June 4, 2020

Electric Cost Allocation
For A New Era:
Technical Topics

Webinar

Jim Lazar, Senior Advisor
The Regulatory Assistance Project (RAP)®

Mark LeBel, Associate

Paul Chernick, President
Resource Insight, Inc.
Questions?

Please send questions through the Questions pane.
First webinar was on principles and concepts.

Available at www.raponline.org

This webinar is a little more technical.
Major Topics for Today

- Principles
- Generation
- Transmission
- Distribution
- Storage
- Metering and Billing
- Marginal Cost Studies
# About the Authors

<table>
<thead>
<tr>
<th>Author</th>
<th>First Rate Case</th>
<th>Dockets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Lazar</td>
<td>1974</td>
<td>&gt;100</td>
</tr>
<tr>
<td>Paul Chernick</td>
<td>1977</td>
<td>&gt;350</td>
</tr>
<tr>
<td>Bill Marcus</td>
<td>1978</td>
<td>&gt;300</td>
</tr>
</tbody>
</table>

Collective experience:

43 states, 8 provinces

Mark LeBel, Editor
1 Principles
What’s New In Cost Allocation?

• Wind, solar and storage
• Customer-sited generation
• Energy efficiency
• Demand response
• Smart grid
• Electric vehicles
• Advanced metering
Basic Thesis: Costs are assigned to time periods
2 Generation Costs
## Generation Methods

*(Electric Cost Allocation for a New Era, Table 19)*

<table>
<thead>
<tr>
<th>Method</th>
<th>Computation and Data Intensity</th>
<th>Accuracy of Cost Causality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight fixed/variable</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>Simple base – intermediate – peak</td>
<td>Low to medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Equivalent peaker</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Probability of dispatch</td>
<td>Medium to high</td>
<td>Highest</td>
</tr>
</tbody>
</table>
### Equivalent Peaker

**Table 14. Equivalent peaker method analysis using replacement cost estimates**

<table>
<thead>
<tr>
<th>Resource type</th>
<th>Cost per kW</th>
<th>Capacity-related share of cost</th>
<th>Energy-related share of cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peaking</td>
<td>$770</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>$3,689</td>
<td>20.9%</td>
<td>79.1%</td>
</tr>
<tr>
<td>Fossil*</td>
<td>$1,976</td>
<td>39.0%</td>
<td>61.0%</td>
</tr>
<tr>
<td>Combined cycle</td>
<td>$1,020</td>
<td>75.4%</td>
<td>24.6%</td>
</tr>
<tr>
<td>Hydro</td>
<td>$4,519</td>
<td>17.0%</td>
<td>83.0%</td>
</tr>
</tbody>
</table>
Base – Intermediate – Peak

![Graph showing power generation by type over the hour of the year, sorted by load. The graph includes categories for Demand response/storage/combustion turbines, Combined cycle, Coal, and Nuclear.]
### Hourly Allocation Methods: Probability of Dispatch

Table 17. Class share of each generation type under probability-of-dispatch allocation

<table>
<thead>
<tr>
<th>Customer class</th>
<th>Generation source</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nuclear</td>
<td>Coal</td>
<td>Combined cycle</td>
<td>Peaking resources</td>
</tr>
<tr>
<td>Residential</td>
<td>34%</td>
<td>34%</td>
<td>32%</td>
<td>31%</td>
</tr>
<tr>
<td>Secondary commercial</td>
<td>28%</td>
<td>29%</td>
<td>39%</td>
<td>42%</td>
</tr>
<tr>
<td>Primary industrial</td>
<td>38%</td>
<td>37%</td>
<td>29%</td>
<td>27%</td>
</tr>
</tbody>
</table>
Wind: Windy Hours

Annual 80-m Diurnal Wind Energy Patterns

Source: Gallegos Wind Farm, LLC
Solar: Sunny Hours

Source: Southern California Public Power Agency

Source: US Energy Information Administration
Class Load in Each Hour

![Graph](image-url)
Generation in Each Hour
Cost Allocation by Hours
3 Transmission Costs
Some Transmission Assets Connect Specific Resources

Figure 38. Transmission system with remote and centralized generation

- Generation = 3 x 300 MWs combined cycle
- Generation = 8 x 100 MWs combustion turbine
- Generation = 3 x 400 MWs coal
- Generation = 0 MWs

- 400 MWs hydro import
- City with 500 MWs peak demand
- Transmission capacity
- 500 MWs
- 600 MWs wind
- 200 MWs
- 350 MWs
- 200 MWs
- 400 MWs
## Many Types of Transmission

*Electric Cost Allocation for a New Era, Table 28*

<table>
<thead>
<tr>
<th>Element</th>
<th>Demand/Energy Methods</th>
<th>Hourly Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk transmission</td>
<td>All energy / 100 highest hours</td>
<td>Hours used or needed</td>
</tr>
<tr>
<td>Remote generation</td>
<td>All energy / 100 highest hours</td>
<td>As remote generation</td>
</tr>
<tr>
<td>Economy interconnection</td>
<td>Energy and demand</td>
<td>Reliability value + all hours</td>
</tr>
<tr>
<td>Local network</td>
<td>High-load hours / 4CP or 12CP</td>
<td>Hours used or needed</td>
</tr>
<tr>
<td>Substations</td>
<td>As lines</td>
<td>As lines</td>
</tr>
</tbody>
</table>
Treating ISO and FERC-Priced Transmission

- Consider how transmission is used
- Do not be bound to FERC methods
- If storage is cheaper, avoid transmission
4 Distribution Costs
Distribution is Built to Supply Customer Needs
Minimum System Fallacy

• Shared distribution system expenses, such as primary conductors, poles and substations, do not meaningfully depend on the number of customers
  • A residential building can be one hotel or 100 apartments.
Substations Have Diversity
Circuits Have Diversity

Figure 40. San Diego Gas & Electric circuit peaks

Within an Apartment Building, Customers Have Diversity
## Distribution Cost Methods: Shared System Elements

<table>
<thead>
<tr>
<th>Element</th>
<th>Demand/Energy Method</th>
<th>Hourly Allocation Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substations</td>
<td><strong>Functionalization:</strong> Entirely primary</td>
<td>Allocate to all hours, with emphasis on high-load hours</td>
</tr>
<tr>
<td></td>
<td><strong>Classification:</strong> Demand and energy</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Demand allocator:</strong> Hours at and near peaks</td>
<td></td>
</tr>
<tr>
<td>Poles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary conductors</td>
<td></td>
<td>Revenue-driven line extension costs allocated on a revenue basis</td>
</tr>
</tbody>
</table>
## Distribution Cost Methods: Site-Specific Elements

<table>
<thead>
<tr>
<th>Element</th>
<th>Method</th>
<th>Hourly Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line transformers</td>
<td>Secondary demand and energy</td>
<td>Transformer peaks and high-load hours</td>
</tr>
<tr>
<td>Secondary conductors</td>
<td>Secondary demand and energy</td>
<td>Line peaks and high-load hours</td>
</tr>
</tbody>
</table>
5 Storage
Storage: Performs Many Functions

Source: Tesla
Storage Functionalization
Storage: Where the FERC System Of Accounts Is Weird

- 363 Energy Storage Equipment – Distribution
- 584 Underground Line Expenses (major only)
- 584.1 Operation of Energy Storage Equipment
- Why is “Operation of Energy Storage Equipment” not in the power supply accounts 560-576?
- Much storage is now owned by wind and solar producers – in Account 555, Purchased Power
6 Metering and Billing
Traditional vs. AMI Metering
Advanced Metering Costs

- “Smart meters” do more than measure kWh
  - Enables new rate designs and demand response programs
  - Enables volt/VAR optimization
  - Data improves system planning
  - Communications system has multiple uses

- **City of Burbank**: using AMI data, transformer right-sizing lowered line losses by 1%, saving $1 million per year
# Advanced Metering Infrastructure

<table>
<thead>
<tr>
<th>Smart Grid Element</th>
<th>Legacy Account</th>
<th>Smart Grid Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart meters</td>
<td>370</td>
<td>Demand, energy and customer</td>
</tr>
<tr>
<td>Distribution control devices</td>
<td>362, 365, 367</td>
<td>Demand and energy</td>
</tr>
<tr>
<td>Data collection</td>
<td>902</td>
<td>Demand, energy and customer</td>
</tr>
<tr>
<td>Meter data management system</td>
<td>391, 903, 905</td>
<td>Demand, energy and customer</td>
</tr>
</tbody>
</table>
7 Marginal Cost Studies
Marginal Cost

- Short-run marginal cost
- Long-run marginal cost
- Hybrid mechanisms
- Total Service Long-Run Incremental Cost

Alfred Kahn
Short-Run Marginal Cost

• Variable operating costs only
• Relevant to system operation
• Very little T&D short-run variable cost
• Will not recover revenue requirement
• Argued to be relevant to economic efficiency by some economists
NERA Methodology: Often Applied With a Flawed Mix of Costs

- Long-run marginal cost of generation capacity
- Short-run marginal cost of energy
- Intermediate marginal cost for transmission
- Long-run marginal cost for customer connections
- Total service long-run marginal cost for billing and collection
- Inequitable if system is excess capacity or deficient
Total Service Long-Run Incremental Cost

- Cost of a new system
- Serving today’s loads
- Optimally configured
- No excess capacity
- Using today’s technologies
- May be cheaper or more expensive than the existing system.

Marginal Generation Cost

• Need to consider long-run capital and operating costs to equitably treat renewables vs. fossil generation.
• Should use economic carrying charge rate, not utility cost of capital
Marginal Distribution Cost

• NERA method: intermediate term for primary distribution, TSLRIC for customer connection

• Better alternatives:
  • TSLRIC for all components
  • New customer only
8 Summary
Summary

• Assign costs to hours
• Distinction between “demand-related” and “energy-related” may be obsolete
• Consider investment-related costs and operating costs together, to avoid bias
• Distribution costs are associated with service in particular hours
• Customer-specific costs are very limited
• Marginal cost studies must use consistent time periods for analysis
“Allocation of costs is not a matter for the slide rule. It involves judgment of a myriad of facts. It has no claim to an exact science.”

Justice William O. Douglas, U.S. Supreme Court

Colorado Interstate Gas Co. v. Federal Power Commission,
324 US 581, 589 (1945)
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 us at:
jlazar@raponline.org
mlebel@raponline.org