Regulation of Modernizing Power Distributors: Lessons From Research on Performance-Based Regulation

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This presentation discusses the regulatory context for distribution system planning.

Traditional cost of service regulation (COSR) is problematic for distributors engaged in accelerated grid modernization.

State engagement in distribution system planning is warranted.

Performance-Based Regulation (PBR) of distributor services may be a sensible complement.

This presentation considers lessons for power distributor regulation of my recent PBR research for Berkeley Lab, *State Performance-Based Regulation Using Multiyear Rate Plans for U.S. Electric Utilities*. 
Cost of Service Regulation

**COSR Basics**

- Base rates adjusted in rate cases that are often irregularly timed
- Tracker/rider treatment of energy expenses
- Usage (e.g., volumetric and demand) charges collect many “fixed” costs

**Sensitivity to Business Conditions**

- Utility performance and regulatory cost vary with business conditions (e.g., inflation and average use trends)
- When conditions are *favorable* to utilities, rate cases are infrequent so regulatory cost is low and performance incentives are strong
- When conditions are *chronically unfavorable*, rate cases are frequent. Regulatory cost is high, performance incentives are weakened, and operating flexibility is restricted
- Performance can deteriorate just when good performance is crucial
Indicators of Electric Utility Financial Attrition

<table>
<thead>
<tr>
<th>Multiyear Averages</th>
<th>Average Annual Electricity Use</th>
<th>GDPPI Inflation²</th>
<th>Summary Attrition Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Residential¹</td>
<td>Commercial¹</td>
<td>Average</td>
</tr>
<tr>
<td>1931-1940</td>
<td>723 5.45%</td>
<td>4,048 2.00%</td>
<td>3.73%</td>
</tr>
<tr>
<td>1941-1950</td>
<td>1,304 6.48%</td>
<td>6,485 5.08%</td>
<td>5.78%</td>
</tr>
<tr>
<td>1951-1960</td>
<td>2,836 7.53%</td>
<td>12,062 6.29%</td>
<td>6.91%</td>
</tr>
<tr>
<td>1961-1972</td>
<td>5,603 5.79%</td>
<td>31,230 8.79%</td>
<td>7.29%</td>
</tr>
<tr>
<td>1973-1980</td>
<td>8,394 2.03%</td>
<td>50,576 2.53%</td>
<td>2.28%</td>
</tr>
<tr>
<td>1981-1986</td>
<td>8,820 0.12%</td>
<td>54,144 0.81%</td>
<td>0.46%</td>
</tr>
<tr>
<td>1987-1990</td>
<td>9,424 1.39%</td>
<td>60,211 2.29%</td>
<td>1.84%</td>
</tr>
<tr>
<td>1991-2000</td>
<td>10,061 1.15%</td>
<td>67,006 1.68%</td>
<td>1.41%</td>
</tr>
<tr>
<td>2001-2007</td>
<td>10,941 0.73%</td>
<td>74,224 0.64%</td>
<td>0.68%</td>
</tr>
<tr>
<td>2008-2014</td>
<td>11,059 -0.38%</td>
<td>75,311 -0.22%</td>
<td>-0.30%</td>
</tr>
</tbody>
</table>


² Bureau of Economic Analysis, Table 1.4.4. Price Indexes for Gross Domestic Product, Gross Domestic Purchases, and Final Sales to Domestic Purchasers, Revised October 28, 2016.

>>> Key business conditions today are much less favorable than in COSR’s “golden age” when it became a tradition
Capex Requirements

Many utilities today seek sustained high distribution capex

• Replace aging facilities
• Improve reliability and resiliency
• Improve system capabilities

This capex doesn’t automatically trigger new revenue

Attrition impact greatest for utility distribution companies (UDCs)
UDCs engaged in accelerated modernization can request frequent rate cases or capital cost trackers. Under a 1-3 year rate case cycle...

Little profit from capex containment
Rate base growth main path to earnings growth
Weak incentive to embrace demand side management (DSM) and distributed generation and storage (DGS)

• Declining average use reduces margins between rate cases
• Less rate base growth
• Rate designs that encourage efficient DSM and DGS are risky
• Tracking of many load-related (e.g., energy procurement, line loss, and transmission) costs weakens incentive to contain them

>>> Weak performance incentives while competition mounts
Review of capex prudence is challenging in era of rapid technical change and shifting demand for distributor services

>>> weak incentives + prudence concerns

= need for distribution system planning

Rate cases divert regulatory resources from other worthwhile activities (e.g., generic proceedings on rate design, distribution system planning)
New Regulatory Frameworks

COSR problems have spurred utilities to adopt alternative forms of regulation (Altreg)

**Targeted Remedies**

- Cost Trackers*
- Revenue Decoupling*
- Targeted Performance Incentive Mechanisms (PIMs)

**Comprehensive Remedies**

- Formula Rate Plans*
- Multiyear Rate Plans (MRPs)

*Precedents for these Altreg approaches detailed in Additional Slides
Performance-Based Regulation

PBR: Regulation designed to improve utility performance with stronger incentives

3 established approaches (can be used in combination):

- Targeted Performance Metrics and Incentive Mechanisms
- Multiyear Rate Plans (MRPs)
- Incentivized Cost Trackers
Performance Metrics

Performance metrics quantify utility activities in key performance areas

Several potential uses

- Monitoring Only
- Monitoring with Target
- Performance Incentive Mechanisms (PIMs)

PIMs strengthen incentives in targeted areas by linking revenue to performance

Performance metric systems can have different approaches for different metrics

“Scorecards” summarize utility performance for public
What do PIMs Target?

PIMs most commonly target service quality and energy efficiency

Need for new performance metrics and incentive mechanisms is focus of recent “utility of the future” proceedings

Peak load management

- System load peak
- Non-wire alternatives to local grid investments

Utilization of advanced metering infrastructure capabilities

Quality of service to DGS customers

MRP practitioners (e.g., Britain, New York, Ontario) are also PIM innovators
# Ontario Scorecard Metrics

## Performance Outcomes
- Customer Focus
  - Services are provided in a manner that responds to identified customer preferences.

## Performance Categories
- Service Quality
  - New Residential/Small Business Services Connected on Time
  - Scheduled Appointments Met On Time
  - Telephone Calls Answered On Time
  - First Contact Resolution

- Customer Satisfaction
  - Billing Accuracy
  - Customer Satisfaction Survey Results

## Operational Effectiveness
- Safety
  - Level of Public awareness [measure to be determined]
  - Level of Compliance with Ontario Regulation 22/04
    - Serious Electrical Incident Index
    - Number of General Public Incidents Rate per 10, 100, 1000 km of line

- System Reliability
  - Average Number of Hours that Power to a Customer is Interrupted
  - Average Number of Times that Power to a Customer is Interrupted

- Asset Management
  - Distribution System Plan Implementation Progress

- Cost Control
  - Efficiency Assessment
  - Total Cost per Customer
  - Total Cost per Km of Line

## Notes:
1. These figures were generated by the Board based on the total cost benchmarking analysis conducted by Pacific Economics Group Research, LLC and based on the distributor’s annual reported information.
2. The Conservation & Demand Management net annual peak demand savings include any persisting peak demand savings from the previous years.
## Ontario Scorecard Categories (continued)

<table>
<thead>
<tr>
<th>Performance Outcomes</th>
<th>Performance Categories</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Policy Responsiveness</td>
<td>Conservation &amp; Demand Management</td>
<td>Net Annual Peak Demand Savings (Percent of target achieved)</td>
</tr>
<tr>
<td>Distributors deliver on obligations mandated by government (e.g., in legislation and in regulatory requirements imposed further to Ministerial directives to the Board).</td>
<td></td>
<td>Net Cumulative Energy Savings (Percent of target achieved)</td>
</tr>
<tr>
<td></td>
<td>Connection of Renewable Generation</td>
<td>Renewable Generation Connection Impact Assessments Completed On Time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New Micro-embedded Generation Facilities Connected On Time</td>
</tr>
<tr>
<td>Financial viability is maintained; and savings from operational effectiveness are sustainable.</td>
<td></td>
<td>Leverage: Total Debt (includes short-term and long-term debt) to Equity Ratio</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Profitability: Regulatory Return on Equity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deemed (included in rates)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Achieved</td>
</tr>
</tbody>
</table>

**Notes:**

1. These figures were generated by the Board based on the total cost benchmarking analysis conducted by Pacific Economics Group Research, LLC and based on the distributor’s annual reported information.
2. The Conservation & Demand Management net annual peak demand savings include any persisting peak demand savings from the previous years.
Multiyear Rate Plans

**Key Components**

- Reduced rate case frequency (e.g., 4-10 year cycle)
- Attrition relief mechanism (ARM) provides automatic relief for cost pressures based on forecast or business condition index with a productivity growth commitment — not a cost tracker or “formula rate”
- Trackers for some costs (e.g., energy)
- PIMs link earnings to reliability and customer service quality

**Optional Components**

- Revenue decoupling*
- Earnings sharing and off-ramp mechanisms
- Marketing flexibility (e.g., optional rates and services)*
- Additional PIMs (e.g., demand-side management)
- Integrated resource and distribution system planning

* Marketing flexibility discussed further in Additional Slides
Streamlined regulation
  Fewer, less overlapping rate cases free resources for other uses
    (e.g., distribution system planning)

Stronger performance incentives

Fourth “leg” for the DSM (and DGS) “stool”
  1) Revenue decoupling
  2) Tracking of DSM Expenses
  3) DSM (and DGS) Performance Incentive Mechanisms
  4) MRP strengthens incentive to use DSM (and DGS) to cut costs
    (e.g., time-varying pricing)
MRPs are common form of Altreg in U.S.
Use of MRPs growing most rapidly for VIEUs
MRPs mandatory for distributors in populous Canadian provinces and many countries overseas (e.g., Australia and RIIO in Great Britain)
ARM Design

ARM design key issue in MRP proceedings

Several well-established approaches

- **Indexing**
  
  \[ \text{growth Revenue} = \text{growth Input Prices} - X + \text{growth Customers} \]

  \[ X \text{ Factor} = \text{Industry Productivity Trend} + \text{Stretch Factor} \]

  Stretch factor sometimes based on statistical benchmarking

- **Forecasting**

- **Hybrid**
Measuring Productivity

Productivity index measures utility efficiency in converting inputs (e.g., labor, materials and capital) to outputs

Productivity grows when real (inflation-adjusted) cost grows more slowly than operating scale

Berkeley Lab paper reports productivity trends of U.S. power distributors; here are 2015-16 updates.*

<table>
<thead>
<tr>
<th></th>
<th>Capital</th>
<th>O&amp;M</th>
<th>Multi-factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>New England</td>
<td>0.14%</td>
<td>0.17%</td>
<td>0.09%</td>
</tr>
<tr>
<td>Broader Northeast</td>
<td>0.54%</td>
<td>0.16%</td>
<td>0.31%</td>
</tr>
<tr>
<td>Full U.S. Sample</td>
<td>0.35%</td>
<td>0.64%</td>
<td>0.43%</td>
</tr>
</tbody>
</table>

* Results for individual New England utilities in Additional Slides
Ontario Energy Board Uses Econometric Benchmarking to Set Stretch Factors

**VARIABLE KEY**

- Input Price:  WK = Capital Price Index
- Outputs:  N = Number of Customers
  C = System Capacity Peak Demand
  D = Retail Deliveries
- Other Business Conditions:  L = Average Line Length (km)
  NG = % of 2012 Customers added in the last 10 years
  Trend = Time Trend

<table>
<thead>
<tr>
<th>EXPLANATORY VARIABLE</th>
<th>ESTIMATED COEFFICIENT</th>
<th>T-STATISTIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>WK*</td>
<td>0.6271</td>
<td>85.5530</td>
</tr>
<tr>
<td>N*</td>
<td>0.4444</td>
<td>8.0730</td>
</tr>
<tr>
<td>C*</td>
<td>0.1612</td>
<td>3.2140</td>
</tr>
<tr>
<td>D*</td>
<td>0.1047</td>
<td>3.4010</td>
</tr>
<tr>
<td>L*</td>
<td>0.2853</td>
<td>13.9090</td>
</tr>
<tr>
<td>NG*</td>
<td>0.0165</td>
<td>2.4110</td>
</tr>
<tr>
<td>Trend*</td>
<td>0.0171</td>
<td>12.5700</td>
</tr>
<tr>
<td>Constant*</td>
<td>12.815</td>
<td>683.362</td>
</tr>
</tbody>
</table>

System Rbar-Squared 0.983

Sample Period 2002-2012

Number of Observations 802

*Variable is significant at 95% confidence level
Agreeing on ARMs for *rapidly modernizing* UDCs is difficult

This has slowed growth of MRPs in U.S. energy distributor regulation

Some regulators (e.g., Alberta, Ontario, Britain) have grappled with issue

Typical treatments: forecasted ARM or indexed ARM + capital cost tracker

British regulators have struggled with utility cost forecasts
Distribution system planning can inform design of ARMs

Enhances understanding of needed cost growth

Statistical cost (e.g., productivity and benchmarking) research can inform distribution system planning

- Identify cost inefficiency
- Measure system age
- Study cost trajectories of older systems
  - Accelerated modernization slows productivity growth
  - But productivity growth should rebound
  - Utilities should plan to achieve long run productivity trend of peers
- Study impact of smart grid on O&M expenses
- Index O&M expenses (e.g. Australia)
- British regulators use benchmarking (and independent engineering assessments) to make cost forecasts
- Ontario requires use of benchmarking and productivity research in utility cost forecasting; forward test year costs are benchmarked in rate cases
Case Study: Central Maine Power

Impetus for MRPs in Maine came from Commission 3 successive plans (here is the last)

Attrition Relief Mechanism:
growth Rates = growth GDPPI – X  (X=1%)

Capital Cost Tracker: Automated metering infrastructure

Earning Sharing: Asymmetric sharing of surplus earnings

Plan term: 5 years (2009-2013)

Service Quality: Multi-indicator penalty mechanism

Marketing Flexibility: Light-handed regulation of optional rate schedules and rate discounts

Distribution Productivity Trends of CMP and Two Northeast Regions*

*Productivity trends of other New England power distributors reported in Additional Slides
Conclusions

Accelerated distribution system modernization weakens performance incentives and raises regulatory cost under COSR

State engagement in distribution system planning needed

Expansive cost trackers and formula rates are dubious alternatives

PBR can complement distribution system planning
  o Stronger incentives reduce prudence concerns
  o Streamlined regulation can free resources for planning
  o MRP design tools like productivity and benchmarking research can aid planning
  o Planning facilitates MRP design
Additional Slides
Electric Revenue Decoupling Precedents
Cost trackers are a common way to finance capex surges

Trackers in a few states track substantially *all* distribution capex
Retail Formula Rate Plan Precedents

Formula rates fund grid modernization in IL
Marketing Flexibility

• MRPs can afford utilities more marketing flexibility by reducing rate case frequency and opportunities for cross-subsidization
  
  e.g., “Streamlined regulation” of optional tariffs and services
  
  Special contracts
  
  Green power packages (utility scale and distributed)
  
  Energy transformation services (e.g., EV charging, heat pump leasing)
  
  Reliability-differentiated services
  
  Other smart-grid-enabled services
  
• MRPs have been popular in utility industries facing competition, technical change, and complex, changing demand

<table>
<thead>
<tr>
<th>Company</th>
<th>Capital</th>
<th>O&amp;M</th>
<th>Multi-Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Mountain Power</td>
<td>0.46%</td>
<td>4.72%</td>
<td>2.27%</td>
</tr>
<tr>
<td>NSTAR Electric</td>
<td>1.64%</td>
<td>2.71%</td>
<td>2.10%</td>
</tr>
<tr>
<td>Western Massachusetts Electric</td>
<td>0.61%</td>
<td>0.47%</td>
<td>0.50%</td>
</tr>
<tr>
<td>Narragansett Electric</td>
<td>1.08%</td>
<td>-0.45%</td>
<td>0.34%</td>
</tr>
<tr>
<td>Central Maine Power</td>
<td>0.99%</td>
<td>0.11%</td>
<td>0.24%</td>
</tr>
<tr>
<td>Fitchburg Gas and Electric Light</td>
<td>-0.03%</td>
<td>-0.76%</td>
<td>-0.31%</td>
</tr>
<tr>
<td>Connecticut Light &amp; Power</td>
<td>-0.32%</td>
<td>0.13%</td>
<td>-0.33%</td>
</tr>
<tr>
<td>United Illuminating</td>
<td>-3.96%</td>
<td>-0.02%</td>
<td>-1.97%</td>
</tr>
<tr>
<td>Massachusetts Electric</td>
<td>-1.78%</td>
<td>-4.13%</td>
<td>-3.01%</td>
</tr>
</tbody>
</table>
Suggestions for Further Reading


e21 Initiative (2016), Phase II Report *On implementing a framework for a 21st century electric system in Minnesota*, [www.betterenergy.org/e21-PhaseII](http://www.betterenergy.org/e21-PhaseII)


Suggestions for Further Reading (continued)

https://emp.lbl.gov/sites/all/files/lbnl-1004130_0.pdf

https://eta.lbl.gov/sites/default/files/publications/multiyear_rate_plan_gmlc_1.4.29_final_report071217.pdf


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• Active in PBR since 1990s
• Specialties: multi-year rate plans, productivity and benchmarking research, revenue decoupling
• Recent clients: Alberta Utilities Consumer Advocate, Association Quebecoise des Consommateurs d’Electricite Industriels, Commercial Energy Consumers of British Columbia, Edison Electric Institute, Green Mountain Power, Ontario Energy Board, Berkeley Lab, Xcel Energy
• Former Penn State University energy economics professor
• PhD Applied Economics, University of Wisconsin
• Ohio native, Wisconsin resident
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