Key Provisions of the CODA

EAI Technical Conference
September 23, 2010
Discussion Framework

- Main elements of CODA
- Flexibility
- Flexible Energy Exchange
Discussion Framework

- Main elements of CODA
- Flexibility
- Flexible Energy Exchange
CODA and the System Agreement differ in a number of key areas

- **Reserve sharing**
  - No equalization of the cost of reserve capacity (e.g., no payments for reserve equalization) -- OpCos responsible for acquiring and providing resources sufficient to meet their own needs (including reserves) each year

- **Energy sharing**
  - New pricing in Economy Energy Exchange
  - New Flexible Energy Exchange

- **Resulting production cost differences**
  - No explicit or implied intention to achieve Rough Production Cost Equalization among the OpCos.
The Economy Energy Exchange is one of the keys to sending the appropriate price signals regarding resource planning.

- A joint dispatch will always result in some OpCos having excess energy (i.e. being “long”) in an hour and others having a deficit (i.e. being “short”).
- Under the CODA, the long and short companies exchange energy priced at the hourly System avoided cost.
- The use of the System avoided cost ensures that the benefits or detriments produced by a generating unit goes to the owner of the generator, not the party buying the energy.
The Economy Energy Exchange is a simple comparison of total resources and loads for each OpCo on an hourly basis.

No need to sort by cost.

All energy bought and sold at Avoided Cost.

“Long”

“Short”

<table>
<thead>
<tr>
<th>MW</th>
<th>Resources</th>
<th>Load</th>
<th>Sell To Exchange</th>
<th>OPCO 1</th>
<th>Resources</th>
<th>Load</th>
<th>Buy From Exchange</th>
<th>OPCO 2</th>
</tr>
</thead>
</table>

Preliminary Results -- Subject to Change
Additional Scenarios Contemplated
This methodology highlights the reason why explicit recognition of the cost of flexibility is necessary.

Consider the Economy Energy Exchange mechanics in a hypothetical hour

<table>
<thead>
<tr>
<th></th>
<th>Long (MWh)</th>
<th>Short (MWh)</th>
<th>Avoided Cost ($/MWh)</th>
<th>Cost of Energy (Actual or Incremental)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OpCo 1</td>
<td>-</td>
<td>10</td>
<td>$110</td>
<td>$90</td>
</tr>
<tr>
<td>OpCo 2</td>
<td>5</td>
<td>-</td>
<td>$110</td>
<td>$60</td>
</tr>
<tr>
<td>OpCo 3</td>
<td>5</td>
<td>-</td>
<td>$110</td>
<td>$120</td>
</tr>
</tbody>
</table>

- Why should OpCo #1 buy Economy Exchange energy at $110/MWh when it has energy available at $90/MWh?
- Why was OpCo #3 operating its generator at $120/MWh when it could have purchased energy at $110/MWh?
The answer to both questions is that the System needed those generators to operate at those levels to supply flexibility.

- OpCo #1’s generator was operated at a level lower than it would otherwise have absent system constraints. It had to buy energy that it could have generated more cheaply.
- OpCo #3’s generator was operated at a level higher than it otherwise would have absent system constraints. It had to sell the energy it generated at a loss.
Discussion Framework

Main elements of CODA

Flexibility

Flexible Energy Exchange

Preliminary Results -- Subject to Change
Additional Scenarios Contemplated
One of the key features of CODA is its explicit identification and allocation of the cost of flexibility among the OpCo’s.

The CODA framework identifies:
- The amount of flexibility the System has each hour and the amount assigned to each OpCo -- OpCo’s “flex responsibility”
- The amount of flexibility supplied by each OpCo in each hour -- OpCo’s “flex supply”
- The cost of the flexibility supplied by each OpCo unit in each hour
  - The cost to make the flexibility available
  - The cost to operate a unit at a level that is lower / higher than it otherwise would have been operated absent system constraints
- The framework used to allocate flexibility costs (i.e. the Flexible Energy Exchange).
The System needs flexibility for a number of reasons

- The provision of operating reserves
- The provision of generator imbalance and ancillary services
- Intra-hour load swings
- Ramping requirements of block purchases
- Responding to orders from Transmission

**Relative Contribution of Flex Cap Drivers**

- Load Swing: 60%
- QF Put: 20%
- GIA: 10%
- Op Reserves: 10%
- Other: 0%
CODA assigns responsibility to the OpCos based on the largest contributors of the need for flex

- Allocators are calculated for each OpCo based on:
  - Daily load swing
  - Daily maximum QF put
  - Operating reserves

- They reflect:
  - OpCo load swing and maximum QF put on the day of the week that the System had the largest load swing and maximum QF put
  - OpCo’s responsibility ratio of operating reserves

i.e. Allocator = \( \frac{\text{OpCo LS+QF+OR}}{\text{System LS+QF+OR}} \)
The amount of flexibility supplied by each OpCo in each hour depends on the units committed by the System

- Consider an illustrative two-company system. Allocation factors are calculated based on the QF put and Daily Swing. (OpCo1 – 40% and OpCo2 – 60%)

- The generators actually committed are evaluated and the total flexibility provided by these generators is calculated (2,645 MW).

- The illustration indicates flex responsibility of:
  - OpCo1 – 40% of 2,645 – 1,058 MW
  - OpCo2 – 60% of 2,645 – 1,587 MW

- And flex supply of:
  - OpCo1 – 1,905 MW (600+600+350+355)
  - OpCo2 – 740 MW (400+340)

**ILLUSTRATIVE**
The key driver of flexibility costs is the cost incurred to make the unit available for dispatch.

- In order for the generators in the previous illustration to provide flexibility, they must be available to serve load within the hour.
- This means that the generator must already be operating or be a “quick start” resource.
- The “commitment cost” of flexibility is the cost to have the resource available in the hour.
  - An available CT with quick-start capability would have zero “commitment cost”
  - For other generators, the “commitment cost” is the cost to have the unit operating at its minimum operating level for the hour.
Focusing on a single generator provides an illustration of the component parts of the cost of flexibility.

Operating Parameters of a Single Generator

- **Minimum operating level of the unit is 100 MW.**
- **Average energy cost at minimum is $140/MWh.**
The “commitment cost” of the unit is the cost to operate the unit in the hour at its minimum level, irrespective of the actual dispatch.

If a party is assigned the benefits of the flexibility of a unit, it must pay the cost of having the unit available.
The dispatch cost of the unit is defined by its incremental heat rate curve.
The Avoided Cost defines what the dispatch level of the unit would have been, absent the actual constraints of the system.
If system constraints limited the output of the unit below its optimal level, the unit is losing a portion of its value.

This area represents the lost opportunity.

If the actual dispatch in the hour is limited to 300 MWh, then the unit is losing the value of the next 100 MWh (~$500 for the hour.)
If system constraints require that the unit be operated above its optimal level, the unit is incurring an additional cost.

Operating Parameters of a Single Generator

If the actual dispatch in the hour is 500 MWh, then the unit is incurring a cost for the last 100 MWh (~$500 for the hour).
The “dispatch cost” component of flexibility in the hour is either the lost opportunity or added cost. It cannot be both.
The sum of the “commitment” and “dispatch” cost components can be divided by the amount of flexibility supplied to compare the flexibility costs of different units.

*Using the illustration of the single generator*

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commitment Cost of Flex</td>
<td>$14,000</td>
</tr>
<tr>
<td>Dispatch Cost of Flex</td>
<td>+ $ 500</td>
</tr>
<tr>
<td>Total Flex Cost</td>
<td>= $14,500</td>
</tr>
<tr>
<td>Flexible energy supplied</td>
<td>= 100 MW (unit minimum)</td>
</tr>
<tr>
<td><strong>Cost of flexible energy supplied</strong></td>
<td><strong>= $145/MWh ($14,500/100)</strong></td>
</tr>
<tr>
<td>Value of flexible energy supplied</td>
<td>= $11,000</td>
</tr>
<tr>
<td>(at avoided cost price of $110/MWh)</td>
<td></td>
</tr>
<tr>
<td>Net Flex Cost</td>
<td>= $3,500 ($14,500-$11,000)</td>
</tr>
<tr>
<td>(Total flex cost minus value of min energy)</td>
<td></td>
</tr>
<tr>
<td>Flexibility supplied</td>
<td>= 600 MW (700-100MW)</td>
</tr>
<tr>
<td><strong>Flex rate for comparison</strong></td>
<td><strong>= $5.83/MW_{FLEX} ($3,500/600)</strong></td>
</tr>
</tbody>
</table>
Discussion Framework

- Main elements of CODA
- Flexibility
- Flexible Energy Exchange
How does the Flexible Energy Exchange work?

- The mechanics of the Flexible Energy Exchange utilize the calculations just discussed.
- The cost of flexibility is calculated hourly for each unit and then sorted hourly by OpCo and the comparison rate.

<table>
<thead>
<tr>
<th>OpCo</th>
<th>Unit</th>
<th>Min MW</th>
<th>Max MW</th>
<th>Flex</th>
<th>Commit Cost</th>
<th>Disp Cost</th>
<th>Total</th>
<th>Value of Min Energy</th>
<th>Net</th>
<th>Flex Compare Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>OpCo1</td>
<td>A</td>
<td>100</td>
<td>700</td>
<td>600</td>
<td>14,000</td>
<td>500</td>
<td>14,500</td>
<td>11,000</td>
<td>3,500</td>
<td>$5.83</td>
</tr>
<tr>
<td>OpCo1</td>
<td>B</td>
<td>150</td>
<td>750</td>
<td>600</td>
<td>20,000</td>
<td>2,000</td>
<td>22,000</td>
<td>16,500</td>
<td>5,500</td>
<td>$9.17</td>
</tr>
<tr>
<td>OpCo1</td>
<td>C</td>
<td>50</td>
<td>400</td>
<td>350</td>
<td>5,500</td>
<td>500</td>
<td>6,000</td>
<td>5,500</td>
<td>500</td>
<td>$1.43</td>
</tr>
<tr>
<td>OpCo1</td>
<td>D</td>
<td>45</td>
<td>400</td>
<td>355</td>
<td>5,000</td>
<td>300</td>
<td>5,300</td>
<td>4,950</td>
<td>350</td>
<td>$0.99</td>
</tr>
<tr>
<td>OpCo2</td>
<td>E</td>
<td>100</td>
<td>500</td>
<td>400</td>
<td>14,000</td>
<td>500</td>
<td>14,500</td>
<td>11,000</td>
<td>3,500</td>
<td>$8.75</td>
</tr>
<tr>
<td>OpCo2</td>
<td>F</td>
<td>210</td>
<td>550</td>
<td>340</td>
<td>25,000</td>
<td>1,200</td>
<td>26,200</td>
<td>23,100</td>
<td>3,100</td>
<td>$9.12</td>
</tr>
</tbody>
</table>
The Flexible Energy Exchange first stacks the generators by OpCo based on the comparison rate.

**ILLUSTRATIVE**
The stack of Flex resources is then compared to each OpCo’s Flexible obligation.
The “long” OpCos in the hour sell their excess flexibility to the “short” OpCos

- **Flex supplied**
  - OpCo1: 900 MW
  - OpCo2: 900 MW

- **Flex obligation**
  - OpCo1: 100 MW
  - OpCo2: 100 MW

- **Sale to Exchange**
  - This equates to 900 MW of the flexibility from Gen A & B.
  - $9.12
  - $8.75
  - $0.99
  - $1.43
  - $9.17
  - $5.83

- **Flex supplied from Exchange**
  - OpCo1: $9.12
  - OpCo2: $8.75

- **Flex obligation from Exchange**
  - OpCo1: $0.99
  - OpCo2: $1.43

This is the flexibility exchanged, but not the energy.
The dollars that are transferred in this process are calculated based on the Flex cost of the units exchanged.

- The selling OpCo is paid “commitment” and “dispatch” cost components associated with the flexibility transferred from its resource(s).
- Using the example, OpCo1 is paid the following:

  From Unit B  All 600 MW of flex transferred  = $22,000
  From Unit A  300 MW of flex (50%) transferred = $ 7,250 (50%)

  Total  900 MW of flexibility transferred  = $29,250

ILLUSTRATIVE
Since buyers are paying for the cost to make the unit available, they receive the energy corresponding to these costs -- the unit’s minimum run level

Using our illustration,

- OpCo1 is paid for 100% of the commitment costs of unit B and 50% of the commitment costs of unit A, therefore, the minimum energy transferred is:
  - For Unit B - 100% * 150 MWh = 150 MWh
  - For Unit A - 50% * 100 MWh = 50 MWh

- The result of the Flexible Energy Exchange is a sale and purchase of 200 MWh of flexible energy at $29,250 ($146.25/MWh)