Congestion Accounting in a Multi-Settlement Market

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Day-Ahead + Balancing Congestion ≠ Real-Time Congestion

**DAY-AHEAD**
No Constraint is binding

**REAL-TIME**
Line is forced out and causes real-time congestion addressed by generation redispatch

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Day-Ahead Settlement

<table>
<thead>
<tr>
<th>Payment</th>
<th>Demand</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit</td>
<td>Gen 1</td>
<td>15,000</td>
</tr>
<tr>
<td></td>
<td>Gen 2</td>
<td>7,500</td>
</tr>
<tr>
<td></td>
<td>Gen 3</td>
<td>0</td>
</tr>
</tbody>
</table>

Balancing Market Settlement

<table>
<thead>
<tr>
<th>Payment</th>
<th>Demand</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit</td>
<td>Gen 1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Gen 2</td>
<td>(6,000)</td>
</tr>
<tr>
<td></td>
<td>Gen 3</td>
<td>22,500</td>
</tr>
</tbody>
</table>

**Two-Settlement Market**
Day-Ahead Congestion = 0
Balancing Congestion = -$16,500

**Single Settlement Market**
Real-Time Congestion = $33,000

Single Real-Time Settlement

<table>
<thead>
<tr>
<th>Payment</th>
<th>Demand</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit</td>
<td>Gen 1</td>
<td>12,000</td>
</tr>
<tr>
<td></td>
<td>Gen 2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Gen 3</td>
<td>22,500</td>
</tr>
</tbody>
</table>
Discussion

• The three node network shows a day-ahead market with no congestion and uniform LMPs at all three nodes (losses are ignored for simplicity)
  – Gen 1 has 300 MW capacity at zero cost, Gen 2 has 200 MW capacity with first 100 MW at 40$/MWh and next 100 MW at 50 $/MWh, Gen 3 has 200 MW at 150$/MWh
• In real-time, a transmission line outage between Gen 2 and Gen 3 results in congestion on transmission line between Gen 1 and Gen 3 requiring generation redispatch
  – the output of an expensive generator (Gen 3) is increased and the output of a less expensive generator (Gen 2) is decreased (these are the only two deviations from the day-ahead schedules)
  – LMPs are no longer the same reflecting congestion
  – Balancing congestion is -$16,500
  – Total congestion = Day-Ahead Congestion + Balancing Congestion = -$16,500
• Now imagine the same real-time conditions in a single settlement market where real-time LMPs apply to entire generation and load (as opposed to just deviations)
  – Real-time congestion = $33,000
Conclusion

• Negative balancing congestion does not necessarily imply a reduction in congestion
• A total congestion metric that uses the sum of day-ahead and balancing congestion may understate the actual congestion in the system
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