Opportunity Cost Calculator

CDTF April 19, 2010

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Opportunity Cost Definition

- Opportunity costs are the value of a foregone opportunity.
- Opportunity costs may result when a unit:
 - Has limited run hours due to an externally imposed environmental limit
 - Is requested to operate for a constraint by PJM and is offer capped.
- Opportunity costs are the net revenue from a higher price hour that are foregone as a result of running at PJM's request during a lower price hour.



Opportunity Cost Definition

- Opportunity costs may be added to a cost-based offer for units with a documented externally imposed environmental regulation based runhour restriction.
- Examples Include:
 - Limit on total emissions
 - Direct run-hour restriction
 - Heat input limitation
- Market Participants may elect to enter their costbased offer with an opportunity cost component which may be a value less than or equal to their calculated opportunity cost.

Opportunity Cost Calculation Method

- Methodology uses forward prices for power and fuel costs and an historical basis period to determine the value of future net revenue for runhour restricted units
- Opportunity cost is calculated using an historical average of the previous three years, combined with forward prices of fuel, electricity, and emission allowances to project the year's LMP at a pricing node.



Issue

- The Manual M-15 which is currently in place (Approved Manual) does not establish a method for the calculation of opportunity cost that is as accurate as it could be.
- The MMU has recommended specific changes to the manual in order to improve the method and make it more accurate.
- The CDTF has reviewed the MMU's proposed changes in detail at multiple meetings and calls.
- The CDTF voted to approve the MMU approach and then the CDTF voted not to approve the specific proposal.
- The MMU is requesting that the MRC review the MMU proposal and approve the MMU proposal.



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Primary Differences Between MMU Method and the Approved Manual

<u>MMU</u>

Rolling Time Period Restrictions Dual Fuel Inputs Spot or Contract Monthly Fuel Flexibility Minimum Run Time Start Up Costs Adjustment for Negative Margins Delivery Adder



MMU Calculation Tool

- The MMU currently has an operating web based tool to calculate opportunity cost as described in the MMU red line to Manual M-15
- Inputs gathered by web portal
- Login with eFuel account
- Easy to use
- Historical / futures data gathered from PJM and MMU databases
 - No need for users to input

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Changes to calculator can be implemented and tested with no impact on users

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No requirement for additional data entry



MMU Input Screen

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Sample MMU Output Screen

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Retrieve	From: Jan/08/2010	99999991-TestUnit1 99999992-TestUnit2 99999993-TestUnit3 Unit(s):	pportunity Cost Results	
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55555555	April 01, 2010	\$ 20.00	200) Jan 01, 2010

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Automatic Updates

- Calculator saves inputs from previous days, including outages
- Automatically updates hours run, without required input from participants
- Recalculates opportunity cost adder daily, without required input from participants
- No need for participant changes unless units change fuel or outage schedule
- Daily automatic updates posted overnight

Ability to Handle Rolling Time Period Restrictions

- Approved Manual does not address rolling time period restrictions
- This feature has been recommended for implementation by the CDTF
- Large percentage of units having emission limitations have rolling time period restrictions
- Proposed change to manual:
 - Account for restrictions based on calendar year or rolling 12 months, depending on actual environmental limits



Dual Fuel Inputs

- Approved Manual does not address use of dual fuel inputs
- This feature has been recommended for implementation by the CDTF
- Proposed change to manual:
 - Permits use of dual fuels for units that may burn multiple fuels
 - For units with restrictions on consumption of specific fuels, this method allows accounting for both fuels in the same calculation.
 - Example:
 - Run hour restriction of combined gas and oil output
 - **o** Unit has restriction only when burning secondary fuel





Spot or Contract Monthly Fuel Flexibility

- Approved Manual does not address flexibility to use spot or contract monthly fuel costs
- This feature has been recommended for implementation by the CDTF
- Proposed change to manual:
 - Flexibility to choose spot price for one fuel and contract price for another fuel or another time period
 - Allows members to identify when a contract will end
 - If contract ends in the middle of a compliance period, permits use of spot prices or new contract prices
 - No need for participants to input fuel spot prices



Minimum Run Time

- Approved Manual does not account for minimum run time limits
- Proposed change to manual:
 - Account for minimum run time parameter limit for each unit
 - Minimum run time has an impact on calculated opportunity costs
 - Inclusion of minimum run time parameter improves accuracy of calculation based on actual unit parameters
 - For minimum run time, the adder is the average hourly adder for a block of hours, rather than the minimum hourly adder for the remaining run hours



Start Costs

- Approved Manual does not account for start costs
- Proposed change to manual:
 - Account for start costs for each unit
 - Start costs are a cost of operation and have an impact on calculated opportunity costs
 - Inclusion of start costs improves accuracy of calculation based on actual unit costs





Proposed Start Costs by Unit Type

- Treatment of start costs based on unit types:
 - Combined Cycle units modeled as cycling units may use "Hot" start costs rather than "Cold" start costs
 - CT and Steam units should use "Cold" start costs as these units are likely to use this cost in actual dispatch
 - Exception process based on documented operating practices/history





Negative Margins

- Calculation of opportunity costs uses both future fuel and electricity prices and historical data to calculate the margin (LMP minus cost) by hour and by bus
- Three years of historical data is used to provide hourly detail and bus detail because future data is not adequately granular
- Negative margins occur during specific hours and at specific buses when cost was greater than LMP
- Hours of negative margin do not reflect hours when a generator was running



Negative Margins

- Approved Manual does not account for negative margins
 - Sets negative margin equal to zero prior to averaging
- Proposed change to manual:
 - Negative margins reflect actual margins from prior years and should be included in calculation
 - Accurately accounts for actual market results by hour/bus
 - Example:

700th Margin (2006) = -\$100 700th Margin (2007) = -\$100 700th Margin (2008) = \$75

Maximum Opportunity Cost Component MMU Method = Max(0, -\$41.67) = \$0 Approved Manual Method = \$25

Fuel Delivery Adder

- Approved Manual does not account for delivery charges of fuel
- As units are not located at trading hub, this adder is needed to enhance accuracy of fuel prices
- Delivery adder is provided by market participants, subject to MMU review
- Proposed change to manual:
 - Fixed delivery adder is added to forward prices in calculation.



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