Traditional Economic Regulation of Electric Utilities

Utility University
Carter Hall, Millwood, VA

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The Regulatory Assistance Project (RAP) is a global NGO providing technical and policy assistance to government officials, agency staff, and others on energy and environmental issues.

- Foundation-funded; some contracts
- Non-advocacy; no interventions
Outline

- 105 minute session
- Brief History of Regulation
- Roles of Utilities and Regulators Today
- Ratemaking Basics:
  - Revenue Requirement
  - Cost Allocation
  - Rate Design Basics
- A Few Shortcomings of the Traditional Approach
A Very Brief History of Regulation
Medieval England Accommodations

- Business “affected with the public interest.”
- Prices regulated due to monopoly stature

New Inn, Gloucester, 1454
US Origins: Munn v. Illinois (1877)

• Grain elevators charging monopoly prices to farmers.
• Supreme Court ruled “affected with the public interest” and subject to price regulation.
Series of Later Court Decisions

- Prudent investment rule
- Utility entitled to a return comparable to companies with similar risks
- “Just and reasonable” standard
  - Tied to cost of service; no class of customers shall be unduly discriminated against
- Intervenors have limited rights

• Requires PUCs to “consider and determine” whether several specific policies should be adopted

  **Rate Design Standards**
  • Cost of Service
  • Time of Day
  • Seasonal
  • Interruptible
  • Declining Block

  **Utility Service Standards**
  • Master Metering
  • Fuel Adjustment Clauses
  • Information to Consumers
  • Termination of Service

• Avoided Cost for Independent Power Qualifying Facilities
  • ...that can produce power for less than what it would have cost the utility to generate the power
The PURPA Right of Intervention

- Any subject utility: 750 million kWh/year
- Any proceeding relating to rates in which issues addressed in PURPA are considered
- Any consumer may intervene
  - Right to present evidence
  - Right to reasonable rules of discovery
  - Right to intervenor compensation if no consumer advocate is funded.
Electric Utilities and Regulatory Commissions
Roles of Utilities

- Provide service to anyone who requests it
- Adhere to strict safety standards
- Adhere to reliability standards
- Provide adequate service
- Be responsive to customer needs
Investor-Owned Utilities (IOUs)

- Privately owned
- Publicly-traded (usually)
- Profit-making enterprises
- Economically regulated by state public utility commissions (PUCs)
- Examples: Duke Energy Carolinas, Mississippi Power, Dominion
Electric Membership Cooperatives

- Owned by members
- Not-for-profit
- Governed by Board of Directors elected by the members
- Less (or no) PUC oversight – varies by state
- Examples: Jackson (GA) EMC, Northern Virginia Electric Coop, SW Louisiana EMC
Public Power Utilities

- Owned by taxpayers
- Not-for-profit
- Governed by locally elected officials or their designees
- Less (or no) PUC oversight – varies by state
- Examples: Orlando (FL) Utilities Commission, City of Huntsville (AL), Nashville (TN) Electric Service
Asset Ownership

• Vertically Integrated Utilities
  • Own generation, transmission, distribution
  • Serve retail customers

• Generation & Transmission Utilities (G&Ts)
  • Own generation and transmission
  • Sell power at wholesale to other utilities
  • No (or few) retail customers

• Distribution Utilities
  • Own distribution, sometimes transmission
  • Buy power from other utilities or from markets
  • Serve retail customers
Roles of Economic Regulators

- Extensions of legislatures, executing powers granted in statutes
- Regulate in “the public interest”
- Pricing: the essential regulatory act
  - More on this later
- Transparent and accessible process
- Service quality standards
- Prudence review
“Regulatory Compact”*

• Utility accepts obligation to serve
• Government will approve rates that will compensate the utility fully for prudently incurred costs

*Not a binding agreement
3 Ratemaking and Rate Cases
“Allocation of costs is not a matter for the slide rule. It involves a judgment of a myriad of facts. It has no claim to an exact science.”

Justice William O. Douglas
US Supreme Court
Colorado Interstate Gas Co. v. Federal Power Commission
324-US 581,589 (1945)

Source: National Center for Education Statistics, 2016
Basics

- “Cost of Service” approach to determining a fair price for electric service:
  - Total costs for providing service are recovered, plus reasonable return on investment
- Regulators concerned with ‘just and reasonable’ rates
  - Sufficient but no more than necessary to cover costs and return on investment
- Rate design: structure of prices
Steps in Utility Ratemaking

Revenue Requirement

Functionalization
- Assign cost to appropriate utility function

Classification
- Classify functionalized costs to demand, energy, customer

Allocation
- Assign cost responsibility among customer classes

Rate Design
- Develop pricing method for recovering assigned costs
Steps in Utility Ratemaking

Revenue Requirement

- Assign cost to appropriate utility function
- Classify functionalized costs to demand, energy, customer
- Assign cost responsibility among customer classes
- Develop pricing method for recovering assigned costs
Revenue Requirement

• First step: revenue requirement
  • Total amount the utility needs to cover costs and earn a fair rate of return on investment
  • Given specified assumptions for sales and costs
• Requires determining:
  1. Amount of investment allowed in rate base
  2. Fair rate of return on that investment
  3. Reasonable expenses to serve customers
• Utilities are most concerned with this step
Test Year Concept

• Definition: A specific time period chosen to assess a utility’s costs of service and revenue requirement.

• Historical
  • Most common approach
  • Actual investments, sales, and costs for recently completed 12-month period

• Projected (“future” or “forecasted”)
  • Estimate of the same data for a future period
Revenue Requirement Formula

Revenue Requirement = (Rate Base Investment \times Rate of Return) + Operating Expenses

- Major capital expenditures, like power plants and transmission lines, but also buildings, computers, fleet vehicles, etc.
- Percent return utilities make annually on their investment
- Regular expenses, like labor, power purchases, fuel, insurance and other costs that recur regularly
Plant In Service At Original Cost

- Generation: $40,000,000
- Transmission: $10,000,000
- Distribution: $60,000,000
- General Plant: $20,000,000
- Total Plant in Service: $130,000,000
Rate Base Calculation

Plant in Service
- Accumulated Depreciation
  (plant that is no longer “used and useful”)
= Net Plant in Service
+ Working Capital
+ Regulatory Assets
- Deferred Taxes
= Rate Base

- $130,000,000
- ($30,000,000)
- $100,000,000
- $ 5,000,000
- $ 1,000,000
- ($6,000,000)
- $100,000,000
Traditional Rate of Return Regulation: Cost of Capital

- Rate of Return
  - Capital Structure
    - Common equity, preferred equity, long-term debt, short-term debt
  - Allowed Return on Equity
    - Return utility must offer to investors
    - Recently ~9-11%
- Cost of Debt
  - Lower rate of return than equity due to lower risk
Rate of Return Calculation

Equity Ratio
\[ \times \text{Allowed Return on Equity} \]
\[ = \text{Weighted Equity Cost} \]

- \( 50\% \)
- \( 10\% \)
- \( 5\% \)

Debt Ratio
\[ \times \text{Cost of Debt} \]
\[ = \text{Weighted Debt Cost} \]

- \( 50\% \)
- \( 6\% \)
- \( 3\% \)

Sum = Rate of Return
\[ = 8\% \]
Operating Expenses

- Production $10,000,000
- Transmission $1,000,000
- Distribution $5,000,000
- Administrative and General $2,000,000
- Taxes $2,000,000
- Depreciation $5,000,000

- Total Expenses: $25,000,000
Traditional Rate of Return Revenue Requirement

Rate Base • $100,000,000
x Rate of Return • x 8%
= Return Requirement • $8,000,000
+ Operating Expenses • $25,000,000
= Revenue Requirement • $33,000,000
Steps in Utility Ratemaking

Revenue Requirement

Functionalization
  • Assign cost to appropriate utility function
Alternative Cost of Service Frameworks

- **Embedded Cost of Service**
  - Rely on same costs used to determine Rev Req

- **Marginal Cost of Service**
  - What it would cost to provide incremental service at current costs of adding facilities
  - Apportion revenue req. to classes in proportion to how they contribute to marginal cost

- **Results are (broadly) similar**
  - Res and small-biz assigned higher total costs because require more dist investment and higher peak usage
Functionalization
Divide Revenue Requirement Among Utility Functions

Generation
Fuel Power Plants O&M

Transmission
High-Voltage Lines (>30 kV) Substations O&M

Distribution
Substations Primary lines Line transformers Secondary lines Poles O&M

Customer
Service drops Meters Billing Metering Customer Service

Lighting
Fixtures Brackets Dedicated poles
Functionalization: Area of Limited Controversy

- Non-utility activities
- Lobbying
- Administrative and General Costs
  - Administrative & General Salaries
  - Outside Services
  - Employee Pensions and Benefits
  - Insurance / Damages
Steps in Utility Ratemaking

Revenue Requirement

Functionalization
- Assign cost to appropriate utility function

Classification
- Classify functionalized costs to demand, energy, customer
Classification: General Categories of Cost Drivers

- Generation
- Transmission
- Distribution
- Customer

- Energy kWh (by time period?)
- Demand kW (Various measures)
- Customer-Related

- Usage
- Peak Loads
- System Coincident Peak
- Equipment Peaks
- Customer Maximum Demand

Number, Size & Type of Customers and Connections (90% = residential)

Note: really important step!
# Engineering vs. Economic-based Cost of Service Studies

Different approaches affect how costs are classified

<table>
<thead>
<tr>
<th>Engineering</th>
<th>Economic</th>
</tr>
</thead>
<tbody>
<tr>
<td>“How” was the system built?</td>
<td>“Why” was the system built?</td>
</tr>
<tr>
<td>Mostly to meet peak demand</td>
<td>Mostly to deliver energy (kWh)</td>
</tr>
<tr>
<td>Nearly all costs treated as demand or customer related</td>
<td>Only costs associated with peak hours (demand response, peak upgrades) treated as demand-related</td>
</tr>
</tbody>
</table>
Classification: Baseload Generation

- Expensive to build
- Cheap to operate
- Lower fuel costs
- Eng: all demand-related
- Econ: portion as energy-related
- Issue: Classify part of capital cost as though it is avoided fuel cost.
Baseload Generation Classification

- Classify 100% to “Demand”, then:
  - 1 coincident peak (1CP)
  - 4CP – average of 4 summer monthly peaks
  - 12CP – average of twelve monthly peak hours
  - Average and Peak

- OR: Classify between “Demand” and “Energy”
  - Peak Credit: ~75% Energy-related

- OR: Base-Intermediate-Peak
  - All baseload costs assigned equally to all hours
Peaking Generation Classification

- Classify 100% to “Demand”, then:
  - 1CP
  - 4CP
  - 12CP
- OR: Classify between “Demand” and “Energy”
  - Peak Credit: ~80% Energy-related
- OR: Base-Intermediate-Peak
  - All peaking costs assigned equally to all peak hours
Classification: Transmission

- Older methods: classify as demand-related, allocate on peak
- But, purpose may be to move power, cheaper than moving fuel close to load
- Issue: Classify a portion of the investment as energy (avoided fuel)?
Classification: Distribution

- Built to deliver **energy**
- Designed to carry peak **demand**
- Connects to every **customer**
- **Eng:** How was the system built? To reach every customer.
- **Econ:** WHY was the system built in the first place? To deliver energy in all hours.
Meters

- **Historical**: Used only for billing → customer-related

- **Smart Meters**:
  - Peak load management
  - Conservation program support
  - Reliability services – voltage reduction
  - Disconnect / reconnect
  - Demand response
Classification: Focus on Customer-Related Costs
Basic Customer Method:

ONLY customer-specific facilities classified as customer-related
Minimum System Method:

~50% of distribution system classified as customer-related
Straight Fixed / Variable:

100% of distribution system classified as customer-related
## Comparing Methods

<table>
<thead>
<tr>
<th>Cost Category</th>
<th>Basic Customer</th>
<th>Minimum System Method</th>
<th>Straight Fixed / Variable</th>
<th>$/month/customer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poles</td>
<td>$ -</td>
<td>$5</td>
<td>$10</td>
<td>$26</td>
</tr>
<tr>
<td>Wires</td>
<td>$ -</td>
<td>$10</td>
<td>$20</td>
<td>$46</td>
</tr>
<tr>
<td>Transformers</td>
<td>$ -</td>
<td>$5</td>
<td>$10</td>
<td></td>
</tr>
<tr>
<td>Services</td>
<td>$1</td>
<td>$1</td>
<td>$1</td>
<td></td>
</tr>
<tr>
<td>Meters</td>
<td>$1</td>
<td>$1</td>
<td>$1</td>
<td></td>
</tr>
<tr>
<td>Billing</td>
<td>$2</td>
<td>$2</td>
<td>$2</td>
<td></td>
</tr>
<tr>
<td>Customer Service</td>
<td>$2</td>
<td>$2</td>
<td>$2</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$6</strong></td>
<td><strong>$26</strong></td>
<td><strong>$46</strong></td>
<td></td>
</tr>
</tbody>
</table>
Comparison of Results of Two Studies: Engineering vs. Economic

- Customer Accounts
- Distribution
- Transmission
- Generation

Res Eng
Res Econ
Comm Eng
Comm Econ
Ind Eng
Ind Econ
Steps in Utility Ratemaking

Revenue Requirement

Functionalization
  • Assign cost to appropriate utility function

Classification
  • Classify functionalized costs to demand, energy, customer

Allocation
  • Assign cost responsibility among customer classes
Customer Classes

- Definition: A collection of customers sharing common usage or interconnection characteristics.
- The utility’s revenue requirement is allocated to different customer classes, typically:
  - Residential
  - Commercial
  - Industrial
Allocation: Revenue Apportionment

- From the cost of service study results to the class allocation of a rate increase (or decrease).
- Mix of arithmetic and policy
- Gradualism
- Perceptions of equity and fairness
Cost of Service Study Results: Presentation Matters

- Rate of Return
- Class Rate of Return Index
- Revenue to Cost Ratio
## Presentation of Results

### Rate of Return and Return Index

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>RESIDENTIAL (0-20 KW)</th>
<th>SMALL GENERAL SVC (20-250 KW)</th>
<th>MEDIUM GENERAL SVC (20-250 KW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocated Rate Base</td>
<td>$87,878,094</td>
<td>$24,943,243</td>
<td>$8,342,091</td>
<td>$18,488,889</td>
</tr>
<tr>
<td>Return at Current Rates</td>
<td>$6,321,882</td>
<td>$342,980</td>
<td>-$587,203</td>
<td>$2,548,888</td>
</tr>
<tr>
<td>Rate of Return</td>
<td>7.19%</td>
<td>1.38%</td>
<td>-7.04%</td>
<td>13.79%</td>
</tr>
<tr>
<td>Index of Class to Average Rate of Return</td>
<td>19.11%</td>
<td>-97.85%</td>
<td>191.63%</td>
<td></td>
</tr>
</tbody>
</table>

### Revenue to Cost Ratio

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>RESIDENTIAL</th>
<th>SMALL GENERAL SVC (20-250 KW)</th>
<th>MEDIUM GENERAL SVC (20-250 KW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Revenue per KWh</td>
<td>$0.1066</td>
<td>$0.1108</td>
<td>$0.1057</td>
<td>$0.1129</td>
</tr>
<tr>
<td>Average Cost of Service per KWh</td>
<td>$0.1066</td>
<td>$0.1138</td>
<td>$0.1200</td>
<td>$0.1072</td>
</tr>
<tr>
<td>Ratio of Revenue to Cost</td>
<td>100.00%</td>
<td>97.37%</td>
<td>88.12%</td>
<td>105.30%</td>
</tr>
</tbody>
</table>
Consider Results of Multiple Studies

<table>
<thead>
<tr>
<th>Class</th>
<th>Revenue to Cost Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Duvall (PP&amp;L)</td>
</tr>
<tr>
<td>Residential</td>
<td>0.91</td>
</tr>
<tr>
<td>General Service</td>
<td>1.13</td>
</tr>
<tr>
<td>Large General Service</td>
<td>1.10</td>
</tr>
<tr>
<td>Large Power Service</td>
<td>1.02</td>
</tr>
<tr>
<td>Secondary</td>
<td><strong>1.14</strong></td>
</tr>
<tr>
<td>Large Power Service</td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td></td>
</tr>
<tr>
<td>Irrigation</td>
<td>1.10</td>
</tr>
<tr>
<td>Street and Area Lighting</td>
<td>1.13</td>
</tr>
<tr>
<td>Other</td>
<td>1.09</td>
</tr>
</tbody>
</table>
Consider Factors Other Than Cost of Service

B. Factors for Consideration in Addition to Cost of Service Study Results

In directing the filing of cost of service studies with future rate filings, the Commission did not manifest an intent to make rate design and rate spread decisions based solely on the mechanical application of cost of service study results. Instead, the Commission indicated it would analyze the cost studies presented, as well as other relevant evidence. The Commission stated the following:

• Overall public interest
• Economic conditions in the service territory
• Perceptions of equity and fairness
• Gradualism
• Elasticity of Demand (results will change)
Gradualism

- Bonbright principle
- Examples:
  - In an increase, no class gets a decrease
  - In a decrease, no class gets an increase
  - 2:1 gradualism: No class gets more than 2X the % increase of the lowest class increase
  - 3:1 gradualism
  - No increase to overpaying classes
Approximate Components of Electric Rates
Steps in Utility Ratemaking

Revenue Requirement

Functionalization
- Assign cost to appropriate utility function

Classification
- Classify functionalized costs to demand, energy, customer

Allocation
- Assign cost responsibility among customer classes

Rate Design
- Develop pricing method for recovering assigned costs
Basics of Rate/Tariff Design

- Customer Charges (Fixed Charges)
- Energy Charges
- Demand Charges: Non-Coincident Peak (NCP) and Coincident Peak (CP)
- Other Charges, for example:
  - Taxes
  - Riders
Basic Rate Design Terminology

- **Customer Charge**: A monthly charge that applies independent of consumption. Also called a Basic, Standing, Meter, or Fixed Charge.

- **Energy Charge**: A price per kWh; may be in more than one time period, or more than one block. May be seasonal, or time-varying.
Basic Rate Design Terminology

- **Demand Charge**: A monthly fee based on the highest instantaneous usage rate (usually highest hour) during the month or year.
  - Common for commercial and industrial customer classes, rare for residential class

- **CP: Coincident Peak**: Usage at the time of the system peak demand

- **NCP: Non-Coincident Peak**: Highest usage by the customer at any time during the month
“Customer Charge” Elements

- Historically NOT Controversial
  - Service drop
  - Meters
  - Meter reading
  - Billing and collection
  - Customer service

- Controversial
  - Distribution circuit costs
  - Transformers
## Example Customer Charges (2014)

<table>
<thead>
<tr>
<th>Customer Charges: Largest U.S. Utilities</th>
<th>State</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Gas &amp; Electric Co.</td>
<td>CA</td>
<td>None</td>
</tr>
<tr>
<td>So Cal Edison</td>
<td>CA</td>
<td>$0.87</td>
</tr>
<tr>
<td>Public Service E&amp;G</td>
<td>NJ</td>
<td>$2.43</td>
</tr>
<tr>
<td>Detroit Edison Co</td>
<td>MI</td>
<td>$6.00</td>
</tr>
<tr>
<td>Virginia Electric Power</td>
<td>VA</td>
<td>$6.73</td>
</tr>
<tr>
<td>Florida Power &amp; Light Co</td>
<td>FL</td>
<td>$7.24</td>
</tr>
<tr>
<td>Georgia Power Co</td>
<td>GA</td>
<td>$9.00</td>
</tr>
<tr>
<td>Commonwealth Edison Co</td>
<td>IL</td>
<td>$15.06</td>
</tr>
<tr>
<td>Consolidated Edison</td>
<td>NY</td>
<td>$15.76</td>
</tr>
</tbody>
</table>

These utilities serve one in six Americans.
Energy Costs and Energy Charges

- Minimum: Fuel and variable portion of purchased power
- Often: Portion of generation, transmission, and distribution plant costs
- Vary by season
- Vary by time of day
- A single fuel charge melds these
“Demand Costs” and Demand Charges

• Some portion of production, transmission, and distribution costs; at least those that are “peak” related
• Often recovered at least partially in energy charges
• Different measures of “demand”
Residential Rate Types: From Simple to Complex

- **Flat Rate**: Uniform rate per kWh for all usage
- **Declining Block**: Lower price for increased usage
- **Inclining Block**: Higher price for increased usage
- **Time of Use (TOU)**: Higher price for on-peak hours
- **Seasonal**: Higher price in peak season
- **TOU with Inclining Block**
- **Critical Peak**: A TOU price that has a much higher price for a limited number of hours [Requires advanced meter]
- **Real-Time Price (RTP)**: A price that changes frequently with market conditions [Requires advanced meter]
Note...

- Many of the rates shown in this presentation are simplified for clarity; they may have tariff riders that raise prices paid by consumers.
- And, undoubtedly, some of these rates have changes since we looked at the on-line tariff books.
# Flat Rate

<table>
<thead>
<tr>
<th>Indiana–Michigan Power (Indiana)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Charge</td>
<td>$7.30/month</td>
</tr>
<tr>
<td>Energy Charge</td>
<td>$0.08634/kWh</td>
</tr>
</tbody>
</table>

Simplicity has its virtues!
### Flat Rate/Seasonal

<table>
<thead>
<tr>
<th>Xcel Energy (Minnesota)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Customer Charge</strong></td>
<td>$8.00/month</td>
</tr>
<tr>
<td><strong>Summer Energy</strong></td>
<td>$0.0867/kWh</td>
</tr>
<tr>
<td>(baseload and</td>
<td></td>
</tr>
<tr>
<td>peaking, plus</td>
<td></td>
</tr>
<tr>
<td>distribution)</td>
<td></td>
</tr>
<tr>
<td><strong>Winter Energy</strong></td>
<td>$.0739/kWh</td>
</tr>
<tr>
<td>(just baseload plus</td>
<td></td>
</tr>
<tr>
<td>distribution)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Newfoundland Power</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summer</strong></td>
<td><strong>Winter</strong></td>
</tr>
<tr>
<td>Per kWh</td>
<td>$0.0965/kWh</td>
</tr>
</tbody>
</table>
## Residential Declining Block Rate

<table>
<thead>
<tr>
<th>Dayton Power and Light (Ohio)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Customer Charge</strong></td>
</tr>
<tr>
<td><strong>First 800 kWh</strong> (power plant investments plus fuel)</td>
</tr>
<tr>
<td><strong>Additional kWh</strong> (mostly just operating costs)</td>
</tr>
</tbody>
</table>

Common in ‘50s and ‘60s, mostly phased out in ‘80s in response to PURPA ("consider and determine" if appropriate).
## Residential Inclining Block Rate

<table>
<thead>
<tr>
<th>City of Palo Alto (California)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Customer Charge</strong></td>
<td>None</td>
</tr>
<tr>
<td>(all costs built into price of good sold)</td>
<td></td>
</tr>
<tr>
<td><strong>First 300 kWh</strong></td>
<td>$0.096/kWh</td>
</tr>
<tr>
<td><strong>Next 300 kWh</strong></td>
<td>$0.130/kWh</td>
</tr>
<tr>
<td><strong>Over 600 kWh</strong> (peak-oriented usage, mostly air conditioning)</td>
<td>$0.174/kWh</td>
</tr>
</tbody>
</table>
## Time of Use (TOU) Rate (optional)

<table>
<thead>
<tr>
<th>Georgia Power (Georgia)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Charge</td>
<td>$10.00/month</td>
</tr>
<tr>
<td>On-Peak (2 – 7 PM, Mon-Fri, June – September) (nearly all G, T&amp;D)</td>
<td>$0.2032/kWh</td>
</tr>
<tr>
<td>Off-Peak</td>
<td>$0.0494/ kWh</td>
</tr>
</tbody>
</table>

Plus $0.04 fuel and other tariff riders.

Pretty “extreme” differential between on-and-off-peak. Should influence customer behavior.
# TOU / Seasonal Rate

<table>
<thead>
<tr>
<th>Tucson Electric (Arizona)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Charge</td>
<td>$11.50/month</td>
</tr>
<tr>
<td><strong>Summer</strong></td>
<td><strong>Winter</strong></td>
</tr>
<tr>
<td>On-Peak</td>
<td>$0.1175/kWh</td>
</tr>
<tr>
<td>Off-Peak</td>
<td>$0.0785/kWh</td>
</tr>
</tbody>
</table>
# Fixed-Period TOU Rates With Inclining Block Design

<table>
<thead>
<tr>
<th>Fixed-Period TOU with Inclining Block</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Charge</td>
</tr>
<tr>
<td>Off-Peak</td>
</tr>
<tr>
<td>On-Peak</td>
</tr>
<tr>
<td>High Use Surcharge, over 500 kWh</td>
</tr>
</tbody>
</table>
Critical Peak Pricing (CPP)

- **Definition:** A very high rate that is in effect only a few hours per event, a few times per year.
- **Goal:** Dramatically reduce peak demand in these events.
- **Design:** Customer receives day-ahead notice when “critical” days will be in effect. On other days, “normal” prices apply.
Oklahoma Gas and Electric “Variable Peak Price” Option

- Customer Charge: $13.00/month
- Summer Energy Charge tied to day-ahead hourly market.
- Maximum 80 Hours at Highest Price

<table>
<thead>
<tr>
<th>Day-Ahead Hourly Price</th>
<th>Retail Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than $.011/kWh</td>
<td>$.029/kWh</td>
</tr>
<tr>
<td>$.011 - $.031/kWh</td>
<td>$.073/kWh</td>
</tr>
<tr>
<td>$.031 - $.170/kWh</td>
<td>$.175/kWh</td>
</tr>
<tr>
<td>Over $.170/kWh</td>
<td>$.380/kWh</td>
</tr>
</tbody>
</table>
Peak-Time Rewards (PTR): CPP In Reverse

- Standard rate at all normal hours
- Critical events called as needed
- Customers get discount for reduced usage below a calculated baseline
- No surcharge for increased usage
- Requires smart meter data to set baseline
PTR Example: Baltimore Gas and Electric

- Customer Charge: $7.90/month
- Energy Charge: $.121/kWh
- Credit During Events: ($1.25/kWh)
Comparing CPP and Peak-Time Rebates (CPR or PTR)

Figure 12. Average Percent Demand Reductions for Customers on CPP and CPR with and without PCTs by Treatment Group.
TOU Rates and Low-Income

- Low-income customers have smaller dwelling sizes and flatter loads
  - Less likely to have major peak-focused loads like central air conditioning
- More likely to have electric water heat, which can be controlled.
- Most (NOT ALL) low-income customers will benefit from TOU rates.
Looking At Costs By Function

- Billing and Collection
- Distribution Peaking
- Distribution Backbone
- Network Transmission
- Baseload Transmission
- Demand Response
- Peaking Production
- Mid-Merit Production
- Baseload Production
Building a Cost-Based TOU Rate

<table>
<thead>
<tr>
<th>Distribution Backbone</th>
<th>Transmission Backbone</th>
<th>Baseload Generation</th>
<th>Peaking Distribution</th>
<th>Peaking Generation</th>
<th>Mid-Merit Generation</th>
<th>Distribution Augmentation for Mid-Peak</th>
<th>Transmission Augmentation for Mid-Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.08</td>
<td>$0.06</td>
<td>$0.04</td>
<td>$0.22</td>
<td>$0.18</td>
<td>$0.10</td>
<td>$0.14</td>
<td>$0.12</td>
</tr>
</tbody>
</table>

DR Rate: $0.75

Critical Peak Rate

On-Peak Rate

Mid-Peak Rate

Off-Peak Rate

Hour of Day

$/kWh

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
### Result: Smart Rates

<table>
<thead>
<tr>
<th>Connect To Grid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Charge</td>
</tr>
<tr>
<td>$/Month</td>
</tr>
<tr>
<td>$4.00</td>
</tr>
<tr>
<td>Site Infrastructure</td>
</tr>
<tr>
<td>$/kW</td>
</tr>
<tr>
<td>$1.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off-Peak</td>
</tr>
<tr>
<td>$/KwH</td>
</tr>
<tr>
<td>$0.08</td>
</tr>
<tr>
<td>Mid-Peak</td>
</tr>
<tr>
<td>$/KwH</td>
</tr>
<tr>
<td>$0.14</td>
</tr>
<tr>
<td>On-Peak</td>
</tr>
<tr>
<td>$/KwH</td>
</tr>
<tr>
<td>$0.22</td>
</tr>
<tr>
<td>Critical</td>
</tr>
<tr>
<td>$/KwH</td>
</tr>
<tr>
<td>$0.75</td>
</tr>
</tbody>
</table>
Choosing Time Periods

• When are different resources operated?
• What is the system load profile?
• What is the class load profile?
• Consideration of Renewable Portfolio Standard (RPS) Obligations
  • Wind may be a night resource, but mandatory.
• Look ahead: is the load shape changing due to solar?
Non-Residential (NR) Rate Design
Examples of Large NR Customers
### Antiquated NR Example Rate
(a real utility in the U.S.)

<table>
<thead>
<tr>
<th>Charge Type</th>
<th>Rate</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Charge</td>
<td>$/Month</td>
<td>$209.00</td>
</tr>
<tr>
<td>Demand Charge</td>
<td>$/kW</td>
<td>$21.35</td>
</tr>
<tr>
<td>Energy Charge</td>
<td>$/kWh</td>
<td>$0.050</td>
</tr>
</tbody>
</table>

- Demand charge is based on NCP demand.
- Energy Charge is not time-differentiated
Non-Residential Rate Example: Georgia Power TOU-GS-10

<table>
<thead>
<tr>
<th>Customer Charge</th>
<th>$/Month</th>
<th>$ 209.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand Charge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-Peak $/kW</td>
<td>$ 15.66</td>
<td></td>
</tr>
<tr>
<td>Maximum Peak $/kW</td>
<td>$ 5.23</td>
<td></td>
</tr>
<tr>
<td>Energy Charge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-Peak $/kWh</td>
<td>$ 0.122</td>
<td></td>
</tr>
<tr>
<td>Shoulder Peak $/kWh</td>
<td>$ 0.063</td>
<td></td>
</tr>
<tr>
<td>Off-Peak $/kWh</td>
<td>$ 0.024</td>
<td></td>
</tr>
</tbody>
</table>

- Higher coincident-peak demand charge.
- 5 hour window
- Steep TOU energy rate.
<table>
<thead>
<tr>
<th><strong>Sacramento Rate Design</strong></th>
<th><strong>NR Best of Class</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Customer Charge</strong></td>
<td>$108/month</td>
</tr>
<tr>
<td><strong>Site Infrastructure Charge</strong></td>
<td>$3.80/kW/month</td>
</tr>
<tr>
<td><strong>Super Peak Demand Charge</strong></td>
<td>$7.65/kW</td>
</tr>
<tr>
<td><strong>Energy Charge</strong></td>
<td></td>
</tr>
<tr>
<td>Super Peak</td>
<td>Summer</td>
</tr>
<tr>
<td></td>
<td>$0.20</td>
</tr>
<tr>
<td>On-Peak</td>
<td>Winter</td>
</tr>
<tr>
<td></td>
<td>$0.137</td>
</tr>
<tr>
<td>Off-Peak</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$0.109</td>
</tr>
</tbody>
</table>

*Summer weekdays 2-7 PM*
Alternative Non-Residential Rate Designs Can Address Peak Demand

- Well-designed Time of Use Prices (TOU)
- Critical Peak Price (CPP)
- Peak Time Rebates (PTR)
- Transparent Real Time Prices (RTP)

- Weak: Coincident Peak Demand Charges
Shortcomings of Traditional Cost of Service / Rate of Return Regulation
Shortcomings of Traditional Cost of Service/Rate of Return Regulation and Rate Design

- Cost Allocation is Not an Exact Science
- Capital Bias ("Averch-Johnson Effect")
- Throughput Incentive
- Regulatory Lag
- Regulatory Capture
Averch-Johnson effect

The tendency to over-invest capital to increase profit

- Results from revenue requirement calculation
- Bias for utility-owned infrastructure
- “Gold plating”
Utility Revenue Requirement: “The Capital Bias”

Revenue Requirement (aka Cost-of-Service) = Capital Investments (Cap-ex) + Operating Expenses (Op-ex)

“Rate Base” x Rate-of-Return (Interest on Shareholders’ “Loan”) = $1 x 10% = $1.10

Pass-Through, No Rate-of-Return = $1 = $1
Utility Revenue Requirement: Discourages Distributed Energy Resources

Revenue Requirement (aka Cost-of-Service) = Capital Investments (Cap-ex) + Operating Expenses (Op-ex)

Both reduce kWh sales => raises rates

Distributed Generation = less need for cap-ex = lower earnings

Energy Efficiency = more op-ex & less need for cap-ex
Throughput incentive

Increased sales lead to increased utility profit

- True when load is served with existing facilities, thus costs are fixed
- Creates incentive to resist measures that reduce sales
## How Changes in Sales Affect Earnings: It’s Significant

<table>
<thead>
<tr>
<th>% Change in Sales</th>
<th>Revenue Change</th>
<th>Impact on Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-tax</td>
<td>After-tax</td>
</tr>
<tr>
<td>5.00%</td>
<td>$9,047,538</td>
<td>$5,880,900</td>
</tr>
<tr>
<td>4.00%</td>
<td>$7,238,031</td>
<td>$4,704,720</td>
</tr>
<tr>
<td>3.00%</td>
<td>$5,428,523</td>
<td>$3,528,540</td>
</tr>
<tr>
<td>2.00%</td>
<td>$3,619,015</td>
<td>$2,352,360</td>
</tr>
<tr>
<td>1.00%</td>
<td>$1,809,508</td>
<td>$1,176,180</td>
</tr>
<tr>
<td>0.00%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-1.00%</td>
<td>-$1,809,508</td>
<td>-$1,176,180</td>
</tr>
<tr>
<td>-2.00%</td>
<td>-$3,619,015</td>
<td>-$2,352,360</td>
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<td>-$5,880,900</td>
</tr>
</tbody>
</table>
Is Something Wrong with the Throughput Incentive?

• There are many reasons why utility sales might go up or down, but what should the utility motivation be?
• Utility rate designs recover embedded investment and labor costs in the kWh charge
  • Sales ↑ Revenue ↑ …. Sales ↓ Revenue ↓
• Public interest appears to be in conflict with throughput incentive
  • Energy Efficiency (EE), Distributed Generation (DG), other policies reduce sales
Regulatory Lag

- Time between when utility costs change and the point when customer rates change
  - Utility concern that higher costs wait until after a rate case. Earned return < allowed return
  - Some consumer advocates may favor lag to keep costs from hitting rates
- Often means there are reconciliation mechanisms in place, which have their own issues
Regulatory Capture

• Elected Commissions
  • Only the utilities have a large vested interest in the outcome.
    • Arizona: Campaign contribution limits

• Appointed Commissions
  • Utilities have undue influence over Governor
    • Consumers need to focus effort
Dealing With Shortcomings

- Decoupling
- Performance-based ratemaking; price-cap regulation
- Incentives for energy efficiency
- Competitive power supply procurement requirements
- Restructuring

Not covering these today…
Discussion
About RAP

The Regulatory Assistance Project (RAP)® is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future.

Learn more about our work at raponline.org

Contact Jessica at: jshipley@raponline.org