The Utility of the Future: Distributed or Not?

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Perspective

→ Primary focus on regulated T&D utility

Are industry developments affecting utility revenues, costs and/or business relationships at a foundational level?

Is it *material* enough to alter the incentives for utilities to invest in critical infrastructure?

Is it *immediate* enough to require near term modification to the regulatory framework?

History
Disruptions
Factors

Utility Future
Industry Foundations

U.S. Installed Capacity

Electrical Sales (1950 - 2035)

Investment In Distribution Plant – US IOUs

Historically

- Economies of scale in centralized power generation
- Ongoing investment in T&D infrastructure
- Increasing and consistent growth in sales
- Universal service obligation / utility-met full customer requirements

Source: U.S. Energy Information Administration.
**Disruptive Forces**
(To Historic Model)

- **Decarbonization & Climate Change**
- **Smart Grid**
- **Flattening Sales & Energy Efficiency**
- **Distributed Generation & Storage**

✓ Primary impact on downstream (low voltage) utility operations and revenue requirements
Factor 1: Declining Growth Rates

- ~9.8% annual growth in 1950s, to ~0.7% in ‘00s
- Current: ~3,900 TWhs; 2035: ~4,700 TWh
- Key factors:
  - Flat growth in industrial
  - Modest growth in commercial (service)
  - Increases in population and disposable income drive modest growth in residential
  - Offset by improved levels of energy efficiency in appliances and equipment

Source: U.S. Energy Information Administration.
Factor 2: Energy Efficiency

♦ Single most effective (and least cost) option to reduce carbon emissions
  • EE is about PV of cost-benefits from investment; utilities have access to low cost capital
  • Currently spend about $4 billion per year on EE programs

♦ … but EE undermines the financial incentive codified under regulatory framework - utilities make money by selling electricity

The Virtuous Cycle of EE
California Example

Factor 3: Ongoing Investment Requirements

Upgrades in T&D system, AMI and SG
- OCLD of IOUs ~$300 billion (not replacement value)
- Upgrading aging distribution system + smart grid investment ~$600 billion
- AMI ~$200-$500 per meter; ~143 million customers in US

Additional investments required to bring renewables (wind) to load centers
- New transmission to integrate renewables and maintain reliability: ~$250 billion

New investments in reliability and resiliency ~ $multi Billion per mid-large utility
- Asset hardening and storm proofing
- System intelligence: awareness, monitoring and control

Sources:
Brattle analysis; Transforming America’s Power Industry: The Investment Challenge 2010-2030, by The Brattle Group for the Edison Foundation. Brattle analysis of FERC Form 1 data; upgrade and replacement estimates based on Brattle analysis
Factor 4: Distributed Generation

Economies of scale (sub-additive costs) for smaller generating units

Significant installed capacity of DG already in place (as much as ~235 GW)
- Large in scale for DG; generally not very green
- Most not connected to the grid; used for back-up and peaking

Currently, small scale (residential) DG has very modest installed capacity in place (e.g., PV capacity ~2,085 MW), but is receiving more and more attention, notably after recent rounds of prolonged outages
- Growing popularity; incentives reduce cost
- Being considered in individual resiliency planning
- Also includes PEVs

Requires utility investment in SG functionality to fully integrate into grid

Erodes baseline sales and compromises cost recovery
Summing The Impacts

→ Declining sales base
  ♦ Slower growth in electricity usage overall (economic and efficiency)
  ♦ Some loads shifting to DG

→ Change in the universal service / full requirement equation
  ♦ DG doesn’t mean off the grid
  ♦ Power and grid required to be there on demand

→ Increasing investment future
  ♦ Upgrading aging system + investments in resiliency
  ♦ And investment in SG needed to integrate VERs, demand resources and DG

  The cost of power relies on silicon and systems as much if not more so than steel

→ Grid costs are up and sales are down

→ Potential for deficiency in cost recover and/or stranded costs
Use of Electricity

As important as ever, but kWh sales have slowed and electricity is not as big a part of GDP as it used to be

- Has implications for depreciation treatment and volumetric cost recovery

Source: U.S. Energy Information Administration.
Factor 5: New Services

Responses To Eroding Revenue Stream

Telco example

♦ Customer interest in new info / content / comm services – even in face of inter-modal competition
♦ *Triple play*: Leverage new services onto embedded network investments
♦ *Quad play*: Add wireless services

More challenging for electrics

♦ Likely add-on info services (e.g., appl monitoring + control, energy mgmt)
♦ But less expansive than telco options, and may be offered by non-utility apps
## Industry Organization

### Business and Regulatory Models

Driven in large part by expected *network effects*

<table>
<thead>
<tr>
<th>Smart Grid Network Effects</th>
<th>Utility as “Smart Integrator”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Favor Verticle Integration</strong></td>
<td><strong>Favor Separation of Generation and Grid Ownership</strong></td>
</tr>
<tr>
<td>Benefits of Generation Competition Increase Under Smart Grid</td>
<td>Generation and retail deregulation</td>
</tr>
<tr>
<td>Benefits of Generation Competition Same or Less</td>
<td>Vertically integrated utility option</td>
</tr>
</tbody>
</table>

**Utility as provider of energy services or Energy Service Utility (“ESU”)**

*Hybrid solution*
- Separate business units
- Arms length rules
- Equal access
“Pure” Business / Regulatory Models

♦ High level of economies of scale in generation and downstream utility markets → *Energy Service Utility*
  • Traditional *vertically integrated utility*; responsible for upgrading to SG (with dynamic pricing); option to include utility-owned or contracted DG
  • Additional requirement to deal with non-utility DG on equal basis
  • Move to customer side of the meter – EE and PEVs
  • Possible shift to “value” pricing (instead of kWhs) – at least for a few services
  • Innovators: In gen and DG markets and on customer side of the meter (EE and E manage)

♦ Lower level of economies of scale in generation and downstream wire utility markets → *Smart Integrator*
  • Focus on wires / distco business, but not involved in selling power (*distribution “pure play”*); deploy and run the Grid
  • Administer the local power market; integrate with generators in order to balance supply and demand, including DG (small scale and CES)
  • May provide back-up mechanism for DG and provide EE
  • Competitors: Power generation market and on customer side of the meter (EE)
Regulatory requirements going forward (under any model):

- Incentives for energy efficiency (e.g., revenue decoupling, profit / avoided cost sharing)
- Access and pricing for DG
- Modified revenue recovery for grid investment (e.g., non-volumetric)
- Mechanisms to deal with stranded costs
- Implementation of some level of dynamic pricing
Final Thoughts

Overall, very promising – but different

- Significant changes in the “low voltage” part of the business
  Market can more efficiently equilibriate when half the market (customer demand) can respond to changing supply conditions

- Talked about for some times; conceptually not new but core and enabling technologies (and regulation) now make it more tangible

- Distributed or not? – definitely distributed

- Will need to think about the value of electricity somewhat differently than volumetrically
  Per kWh rate may be up / overall price steady or down

- Distributed generation
  (small scale renewables)

- Demand resources
  (AMI + dynamic pricing)

- Bi-directional dist grid
  (comm + wires; microgrids)

- Energy services
  (cardinal role of EE)