

Opportunity Cost Calculator

MRC
March 17, 2010

Howard Haas
Joe Bowring
Vik Modi
Bill Dugan



Monitoring Analytics

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 run-hour restriction.**
- **Examples Include:**
 - **Limit on total emissions**
 - **Direct run-hour restriction**
 - **Heat input limitation**
- **Market Participants may elect to enter their cost-based 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 run-hour 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.**



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**
- **Changes to calculator can be implemented and tested with no impact on users**
 - **No requirement for additional data entry**



MMU Input Screen

Administration Opportunity Cost Operation Data Validation Card Data Reports Tools Logout Help

Opportunity Cost Calculator

Retrieve Effective Date: **Apr/01/2010** Unit: **5555555-TestUnit5** Currently showing data with effective date of : **04/01/2010** and modified by : **0001modiv**

Field	Value	Year	Month	Percent of Fuel type A	Percent of Fuel type B	Percent Fuel type A is Contract	Percent Fuel type B is Contract	Percent Fuel type A is Spot	Percent Fuel type B is Spot	Contract Price for Fuel type A	Contract Price for Fuel type B
Unit ID	55555555										
Has 12-Month Rolling Run-Hour Restriction?	No										
Minimum Run Time (hours)	24										
Startup Costs (dollars)	.00										
Econ. Max (MW)	.00	2010	Jan	75.00	25.00		100.00	100.00			13.0000
Summer Average Heat Rate (mmbtu/mwh)	11.8000	2010	Feb	75.00	25.00		100.00	100.00			13.0000
Winter Average Heat Rate (mmbtu/mwh)	11.8000	2010	Mar	75.00	25.00		100.00	100.00			13.0000
NOX Emission Rate - annual (lbs/mmbtu)	.30000	2010	Apr	75.00	25.00		100.00	100.00			13.0000
NOX Emission Rate - seasonal (lbs/mmbtu)	.30000	2010	May	75.00	25.00		100.00	100.00			13.0000
SO2 Emission Rate (lbs/mmbtu)	.98000	2010	Jun	75.00	25.00		100.00	100.00			13.0000
CO2 Emission Rate (lbs/mmbtu)	.00000	2010	Jul	75.00	25.00		100.00	100.00			13.0000
VOM (\$/mwh)	3.500	2010	Aug	75.00	25.00		100.00	100.00			13.0000
FMU (\$/mwh)	.00	2010	Sep	75.00	25.00		100.00	100.00			13.0000
Scaling Factor (%)	10.00	2010	Oct	75.00	25.00		100.00	100.00			13.0000
Delivery charge adder for Fuel Type A (\$/mmbtu)	.0000	2010	Nov	75.00	25.00		100.00	100.00			13.0000
Delivery charge adder for Fuel Type B (\$/mmbtu)	.0000	2010	Dec	75.00	25.00		100.00	100.00			13.0000

Platt's Forward Fuel Index for Fuel Type A :

CL11A-Coal - ILLB 11800B 2.655 RAIL

Platt's Forward Fuel Index for Fuel Type B :

OL04B-Oil - No.2 NYH Swap

Outage Input

Start: **Jan/08/2010** 08:00

End: **Jan/08/2010** 08:00

Start	End
03/19/2010 22:00	04/05/2010 08:00
11/26/2010 22:00	12/06/2010 06:00

Run Hour Limitation:

Run Hours Used to Date:

Sample MMU Output Screen

Administration Opportunity Cost Operation Data Validation Card Data Reports Tools Logout Help

Opportunity Cost Results

Retrieve From: **Jan/08/2010** To: **Jan/08/2010** Unit(s):
99999991-TestUnit1
99999992-TestUnit2
99999993-TestUnit3
99999994-TestUnit4
55555555-TestUnit5 Select All

Unit	Transaction Date	Opportunity Cost Component	Run Hours Used to Date	Modified Date
55555555	April 01, 2010	\$ 20.00	200	Jan 01, 2010

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**
 - **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 = $\text{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.**



Monitoring Analytics, LLC

2621 Van Buren Avenue

Suite 160

Eagleville, PA

19403

(610) 271-8050

MA@monitoringanalytics.com

www.MonitoringAnalytics.com

