talk will investigate the drivers of change, and discuss the state of play within NYS.

• We’ll start with a discussion on NYS electricity markets...

• then discuss general concepts of networked markets and ‘platforms’ they utilize...

• And finally discuss the path forward and speculate some....
Reforming the Energy Vision: REV

The twentieth-century power system is unsustainable, both environmentally and economically. Rising energy bills, more frequent extreme weather, and the environmental imperative to reduce carbon emissions require us to reinvent how we produce, deliver, and consume energy. Meanwhile, increasingly affordable clean energy technologies such as the rapidly declining costs of solar electric (also referred to as solar PV) and other clean distributed generation alternatives, offer the opportunity to address our energy challenges in innovative ways, creating new jobs, promoting economic development, and improving value for customers. REV unlocks clean energy markets to capture these opportunities, building a brighter future for New York.
Situation: NYS electricity costs are the highest in the continental US

- Peak demand growing faster than base, resulting in an increasingly inefficient electricity market
  
  **Flattening the 100 hours of peak load = $1.5B for consumers**

- A key issue for improving efficiency is creating a more efficient distribution system
  
  **The LIPA system has a utilization rate of about 40%**
Electricity Generation, Transmission, and Distribution
New York’s Transmission System

Transmission Capability Added Since 2000 1,655 MW

Legend
- New
- 765 kV
- 500 kV
- 345 kV
- 230 kV

ConEd M29 AC 350 MW
Linden VFT 315 MW
Cross Sound DC Cable 330 MW
Neptune DC Cable 660 MW
Structure of Firms and Markets (notional)

- **Legal or strategic monopolies**
  - Standard Oil (before 1911)
  - Microsoft (before 1998)

- **Natural Monopolies**
  - Vertically Integrated Utilities
  - Airlines (prior to 1980s)
  - Phone System (prior to 1982)
  - Cable
  - Water Authorities

- **Competitive Markets**

- **Public Goods and Services**
  - Transportation
  - Schools

After Corneli & Kihm, Future Electric Utility Regulation, Report 1, LBNL-1003823, November, 2015
Coordinated, networked, and regulated infrastructures are platforms for businesses/services/markets for many sectors of the economy.

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After Corneli & Kihm, Future Electric Utility Regulation, Report 1, LBNL-1003823, November, 2015
There are "disruptive" trends in the electricity sector which are eroding the natural monopoly of the distribution utility

- Ever increasing connectivity/networking of energy systems
  - enabling improved state estimation, more coordination, more facile operations

- Falling costs of distributed generation (PV, wind, etc.) and other distributed energy resources (DER) while electric rates are rising
  - In ~20 years, prices are likely to reach cost parity with conventional generation

- Gov’t actions are aimed at commercialization and deployment of new DER and DSM technologies
  - NYS/federal programs for development and commercialization of DER/DSM
  - Programs aimed at lowering the cost and reducing the time for deployment
  - Programs aimed at enabling demand response (100% AMI in ConEd Territory)
  - Policies to reduce GHG emission, and increasing resilience
Numerous studies predict DER cost-parity with 10-30 years
(Example: solar + energy storage)
NYS is creating the “Distribution System Platform”

NYS will transform today’s utility distribution system into a platform technology for markets at the distribution layer.

Primary products to be traded: real power, reactive power, reserves.
The Distribution System Platform (I)

• With the DSP, DER will provide three main products:
  Real energy, reactive power, reserves

• Value propositions
  • DSP markets could deliver total lower costs to consumers over BAU
    • Models estimate as much as 5% in peak summer for real power
    • Cost of reactive power charged to consumers as much as 25% lower
    • TOD pricing for flexible customers saves ~10% - 15%

• Improving system performance
  • Increase system utilization
  • Align DER locational adoption with local system needs (avoid capacity upgrades)
  • Implement new technologies (inverter-based), enable volt-var control at lower cost

• Support for new combinations of products and services
  • Support for transactions among participants, creating new combinations of offerings
  • ESOCs, aggregators, service suppliers able to come together to bundle and market DER resources – “network effect”
The Distributed System Platform (II)

• Utilities will operate the physical platform
  • Plan and operate their systems (wires and poles)
  • Utilities will not own generation, DER resources (to first order)
  • Regulation moves from cost of service model to performance based regulation
  • Co-owners of a single, state-wide digital platform to enable market transactions (?)

• Electricity marketplace – similar to ISO markets
  • Forward market for electric “products” (advance, up to closure of day ahead)
    • Bids and offers transparent, visible to all (not entities making bids/offers)
    • Location and time-based bids bilaterally matched
  • Separate clearing market
    • Resolves differences between scheduled supply and actual consumption
    • Real-time load-flow calcs, LMP, etc.

• Not clear who will operate the financial marketplace.
  • Concern about utility conflicts of interest as system and marketplace operators

NYS PUC Rulings
Lowry & Woolf, Performance-Based Regulation in a High Distributed Energy Resources Future, LBNL Report 1004130, January 2016
Tabors, Caramanis, Rudkevich, White Paper on Developing Competitive Electricity Markets and Pricing Structures, NYSDPS, April 2016
The Distributed System Platform Evolution

Stage 1: Grid Modernization
- Streamline DER permitting/interconnection
- Assess hosting capacity
- Conduct locational value assessments
- Identify areas where DER adds greatest system benefit

Stage 2: Moderate DER Integration
- Two-way power flow management
- Deploy advanced control technologies
- D&D advanced grid protection schemes
- Coordination between TSO & DSO

Stage 3: Distributed Markets
- High DER Penetration
- Full transaction market enacted
- Full coordination with NYISO
- Cost recovery of DSP operations

DSP Development Cost ~ $100M
DSP Operations Cost ~ $40M/yr

Tabors, Caramanis, Rudkevich, White Paper on Developing Competitive Electricity Markets and Pricing Structures, NYSDPS, April 2016
Implications?

- New Platforms can bring entirely new levels of value to consumers

- New modes of service for consumers
  - Whole home energy systems, smart appliances, smart meters...
  - PV, storage, fuel cells, etc. etc.
  -ESCOs that provide thermal services (instead of HVAC systems)?

- New ways for consumers to manage their energy bills
  - Participate in markets?
  - Demand management
  - Reactive power? Real power? Reserves?

- New business models for utilities
  - % per transaction vs. reimbursement for cost of service
  - Note: eBay charges ~ 9%/transaction, Open Table ~ 2%
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- A key issue for improving efficiency is creating more “elasticity” in demand