Cost Based Offers in Performance Based Regulation (PBR)
Educational Document

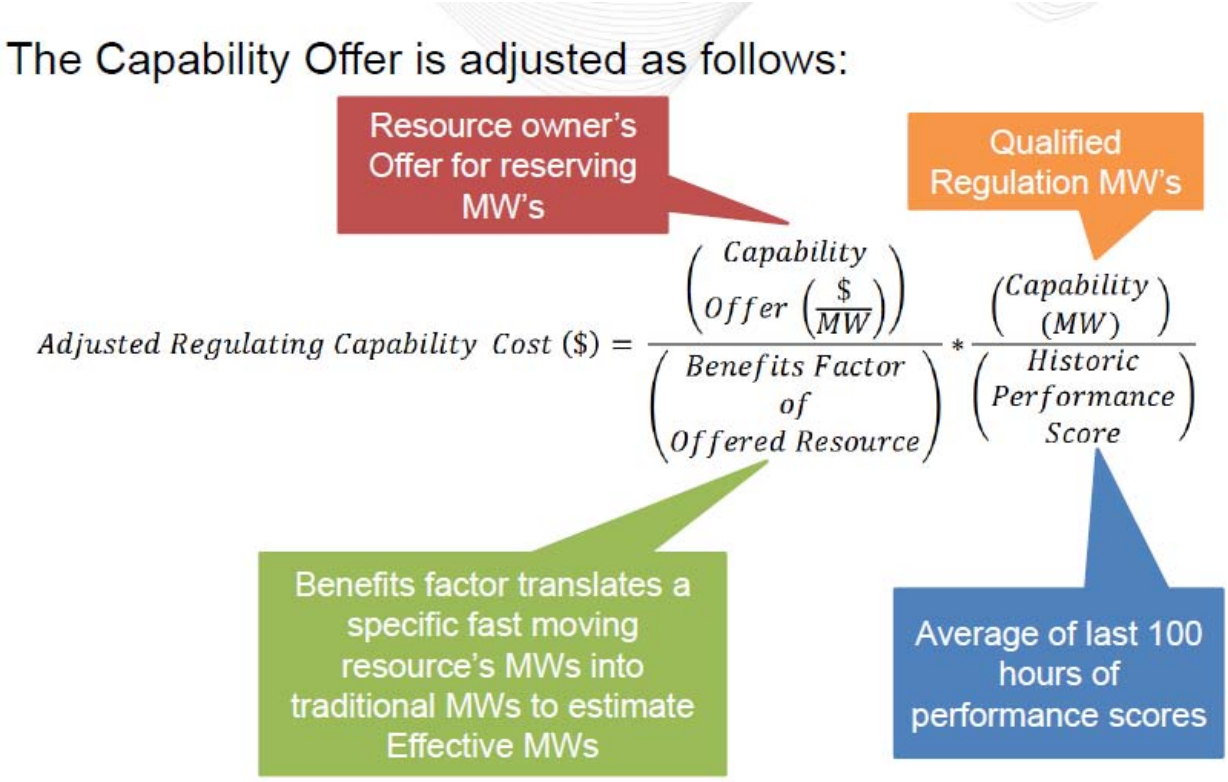
Introduction

In order to comply with FERC Order 755, PJM redesigned the Regulation Market. This redesigned market went into operation on October 1, 2012.

Performance Based Regulation

Performance Based Regulation (PBR) is a methodology for regulation qualification, offers, clearing, pricing and settlement that rewards resources for their performance relative to the regulation control signal. The PBR implementation includes:

Two part offer for Capability and Performance was added to the new regulation market structure. Under the pay-for-performance construct, resources making an offer for regulation has both a regulation capability and regulation performance cost. The capability component of the offer reflects the cost to reserve regulation MWs from a resource. The capability offer component is made in $/MW and is adjusted by the unit specific benefits factor and historic performance score to better reflect the expected performance based on history as well as the effective output of the MWs.



The performance component of the offer reflects the incremental cost to move a resource's regulation output. The performance offer component is made in $/ΔMW (sometimes called "$/mile") and it is adjusted by the unit specific benefits factor, historic performance score and a mileage conversion factor that is reflective of the regulation signal the resource follows. Performance offers are converted from $/ΔMW into $/MW by the mileage conversion factor which is the 30 day rolling average mileage for the regulation signal type either Regulation A or Regulation D, once

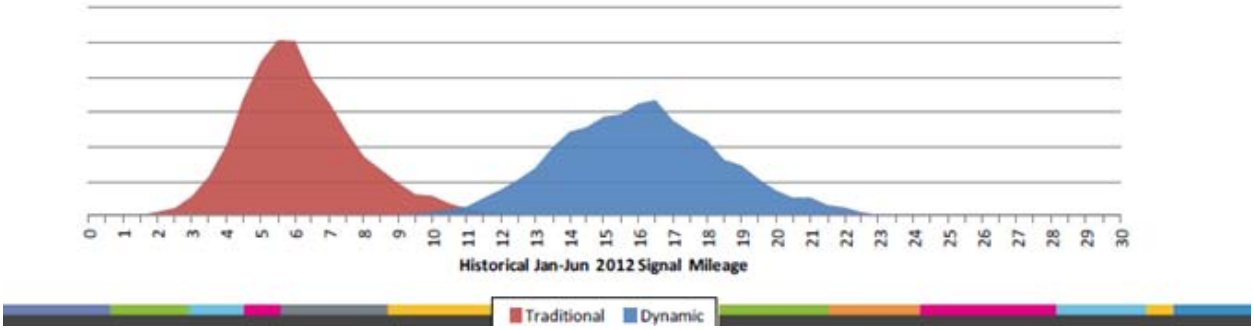
the performance offers are converted the offers have the same units and can be added together.

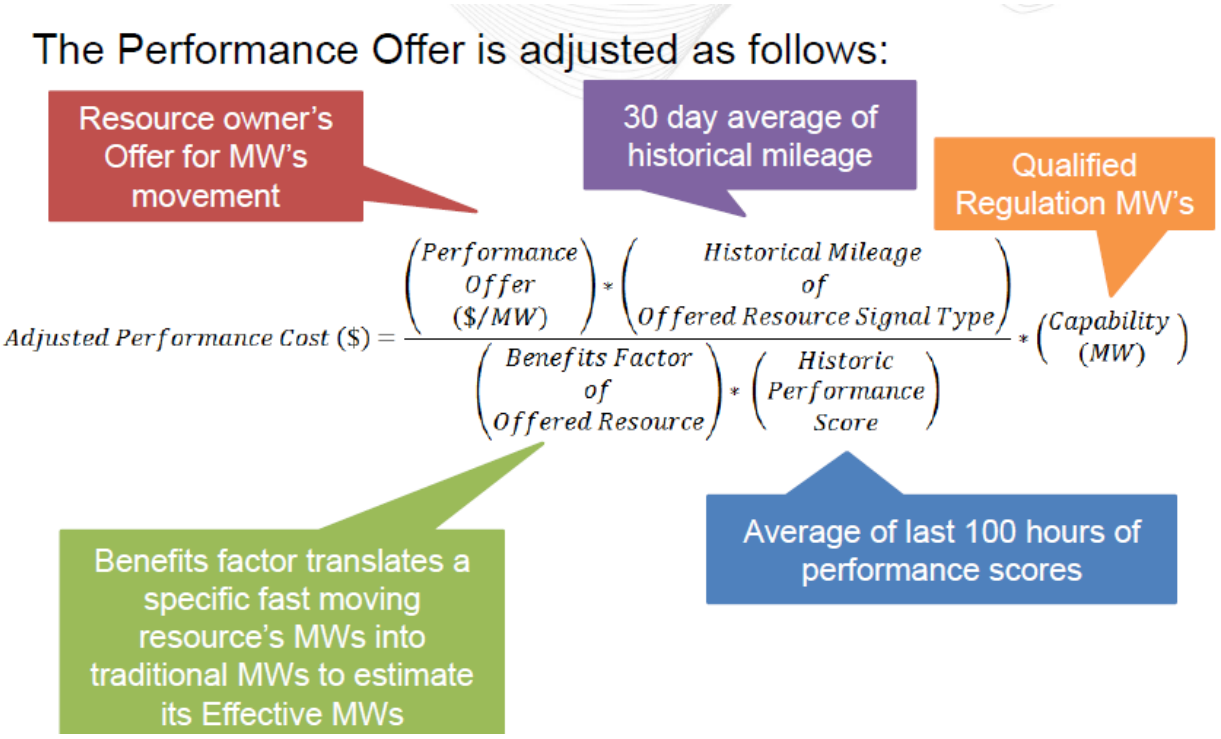
- Mileage is the absolute sum of movement of the regulation signal in a given time period

$$Mileage_{RegA} = \sum_{i=0}^{n} |RegA_i - RegA_{i-1}|$$

$$Mileage_{RegD} = \sum_{i=0}^{n} |RegD_i - RegD_{i-1}|$$

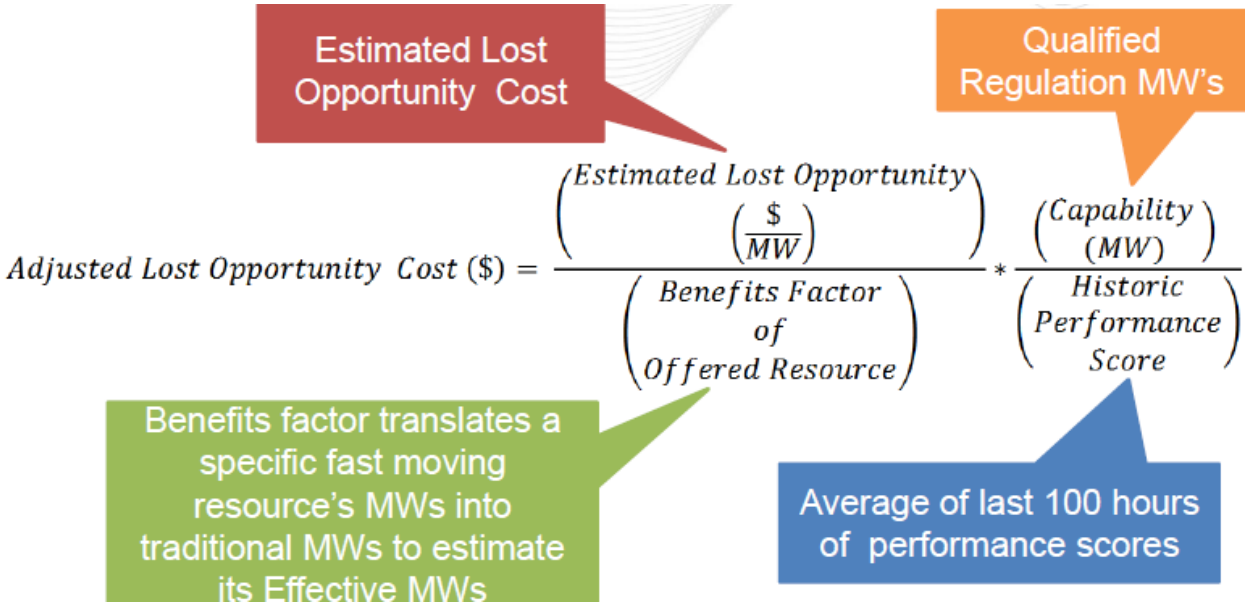
- Resources following the dynamic signal will move much more than those on traditional signal





Two part settlement for capability and performance is now included in the new performance based regulation market. Under the pay-for-performance construct, resources are credited based on the hourly Regulation Market Capability Clearing Price (RMCCP) and Regulation Market Performance Clearing Price (RMPCP) for each MW of regulation supplied, with consideration of the resource's regulation performance and benefit to system control.

Minimum requirements for Eligibility, based on performance scores, must now be met for the unit to receive hourly regulation credit. A resource's actual regulation performance score for the hour (or the portion of the hour) will determine the resource's eligibility for regulation credit and lost opportunity cost (LOC) for that hour. A resource whose performance score for the hour is below 25% will forfeit regulation credit and LOC.



References to PJM Documents

Open Access Transmission Tariff (OATT)

"In addition to any market-based offer for Regulation, the Market Seller also shall submit a cost-based offer. A cost-based offer must be in the form specified in the PJM Manuals and consist of the following components as well as any other components specified in the PJM Manuals:

i. The costs (in $/MW) of the fuel cost increase due to the *steady-state* heat rate increase resulting from operating the unit at lower megawatt output incurred from the provision of Regulation *shall apply to the capability offer*;

ii. The cost increase (in $/ΔMW) in *costs associated with movement of the regulation resource* incurred from the provision of Regulation *shall apply to the performance offer;* and

iii. An adder of up to $12.00 per megawatt of Regulation provided applied to the capability offer.

Qualified Regulation capability must satisfy the measurement and verification tests specified in the PJM Manuals."[1]

Manual 15 Section 2.8 Regulation Service

In the Cost Development Guidelines (M15),; regulation is defined as "capability of a specific resource with appropriate telecommunications, control and response capability to increase or decrease its output in response to a regulating control signal to control for frequency deviations"

The total costs to provide Regulation Service from a unit shall include the following components up to but not exceeding:

Regulation Costs ($ / MWh) ≤

(Fuel Cost Increase and Unit Specific Heat Rate Degradation due to Operating at Lower Loads)
+ Cost Increase due to Heat Rate Increase during nonsteady state operation

(above heat rate factor not to exceed 0.35%) + Cost Increase in VOM + Margin Risk Adder

Where the Fuel Cost Increase and Unit Specific Heat Rate Degradation due to Operating at lower loads: is defined as "the costs (in $/MWh of Regulation) to provide Regulation service from units shall not exceed the fuel cost increase due to operating the unit at lower loads than at the optimal economic dispatch level load and the unit specific heat rate degradation from operating at lower loads, resulting from operating the unit at lower MW output incurred from the provision of Regulation over the entire generator MW range of providing Regulation service."

The Cost Increase due to Heat Rate increase during non-steady state: is defined as "the cost (in $/MWh of Regulation) increase due to the heat rate increase resulting from operating the unit at a non steady-state condition. This heat rate loss factor rate shall not exceed 0.35% of the top Regulation load MW heat rate value."

The cost increase in VOM is defined as "the cost increase (in $/MWh of Regulation) of variable operations and maintenance (VOM) cost resulting from operating the unit at lower MW output incurred from the provision of Regulation. VOM costs shall be calculated by the following methods and shall not exceed those levels below:

For non-hydro units that have been providing Regulation service for less than 10 years, or all hydro units regardless of the historical years of Regulation service, the following variable operation and maintenance (VOM) costs can be applied by unit type up to the following:

[1] Items in italics have not been expressly approved by FERC.

Super-critical Steam:	$10.00 per MWh of Regulation
Sub-critical Steam:	$3.50 per MWh of Regulation
Combined Cycle:	$2.50 per MWh of Regulation
Combustion Turbine:	$2.00 per MWh of Regulation
Hydro:	$1.00 per MWh of Regulation

Exhibit 4: VOM for All Hydro Units or Non-Hydro Units providing service for less than 10 years

For non-hydro units that have been providing Regulation service for more than 10 years, the VOM rates above can be utilized only if the annual VOM dollar amounts resulting from those rates and included in Regulation cost based offers, are subtracted from the escalated 10 or 20 year historical total VOM accounts and the Regulation MWh based on the average of the last three years."

Finally, the "Margin Risk Adder shall not exceed $12.00 per MWh of Regulation service provided."

Regulation information for specific unit types can be found in their specific chapters in M15.

Manual 11 Section 3.2.1 Regulation Market Eligibility

"Cost-Based Regulation Offer ($/MWh): This value will be validated using the resource-specific operating parameters submitted with the regulation offer and the applicable $12/MWh regulation margin adder. The portions of the cost based offer are split into:

Regulation Capability portion capturing the Fuel Cost Increase and Unit Specific Heat Rate Degradation due to Operating at Lower Loads. The margin adder may only be added to the Regulation Capability portion; and,

Regulation Performance portion representing Cost Increase due to Heat Rate Increase during non-steady state operation and Cost Increase in VOM.

The $/MW value determined in this step will be converted to $/ΔMW by multiplying the value by the ratio of ΔMW/MW for the applicable signal for that offer.

Price-Based Regulation Offer ($/MWh, optional): This value is capped at $100/MWh, and its submission is optional on the part of the market participant. The portions of the cost based offer are split into:

Regulation Capability portion the capturing the resource owner's price to reserve MWs for regulation in $/MW; and,

Regulation Performance portion capturing the resource owner's price to provide regulation movement in $/ΔMW.

The $/MW value determined in this step will be converted to $/ΔMW by multiplying the value by the ratio of ΔMW/MW for the applicable signal for that offer. In addition to the cost-based regulation offer price, each market participant may also submit additional information to support the cost-based offer price. Using the calculations in Manual M-15: Cost Development Guidelines, PJM will validate the cost-based regulation offer price to ensure that it does not exceed actual regulating cost as determined by this manual, plus the applicable regulation margin adder. Any cost-based offer prices that exceed this value will be rejected by the eMKT System. An example of this calculation is available on the PJM website at http://www.pjm.com/markets-and-operations/ancillary-services/mkt-based-regulation.aspx.

If a market participant does not submit a cost-based regulation offer price they will not be permitted to participate in the PJM Regulation Market until such offer has been validated. Any participants that do not submit any of the supporting parameters below will have their cost-based regulation offer price capped at the margin adder of $12/MWh.

The following optional parameters may be submitted in the eMKT System to support the cost-based regulation offer price. If any of these parameters are not submitted they will default to zero.

Heat Rate @ EcoMax [BTU/kWh]: The heat rate at the default economic maximum for a resource. The economic maximum that will correspond to this rate value will be the default economic maximum that is shown on both the Daily Regulation Offers and Unit Details pages.

Heat Rate @ RegMin [BTU/kWh]: The heat rate at the default regulation minimum for a resource. The regulation minimum that will correspond to this rate value will be the default regulation minimum that is shown on both the Daily Regulation Offers and Unit Details pages.

VOM Rate [$/MWh of Regulation]: The increase in VOM resulting from operating the regulating resource at a higher heat rate than is otherwise economic for the purpose of providing regulation.

Fuel Cost [$/MBTU]: The fixed fuel costs of the resource. This value will be used to determine the heat rate adjustments during steady-state and non steady-state operation for the purpose of providing regulation.”

Link to XLS with Two Part Cost Based Offer in PBR

http://www.pjm.com/markets-and-operations/ancillary-services/~/media/markets-ops/ancillary/regulation-two-part-cost-based-offer-effective-10-1.ashx