Having a Capacity Supply Obligation
Lesson 2A: Pay-For-Performance (PFP) Basics

Forward Capacity Market (FCM 101)

Matt Brewster
Principal Analyst, Market Development
Topics

- Concept of Pay-For-Performance (PFP)
- Capacity Scarcity Condition (CSC)
- Performance Credits and Charges Mechanics
- Examples
Objectives

- Understand key concepts of pay-for-performance
- Identify a capacity scarcity condition event
- Explain how PFP charges and credits work
<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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<td>FCA</td>
<td>Forward Capacity Auction (First auction and process where majority of capacity is procured)</td>
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<td>CSC</td>
<td>capacity scarcity condition (A settlement interval in which pay-for-performance settlement calculations are performed)</td>
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<td>RCPF</td>
<td>reserve constraint penalty factor (Maximum real-time reserve clearing price when particular reserve requirement is violated (deficient))</td>
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<td>ACP</td>
<td>actual capacity provided (Energy and/or reserves provided by a resource during a capacity scarcity condition)</td>
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<td>PPR</td>
<td>performance payment rate (Fixed number used in pay-for-performance settlement calculations)</td>
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<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 (Variable used in pay-for-performance settlement calculations)</td>
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A Few Introductory Notes

• Majority of FCM 101 lessons address how to acquire a capacity supply obligation (CSO) and how resources are paid for that forward obligation to provide capacity

• It is equally important to realize that performance-based credits and charges will have a material effect on net capacity supply payments
  – In this lesson, we review how performance-based credits and charges work
  – Understanding performance credits and charges may help inform how to develop a forward auction offer/bid price for a CSO
Forward Capacity Market Process

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

Capacity Commitment Period
- June through May of the following year
- Settle payments and charges each month
Performance Problems When Capacity Is Needed

The original market design:

- Placed more value on “being there” than on performance
- Provided little consequence for failure
- Lacked incentives to invest in aging resources

The consequence:
Capacity resources couldn’t always start when needed the most

Capacity resources are used day-to-day but are really needed when the system is stressed (e.g., high loads, contingencies)
Monthly Capacity Market Settlement

Monthly capacity payments are based on the sum of two revenue streams

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

- Per MW of capacity supply obligation (CSO)
- Paid forward price (e.g., Forward Capacity Auction (FCA) clearing price)
- Charged to load (consumers)

- Per MWh of energy and reserve provided – relative to CSO – during scarcity events
- Paid at performance payment rate $2,000, increasing to $5,455/MWh
- Can be negative, zero, or positive
- Transfer among suppliers
Who Pays for the Performance Payment?

Charges collected from *under-performing* resources are credited to *over-performing* resources

- Under-performing resources get charged
- Over-performing resources get paid

- The rate ($2,000/MWh) is the same for all resource types
- It is *not* necessary to have a CSO to receive a credit; *any* resources providing energy or reserves will receive a performance credit
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
  - And where if you don’t actually provide, you don’t get paid

- Achieved by:
  - **Measuring** each resource’s performance during a scarcity condition (i.e., when prices are high)
  - **Comparing** performance to resource’s obligated share of system requirements (i.e., deviations)
  - **Crediting** for over-performance and **charging** for under-performance, at a high rate ($2,000+/MWh)

PFP 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?

• Any five-minute market interval in which system has a reserve deficiency (i.e., available reserves are not enough to meet reserve requirements)

• 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)

• A CSC is not declared ahead of time and may or may not align with abnormal conditions
Background Information on Reserves and Reserve Pricing

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

• 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
  – Reserve price reflects opportunity cost of resource(s) backed down and is included in locational marginal energy price (LMP)
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 limit is reached, the algorithm stops trying to re-dispatch resources 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
  – Zonal reserve requirement RCPF = $250/MWh

• A capacity scarcity condition is any five-minute market interval where real-time reserve clearing price is equal to RCPF (and RCPF price is also included in energy price)

Pay-for-performance settlement applies only during a CSC
Illustrative Reserve Re-Dispatch and Deficiency

- **Reserve Amount**
  - **Surplus**
  - **Deficient**

- **Time**
  - **Reserve Requirement**
  - **Re-dispatch**
  - **Reserve Deficiency (Scarcity Condition)**

- **Real-Time Reserve Clearing Price**
  - **Reserve Constraint Penalty Factor (RCPF)**
  - **$/MWh**
Capacity Scarcity Event in Action – September 3, 2018

Primary contributing factors:
• Loads above forecast due to higher temperatures and humidity
• Large generator outages and reductions totaling ~1,650 MW
  – Single loss of ~1,050 MW occurred between 15:00 and 15:30
• Real-time hub LMP reached a high of $2,677/MWh
Capacity Scarcity Event in Action – September 3, 2018, continued

• Resources able to respond quickly over-performed, while longer-lead resources under-performed during the event
  – Imports credited ~$15M (with about half going to non-CSO imports)
  – Steam turbines charged ~$22M
  – Combined-cycle units credited ~$14M and charged ~$9M

• FCM revenue streams for the month
  – Base payments (CSO) = ~$336M
  – Performance payments credits for CSO resources = ~$36M
What is Value of Performance During a Capacity Scarcity Condition?

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

<table>
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<tr>
<th>Value of Energy and/or Reserves</th>
<th>Value of Performance</th>
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<tr>
<td>Reserve price will be at least $1,000/MWh and included in energy price (LMP)</td>
<td>Every MWh provided (energy or reserves) is worth an additional $2,000/MWh</td>
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<tr>
<td>If marginal energy is $750/MWh, LMP is at least $1,750/MWh</td>
<td></td>
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• From a supplier’s perspective, value of delivering during a scarcity condition is:
  – $3,750+/MWh for providing energy
  – $3,000+/MWh for providing reserve

• That is, the financial incentive to perform is high
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 next slide)

3. Credit over-performance and charge under-performance
   - Performance payment rate (PPR) is a function of Net cost of new entry (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
Share of System Requirements: 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).

**Concept:** A resource with 300 MW of CSO will be financially responsible for delivering up-to 300 MW of energy or reserves during a scarcity condition, but possibly a lesser amount if the Br < 1.

\[
Balancing\ Ratio = \frac{[energy\ +\ reserve\ requirements]}{total\ CSO}
\]

<table>
<thead>
<tr>
<th>During low-load periods</th>
<th>During high-load periods</th>
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<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>
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Calculating a Resource’s Performance Score and Payment

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<tr>
<th>Calculation</th>
<th>Equation</th>
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<tr>
<td><strong>A resource’s performance score is:</strong></td>
<td><strong>Performance Score = ACP - (Br x CSO)</strong></td>
</tr>
<tr>
<td><strong>A resource’s performance payment is:</strong></td>
<td><strong>Performance Payment = PPR x Performance Score = PPR x (ACP - (Br x CSO))</strong></td>
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**Observations**

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

**Performance Payment = PPR x (ACP - (Br x CSO)) = PPR x 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** |

<table>
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<tr>
<th><strong>System variables:</strong></th>
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</thead>
<tbody>
<tr>
<td>• Balancing ratio (Br) = <strong>0.65</strong> <em>(a function of system load during scarcity conditions)</em></td>
</tr>
<tr>
<td>• Performance payment rate (PPR) = <strong>$2,000/MWh</strong></td>
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</tbody>
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<th><strong>Resource variables:</strong></th>
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<tr>
<td>• Capacity supply obligation (CSO) = 300 MW (or 300 MWh for a full hour)</td>
</tr>
<tr>
<td>• Actual capacity provided (ACP) = 240 MWh <em>(what was actually provided during scarcity conditions)</em></td>
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**For a full hour of scarcity:**  
**Performance Payment** = \( PPR \times (ACP - Br \times CSO) \)  
\[ = $2,000/MWh \times (240 \text{ MWh} - 195 \text{ MWh}) = $90,000 \]
Calculate base payment and performance payments for a resource with a CSO of 300 MW (ignore energy/reserves revenues)

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

**System variables:**
- Balancing ratio (Br) = 0.90 (different 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 = PPR x (ACP - Br x CSO)
= $2,000/MWh x (240 MWh - 270 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)

<table>
<thead>
<tr>
<th>Base payment</th>
<th>$0/month</th>
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</table>

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

**Resource variables:**
- Capacity supply obligation (CSO) = 0 MWh
- Actual capacity provided (ACP) = 240 MWh

**For a full hour of scarcity:**
Performance Payment = PPR x (ACP - Br x CSO)
= $2,000/MWh x (240 MWh - 0 MWh) = $480,000

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

• Capacity settlements are billed monthly, in arrears (e.g., June’s settlement is billed in July)

• A resource’s performance payment for the month is the total of its capacity performance payments for each capacity scarcity condition during the month
  – Credits (for over-performance) and charges (for under-performance) are aggregated across all capacity scarcity conditions that occurred within the month

• A supplier with multiple resources will, generally, have a performance payment for the portfolio that reflects its aggregate performance; i.e., portfolio score = \( \Sigma ACP - Br \times (\Sigma CSO) \)

• PFP rules include “stop loss” mechanisms that cap the financial risk of a CSO
  – At most, a resource could be charged an amount equal to its entire annual base payment plus the equivalent of three months of payments at FCA starting price (over duration of CCP)
  – Details of monthly and annual caps are explained in Lesson 6B3
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 CCP, you might want to increase your bid price (to reflect the cost associated with obtaining a CSO)
- This is how performance is now included in capacity prices; it adds elasticity (slope) to supply curve (a good thing)
Summary: What to Remember About Pay-for-Performance

In this lesson, you learned:

• Key concept behind pay-for-performance
  – Make it look from a supplier’s perspective like a high-price energy-only market
    *in order to provide a strong, financial incentive to perform when needed*

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

• How performance payments work
  – Not a function of CSO alone – balancing ratio scales obligation
  – It is not necessary to have a CSO or be a capacity resource to receive (positive)
    performance payments
  – Performance payments are aggregated for monthly settlement
Questions
Evaluations