Proposal 1: Eliminate The Process

• Current approach favors non-market solutions over market solutions to market signals
  • Markets shift risk to those that can best internalize the risk
  • Fundamental premise of PJM markets not represented in efficiency project approach
  • Rate of return assets vs. competitive market responses to prices
Proposal 1: Eliminate The Process

- Uncertain benefits streams highly sensitive to assumptions regarding fuel mix and fuel prices
  - Dramatic changes in projected benefits and costs possible
  - Risk of incorrect answer forced on customers in the form of a regulated rate of return asset
  - Market would be able to correct for a bad investment, same is not true of regulated assets
- LMPs are correct, not a sign of market inefficiency
  - Congestion the result of least cost security constrained optimization
  - LMP provide the marginal price of energy by location
Overview: Proposals 2 and 3
Benefit/Cost Analysis: Basic Concepts

• Sum Identified Benefits (positive and negative)
  • Inclusive list of benefits and costs
  • Cost/Benefit analysis is intended to measure the positive or negative consequences of a project.
• To evaluate benefits:
  ○ List all parties/categories of parties affected by the project
    – Add the positive or negative value of the project to each party
    – Benefit = the net benefits
Benefit/Cost Analysis: Basic Concepts

• Risk associated with project outcomes is usually handled with probability theory.
  • Can be factored into the discount rate
  • Can/should be considered separately
  • Risk can be used to weight results

• Uncertainty in assumptions/parameters should be evaluated with sensitivity analysis
  • Monte Carlo
  • Both Benefits and Costs subject to uncertainty
PJM Benefit Cost Analysis

- **Market Efficiency Projects** intended to address:
  - **Energy market constraints**
    - Compare Benefits to Costs
  - **Capacity market constraints**
    - Compare Benefits to Costs
- **Total Benefits = Energy Benefits + Capacity Benefits**
PJM Regional Energy Benefit Analysis

• Regional Projects: 50 percent Change in Total Energy Production Cost + 50 percent Change in Load Energy Payment

• Change in Total Energy Production Cost
  • Calculated for the whole PJM Region
  • Total change in energy production cost

• Change in Load Energy Payments
  • Calculated for each transmission zone
  • Includes only zones that show a reduction in load energy payments
  • Total change in load energy costs not considered.
PJM Low Voltage Energy Benefit Analysis

• Regional Projects: 100% of change in Load Energy Payments
• Change in Load Energy Payments
  • Calculated for each transmission zone
  • Includes only zones that show a reduction in load energy payments
  • Total change in load energy costs not considered.
PJM Capacity Benefit Analysis

- Mirrors Energy Benefit Analysis
- Regional Projects: 50% Change in System Capacity Cost + 50% Change in Load Capacity Payment
  - Total system capacity cost
  - Load capacity payments included if lowers cost
- Lower Voltage Projects: 100% change in Load Capacity Payment
  - Load capacity payments included if lowers cost
Issues with Benefit Analysis

• Current B/C Analysis only lists energy benefit to those zones that would benefit from the project
  • Ignores zones that would be hurt by the project.
• To evaluate benefits, need to list all parties/categories affected by the project
  • Add the positive or negative value of the project to each party
  • Benefit = the net benefits
Need to account for Risk in Benefit/Cost Analysis

• Uncertainty in assumptions/parameters can be evaluated with a sensitivity analysis
  o Monte Carlo
  o Both Benefits and Costs subject to uncertainty
Need to account for Risk in Benefit/Cost Analysis

• Benefit assumptions in B/C analysis are not subject to rigorous sensitivity analysis
  • One benefit estimate used in ratio
  • Does not explicitly account for different probabilities (generation build, changes in fuel costs, load change) in ratio

• Uncertainty in assumptions/parameters can be evaluated with a sensitivity analysis
  o Monte Carlo
  o Both Benefits and Costs subject to uncertainty
Proposal 2 and 3

MEPETF
September 24, 2019

Howard Haas
Proposal 2: Benefit measured as changes in system wide load costs, net of modeled congestion allocation

• Proposal is to correct the calculation of benefits in the B/C analysis

• Difference in total load costs before and after proposed project
  • Positive and negative benefits (load costs)
  • Accounting for changes in ARR related offsets
    – Methodology would update with any changes in the ARR/FTR market construct
  • Use the average of the forecasted benefits

• Same metric for benefit calculation used for regional and local projects
Proposal 3: Benefit measured as changes in system wide production costs

• Proposal is to correct the calculation of benefits in the B/C analysis
  • Difference in total system-wide production costs before and after proposed project
    o Positive and negative benefits (production costs)
    o Method assumes perfect allocation of congestion to those that pay (no difference between generation payments and load payments)
      – Methodology matches IMM proposed revisions to ARR/FTR market
    o Use the average of the forecasted benefits (changes in production costs)
  • Same metric for benefit calculation used for regional and local projects
Example 1
### Congestion

- **Payment to Gen A**
- **Payment to Gen B**
- **Maximum congestion credit**

---

**Day Ahead**

<table>
<thead>
<tr>
<th>Bus A Price</th>
<th>Bus B Price</th>
<th>Bus B Load</th>
<th>Bus B Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$50</td>
<td>$100</td>
<td>200 MW</td>
<td>100 MW</td>
</tr>
</tbody>
</table>

**Day Ahead Bus A**

<table>
<thead>
<tr>
<th>Price</th>
<th>Load</th>
<th>Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$50</td>
<td>200</td>
<td>300</td>
</tr>
</tbody>
</table>

**System Total**

- **Load**
  - A: $10,000.00
  - B: $20,000.00
  - Total: $30,000.00
- **Generation**
  - A: $15,000.00
  - B: $10,000.00
  - Total: $25,000.00
- **Total**
  - Load: $10,000.00
  - Generation: $10,000.00
  - Total: $5,000.00

**(Load charges - congestion allocation)/(Total Load)**

- A: $50.00
- B: $75.00
- Total: $62.50

**(Generation credits/Total Load)**

- Total: $62.50
### Day Ahead

<table>
<thead>
<tr>
<th>Bus A</th>
<th>Bus B</th>
<th>System Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load</td>
<td>$12,000.00</td>
<td>$18,000.00</td>
</tr>
<tr>
<td>Generation</td>
<td>$21,000.00</td>
<td>$4,500.00</td>
</tr>
</tbody>
</table>

**Total**

| Load charges - congestion allocation/(Total Load) | $60.00 | $67.50 | $63.75 |
| Generation credits/(Total Load) | $63.75 | $63.75 | $63.75 |

---

**Legend**

- **200 MW Load at A**
- **200 MW Load at B**
- **$100**
- **$60**
- **$90**
- **$50**

**Maximum congestion credit**

**Payment to Gen A**

**Payment to Gen B**

**150 MW export from A to B**

**50 MW from Generator B**

**Payment to Gen A**

**Payment to Gen B**

**Maximum congestion credit**

**Load**

**Generation**

**Total**

**Bus A**

**Bus B**

**Price** $60 $90

**Load** 200 200

**Generation** 350 150 MW 50
## Comparing Approaches to Benefit Calculation

### Changes in costs (+ Higher Cost)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upgrade Change in Load Costs</td>
<td>$2,000</td>
<td>-$2,000</td>
<td>$0</td>
</tr>
<tr>
<td>Change in Congestion Offset</td>
<td>NA</td>
<td>-$500</td>
<td>-$500</td>
</tr>
<tr>
<td>Change in Total Load Costs</td>
<td>$2,000</td>
<td>-$1,500</td>
<td>$500</td>
</tr>
<tr>
<td>Change in Generation Costs</td>
<td>$6,000</td>
<td>-$5,500</td>
<td>$500</td>
</tr>
</tbody>
</table>

### Benefit

- **PJM Method Regional (50 +50), Positive Load Only**: $500.00
- **PJM Method Local (local load only)**: $1,500.00
- **IMM Proposal 2**: -$500.00
- **IMM Proposal 3**: -$500.00

### Transfer A to B

<table>
<thead>
<tr>
<th>Day Ahead</th>
<th>Bus A</th>
<th>Bus B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>$50</td>
<td>$100</td>
</tr>
<tr>
<td>Load</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Generation</td>
<td>300 MW</td>
<td>100 MW</td>
</tr>
</tbody>
</table>

### Total System Load

<table>
<thead>
<tr>
<th>Day Ahead</th>
<th>Bus A</th>
<th>Bus B</th>
<th>System Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load</td>
<td>$10,000.00</td>
<td>$20,000.00</td>
<td>$30,000.00</td>
</tr>
<tr>
<td>Generation</td>
<td>$15,000.00</td>
<td>$10,000.00</td>
<td>$25,000.00</td>
</tr>
<tr>
<td>Total</td>
<td>$5,000.00</td>
<td>$10,000.00</td>
<td>$5,000.00</td>
</tr>
</tbody>
</table>

### Load Charges - Congestion Allocation

- $(Load charges - congestion allocation)/(Total Load) = $62.50$.

### Generation Credits

- $(Generation credits/Total Load) = $62.50$.
Example 2
Example 2

Day Ahead

<table>
<thead>
<tr>
<th>Bus A</th>
<th>Bus B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>$50</td>
</tr>
<tr>
<td>Load</td>
<td>200</td>
</tr>
<tr>
<td>Generation</td>
<td>300 100 MW</td>
</tr>
</tbody>
</table>

Day Ahead System Total

<table>
<thead>
<tr>
<th>Bus A</th>
<th>Bus B</th>
<th>System Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load</td>
<td>$10,000.00</td>
<td>$20,000.00</td>
</tr>
<tr>
<td>Generation</td>
<td>$15,000.00</td>
<td>$10,000.00</td>
</tr>
<tr>
<td>Total</td>
<td>-$5,000.00</td>
<td>$10,000.00</td>
</tr>
</tbody>
</table>

(Load charges - congestion allocation)/(Total Load) $50.00 $75.00 $62.50
(Generation credits/Total Load) $62.50
Example 2

Day Ahead

<table>
<thead>
<tr>
<th>Bus A</th>
<th>Transfer A to B</th>
<th>Bus B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>$55</td>
<td>$90</td>
</tr>
<tr>
<td>Load</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Generation</td>
<td>350 150 MW</td>
<td>50</td>
</tr>
</tbody>
</table>

Day Ahead

<table>
<thead>
<tr>
<th>Bus A</th>
<th>Bus B</th>
<th>System Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load</td>
<td>$11,000.00</td>
<td>$18,000.00</td>
</tr>
<tr>
<td>Generation</td>
<td>$19,250.00</td>
<td>$4,500.00</td>
</tr>
<tr>
<td>Total</td>
<td>-$8,250.00</td>
<td>$13,500.00</td>
</tr>
</tbody>
</table>

(Load charges - congestion allocation)/(Total Load) = $55.00 / $11,000.00 = $59.38
(Generation credits / Total Load) = $55.00 / $29,000.00 = $59.38
### Comparing Approaches to Benefit Calculation

<table>
<thead>
<tr>
<th>Day Ahead</th>
<th>Bus A to B</th>
<th>Bus B</th>
<th>System Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>$50</td>
<td>$100</td>
<td>$150</td>
</tr>
<tr>
<td>Load</td>
<td>200</td>
<td>200</td>
<td>400</td>
</tr>
<tr>
<td>Generation</td>
<td>300 100 MW</td>
<td>100</td>
<td>400</td>
</tr>
</tbody>
</table>

#### Changes in costs (+ Higher Cost)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upgrade Change in Load Costs</td>
<td>$1,000</td>
<td>-$2,000</td>
<td>-$1,000</td>
</tr>
<tr>
<td>Change in Congestion Offset</td>
<td>NA</td>
<td>$250</td>
<td></td>
</tr>
<tr>
<td>Change in Total Load Costs</td>
<td>$1,000</td>
<td>-$2,250</td>
<td>-$1,250</td>
</tr>
<tr>
<td>Change in Generation Costs</td>
<td>$4,250</td>
<td>-$5,500</td>
<td>-$1,250</td>
</tr>
</tbody>
</table>

#### Benefit

<table>
<thead>
<tr>
<th>Method</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PJM Method Regional (50+50), Positive Load Only</td>
<td>$1,750.00</td>
</tr>
<tr>
<td>PJM Method Local (local load only)</td>
<td>$2,250.00</td>
</tr>
<tr>
<td>IMM Proposal 2</td>
<td>$1,250.00</td>
</tr>
<tr>
<td>IMM Proposal 3</td>
<td>$1,250.00</td>
</tr>
</tbody>
</table>