Lesson 2A: Pay-for-Performance (PFP) Basics

Forward Capacity Market (FCM 101)

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Topics

• Concept of Pay-for-Performance (PFP)
• Capacity Scarcity Condition (CSC)
• How Performance Charges and Credits Work
• Examples
Objectives

- Recognize key concepts of pay-for-performance
- Identify a capacity scarcity condition
- Explain how performance charges and credits work
A Few Introductory Notes

• Majority of FCM 101 lessons will focus on how you get a capacity supply obligation (CSO), and how and at what price you are paid for supplying capacity

• It’s equally important to realize that credits and charges based on your resource’s performance can have a material effect on your net payments
  – In this lesson, we will review how these performance credits and charges work
  – With this knowledge, you can then make more informed decisions about the bid or offer price you submit for a resource in the various capacity auctions
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tbody>
<tr>
<td>CSO</td>
<td>capacity supply obligation. A resource that has sold capacity has a capacity supply obligation.</td>
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<tr>
<td>FCA</td>
<td>Forward Capacity Auction. The first auction and process wherein the majority of capacity is procured.</td>
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<tr>
<td>CSC</td>
<td>capacity scarcity condition. A settlement interval in which pay-for-performance settlement calculations are performed.</td>
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<tr>
<td>RCPF</td>
<td>reserve constraint penalty factor. The maximum real-time reserve clearing price when the particular reserve requirement is violated (deficient).</td>
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<tr>
<td>ACP</td>
<td>actual capacity provided. The energy and/or reserves provided by a resource during a capacity scarcity condition.</td>
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<tr>
<td>PPR</td>
<td>performance payment rate. A (fixed) number used in pay-for-performance settlement calculations.</td>
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<tr>
<td>CCP</td>
<td>capacity commitment period. Period begins in June (beginning of summer season) and ends following May (end of following winter season).</td>
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<tr>
<td>Br</td>
<td>balancing ratio. A variable used in pay-for-performance settlement calculations.</td>
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Forward Capacity Market Process – What are We Talking About in this Section?

Qualification
- Establish requirements, zones, and demand curves
- Show of interest submittal for new projects
- Set qualified amounts for capacity resources
- Submit bids and offers

Forward Capacity Auction
- Conduct auction (primary and substitution auction)
- Clear bids and offers (obligations obtained, or not)

Reconfiguration Auctions & Bilateral Trading
- Adjust capacity obligation amounts

Capacity Commitment Period (June - May)
- In this lesson we will discuss capacity resource performance
Monthly capacity payments are based on the sum of two payment streams.

\[
\text{Capacity Payment} = \text{Base Payment} + \text{Performance Payment}
\]

- A transfer between suppliers
- Based on system conditions and resource performance during a scarcity condition
- May be negative, zero, or positive

Based on capacity supply obligation (CSO); for example, at Forward Capacity Auction (FCA) price.
Pay-for-Performance Concept

• Idea behind pay-for-performance is to make it look, from a supplier’s perspective, like a very high-priced energy-only market
  – Where prices can reach several thousand dollars per MWh (~$4,000+/MWh)
  – Where suppliers get paid for the energy and reserves they are actually providing – if you don’t actually sell in an energy-only market when prices are high priced, you don’t get paid

• Achieved by:
  – Measuring each resource’s performance during a scarcity condition (i.e., when prices are high)
  – Comparing performance of resource to its obligated share of system requirements (is resource under- or over-performing?)
  – Compensating over-performance and charging under-performance a high rate ($2,000/MWh)

This compensation is separate from energy and reserve market revenues but as we will see, the combination adds up to several thousand dollars per MWh
What is a Capacity Scarcity Condition?

• A capacity scarcity condition (CSC) is any five-minute settlement interval in which the system has a capacity deficiency; specifically, when the system is not meeting certain reserve requirements (i.e., when system is deficient in reserves)

• For pay-for-performance purposes, this is a deficiency of:
  – Minimum total reserve requirement
  – Ten-minute reserve requirement
  – Zonal reserve requirement (a local capacity scarcity condition)
Background Information on Reserves and Reserve Pricing

Real-time reserve clearing price is normally zero because there are usually more reserves available than required.

• However, when reserves become scarce they can be created by re-dispatching the system
  – Fast ramping resources can be dispatched down to create reserve capability
  – At same time, slow ramping resources can be dispatched up providing energy in lieu of fast resources

This is not optimal dispatch for energy; hence the shorthand phrase *re-dispatch*

When system is re-dispatched, real-time reserve clearing price will be greater than zero

• Price reflects opportunity cost of resource(s) backed down and is also included in (added to) energy price
Re-Dispatch and Capacity Scarcity Conditions

- There is a limit on how much reserves can be created by re-dispatching system; there’s only so much re-dispatching that can be done
- When the limit is reached, the algorithm stops trying to re-dispatch system and sets the real-time reserve clearing price equal to reserve-constraint penalty factor (RCPF)
  - Ten-minute reserve requirement RCPF = $1,500/MWh
  - Minimum total reserve requirement RCPF = $1,000/MWh
- A capacity scarcity condition occurs in any five-minute settlement interval where the real-time reserve clearing price is equal to the RCPFs above, and this price is also included in energy price

This is when (and only when) the pay-for-performance settlement provisions apply
Re-Dispatch and Reserve Deficiency

Reserve Amount

Surplus

Deficient

Re-dispatch

Reserve Requirement

Reserve Deficiency

Scarcity Condition

Real-Time Reserve Clearing Price

$/MWh

Reserve Constraint Penalty Factor (RCPF)

Time
Example of Reserve-Constraint Penalty Factor in Action

Reserve Constraint Penalty Factor (RCPF) Activation Data
Includes files providing historical data and certain simulation results on real-time reserve deficiencies (scarcity conditions) indicated by ISO's dispatch and pricing system.
### Value of Energy and/or Reserves

- Real-time reserve price will be at least $1,000/MWh and added to energy price
- If energy price is $750/MWh, the LMP is $1,750/MWh

### Value of Performance

- Every MWh provided (energy or reserves) is worth an additional $2,000/MWh

A generator, for example, if online and/or reserve-capable during the scarcity condition interval would be paid:

From a supplier’s perspective, the value of delivering during a scarcity condition is then $3,750/MWh.
How Do Performance Payments Work?

Recall the basic steps outlined earlier:

1. Measure each resource’s performance during a scarcity condition
   - This is actual capacity provided (ACP) (energy and/or reserves actually provided by resource)

2. Compare resource’s ACP to its obligated share of system requirements
   (in other words, what is resource’s performance score?)
   - Resource’s share of system requirements is determined by using a system variable called the balancing ratio (more about this on the next slide)

3. Compensate over-performance and charge under-performance
   - Performance payment rate (PPR) is a function of net cost of new entry (net CONE) and number of expected scarcity hours at criteria; we will discuss this in more detail in Lesson 4

Performance payment rate for capacity commitment periods (CCPs) 9-11 is $2,000/MWh; for CCPs 12-14 it is $3,500/MWh; and for CCPs 15+ it is $5,455/MWh
Performance Payment Rates are Specific to a Commitment Period

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<thead>
<tr>
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<tbody>
<tr>
<td>CCP 9</td>
<td>CCP 10</td>
<td>CCP 11</td>
<td>CCP 12</td>
<td>CCP 13</td>
<td>CCP 14</td>
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Upcoming Auctions

<table>
<thead>
<tr>
<th>ARA 1</th>
<th>June ’16</th>
<th>June ’17</th>
<th>June ’18</th>
<th>June ’19</th>
<th>June ’20</th>
<th>June ’21</th>
</tr>
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<tbody>
<tr>
<td>ARA 2</td>
<td>August ’17</td>
<td>August ’18</td>
<td>August ’19</td>
<td>August ’20</td>
<td>August ’21</td>
<td>August ’22</td>
</tr>
<tr>
<td>ARA 3</td>
<td>March ’18</td>
<td>March ’19</td>
<td>March ’20</td>
<td>March ’21</td>
<td>March ’22</td>
<td>March ’23</td>
</tr>
</tbody>
</table>

Annual Reconfiguration Auctions

<table>
<thead>
<tr>
<th>Net Regional Clearing Price (NRCP)</th>
<th>Marginal Value Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>$11.08</td>
<td>MRI Curves</td>
</tr>
<tr>
<td>$10.81</td>
<td>Annual Reconfiguration Transactions (ARTs)</td>
</tr>
<tr>
<td>$11.64</td>
<td>$8.04</td>
</tr>
<tr>
<td></td>
<td>$8.16</td>
</tr>
<tr>
<td>$3,500/MWh</td>
<td>TBD</td>
</tr>
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Notable Aspects & Differences

<table>
<thead>
<tr>
<th>Cost Allocation Method</th>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td>Demand Curves Used</td>
<td>Sloped System (only) Demand Curve</td>
<td>Marginal Reliability Impact (MRI) Demand Curves w/transition segment</td>
</tr>
<tr>
<td>Capacity Supply Obligation (CSO) Transactions</td>
<td>Annual CSO Bilateral Transactions</td>
<td>Annual Reconfiguration Transactions (ARTs)</td>
</tr>
<tr>
<td>Net Cone ($/kW-month)</td>
<td>$11.08</td>
<td>$10.81</td>
</tr>
<tr>
<td>Pay-for-Performance Rate (PPR)</td>
<td>$2,000/MWh</td>
<td>$3,500/MWh</td>
</tr>
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Share of System Requirements: The Balancing Ratio

- By assuming a capacity supply obligation, you essentially assume responsibility for a share of system requirement(s) during scarcity conditions.
- This is reflected through the balancing ratio (Br).

\[
\text{Balancing Ratio} = \frac{\text{load (energy) + reserve requirement}}{\text{total CSO}}
\]

**Example:** With 30,000 MW of CSO in the system and your resource with 300 MW of CSO, your resource is then responsible for one percent (1%) of system requirement during a scarcity condition.

<table>
<thead>
<tr>
<th>During low-load periods</th>
<th>During high-load periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balancing ratio during a scarcity condition will be <strong>lower</strong> (e.g., 0.65)</td>
<td>Balancing ratio during a scarcity condition will be <strong>higher</strong> (e.g., 0.90)</td>
</tr>
</tbody>
</table>
Calculating a Resource’s Performance Score and Payment

A resource’s performance score is:

\[ \text{Performance Score} = ACP - (Br \times CSO) \]

A resource’s performance payment is:

\[ \text{Performance Payment} = PPR \times \text{Performance Score} = PPR \times (ACP - (Br \times CSO)) \]

Observations

A resource without a CSO has no forward payment but may get a performance payment:

\[ \text{Performance Payment} = PPR \times (ACP - (Br \times CSO)) = PPR \times ACP \]
To better demonstrate the effects of performance payments, the examples on the next few slides will assume there is one full continuous hour of scarcity conditions (12, five-minute intervals) so we don’t have to worry about units of measurement. One (1) MWh is not the same as running at 1 MW for five minutes; it would take an hour to make 1 MWh. Examples are conceptual only.
Example #1 – Low Load Condition

Calculate base payment and performance payments for a resource with a CSO of 300 MW (ignore energy/reserve revenues)

Base payment = $5.00/kW-month x 300 MW = $1,500,000/month

System variables:
- Balancing ratio (Br) = 0.65 \textit{(a function of system load during scarcity conditions)}
- Performance payment rate (PPR) = $2,000/MWh

Resource variables:
- Capacity supply obligation (CSO) = 300 MW (or 300 MWh for a full hour)
- Actual capacity provided (ACP) = 240 MWh \textit{(what was actually provided during scarcity conditions)}

For a full hour of scarcity:

\[
\text{Performance Payment} = PPR \times (ACP - Br \times CSO) = $2,000/MWh \times (240 \text{ MWh} - 0.65 \times 300 \text{ MWh}) = $90,000
\]
**Example #2 – High Load Condition**

**Calculate base payment and performance payments**

*for a resource with a CSO of 300 MW (ignore energy/reserves revenues)*

<table>
<thead>
<tr>
<th><strong>Base payment</strong></th>
<th><strong>= $5.00/kW-month x 300 MW = $1,500,000/month</strong></th>
</tr>
</thead>
</table>

**System variables:**
- Balancing ratio (Br) = **0.90** (this is the only difference from Example #1)
- Performance payment rate (PPR) = **$2,000/MWh**

**Resource variables:**
- Capacity supply obligation (CSO) = 300 MW (or 300 MWh for a full hour)
- Actual capacity provided (ACP) = 240 MWh

For a full hour of scarcity:

**Performance Payment**

\[
\text{Performance Payment} = \text{PPR} \times (\text{ACP} - \text{Br} \times \text{CSO})
\]

\[
= $2,000/\text{MWh} \times (240 \text{ MWh} - 0.90 \times 300 \text{ MWh}) = ($60,000)
\]

What if in the same month there was one full hour of scarcity at low load (Example #1) and one full hour of scarcity at high load (Example #2)?
Example #3 – High Load Condition; No CSO

Calculate base payment and performance payments
for a 300 MW resource without a CSO (ignore energy/reserves revenues)

Base payment = \(5.00/\text{kW-month} \times 0 \text{ MW} = 0/\text{month}\)

System variables:
- Balancing ratio (Br) = 0.90
- Performance payment rate (PPR) = \$2,000/\text{MWh}

Resource variables:
- Capacity supply obligation (CSO) = 0 \text{ MWh}
- Actual capacity provided (ACP) = 240 \text{ MWh}

For a full hour of scarcity:

Performance Payment = \(\text{PPR} \times (\text{ACP} - \text{Br} \times \text{CSO})\)
= \$2,000/\text{MWh} \times (240 \text{ MWh} - 0.90 \times 0 \text{ MWh}) = 480,000

Does it matter in this case whether it is a high or low load condition?
Some Other Things to Know

• Capacity payments are made monthly; performance payments are a function of the resource’s cumulative score for all scarcity conditions that occur within the month (i.e., any five-minute interval that is a scarcity condition), multiplied by performance payment rate

• This means that if the scarcity condition is system-wide and you have more than one resource, the scores from each resource in that interval are also additive

Participant Portfolio Score = \( \sum ACP - Br \times (\sum CSO) \)
## Portfolio Example

<table>
<thead>
<tr>
<th>Interval*</th>
<th>Balancing Ratio</th>
<th>Resource A</th>
<th>Resource B</th>
<th>Resource C</th>
<th>Total</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.65</td>
<td>300</td>
<td>300</td>
<td>0</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.90</td>
<td>(30)</td>
<td>(30)</td>
<td>240</td>
<td>180</td>
<td>Resource C is off-line (ACP = 0)</td>
</tr>
<tr>
<td>3</td>
<td>0.80</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Resource C is off-line (ACP = 0)</td>
</tr>
<tr>
<td>4</td>
<td>0.90</td>
<td>(270)</td>
<td>(30)</td>
<td>240</td>
<td>(60)</td>
<td>Resource A is off-line (ACP = 0)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>(255)</strong></td>
<td><strong>(15)</strong></td>
<td><strong>480</strong></td>
<td><strong>210</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Each record/interval is one full hour

If CSO in interval 4 was moved from Resource A to Resource C it would make no difference at the portfolio level

4 0.90 0 (30) (30) (60) Resource A is off-line (ACP = 0)
Effect on Price Elasticity

Knowing how pay-for-performance (PFP) works, you might want to include your resource’s expected performance into your resource’s bid or offer price

- For example, if you expect your resource will have a cumulative negative score over a capacity commitment period, you might want to increase your bid price (above resource’s going-forward costs)
- This is how performance is now included in capacity prices; it adds elasticity (slope) to the supply curve (a good thing)
Summary: What to Remember About Pay-for-Performance

In this lesson, you learned:

• The key concept behind pay-for-performance
  – Make it look from a supplier’s perspective like a high-price energy-only market

• When the pay-for-performance settlement occurs
  – Only for the intervals when there is a capacity scarcity condition

• How the performance payments work
  – Not a function of capacity supply obligation (CSO) alone – the balancing ratio scales the obligation
  – It is not a requirement to have a CSO or be a capacity resource to receive performance payments
  – Score and performance payments across your portfolio within a month
Questions