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Monitoring Analytics

DATE: October 29, 2009

TO: CDTF

FROM: Monitoring Analytics

SUBJECT: Opportunity cost calculations

Monitoring Analytics has calculated the opportunity cost adder using the method defined in the approved manual language (approved method) and the method defined in Monitoring Analytics' proposed manual language (proposed method) for a range of scenarios that show the impact of the treatment of negative margins and the impact of the inclusion of minimum run time restrictions.

1. Static Inputs

Listed below are the static inputs used in calculations for both the approved method and the proposed method.

1. Bus ID = X
2. Time Period = Calendar Year
3. Startup Costs = $0
4. Summer Average Heat Rate = 11.75
5. Winter Average Heat Rate = 11.75
6. NOx Emission Rate (annual) = 0.38
7. NOx Emission Rate (seasonal) = 0.38
8. SO2 Emission Rate = 1.2
9. CO2 Emission Rate = 200
10. VOM = 3.75
11. FMU = 0.0
12. Scaling Factor = 10%
13. Platt's Forward Fuel Index for Fuel Type A = CTL APP 12500B 1.5S CSX
14. Percent of Fuel Type A = 100%
15. Percent of Fuel Type A Spot = 100%
16. Fuel Type A Transportation Costs = 0.0
17. Seasonal NOx Cost = 0.0
18. NOx Cost = 1375.00
19. SO2 Cost = 200.00
20. Outages:

a. 01APR2009:04:00:00 through 05APR2009:08:00:00
b. 01DEC2009:22:00:00 through 08DEC2009:06:00:00

2. Results with One Hour Minimum Run Time

This example uses a minimum run time (MRT) of one hour with a range of run hours (from 20 to 4,000) available under a unit's externally imposed limit, to calculate the opportunity cost at three different points in the 2009 calendar year, January 1, June 1 and December 1.

Opportunity Cost Calculated as of **January 1, 2009**

Approved Method

MRT=1 Hours Left	01JAN2009
4000	$ 16.78
2000	$ 41.20
500	$ 94.71
100	$ 170.72
20	$ 265.08

Proposed Method

MRT=1 Hours Left	01JAN2009
4000	$ 16.78
2000	$ 41.20
500	$ 94.71
100	$ 170.72
20	$ 265.08

Opportunity Cost Calculated as of **June 1, 2009**

Approved Method

MRT=1 Hours Left	01JUN2009
4000	$ -
2000	$ 13.05
500	$ 52.20
100	$ 107.61
20	$ 185.20

Proposed Method

MRT=1 Hours Left	01JUN2009
4000	$ -
2000	$ 13.05
500	$ 52.20
100	$ 107.61
20	$ 185.20

Opportunity Cost Calculated as of **December 1, 2009**

Approved Method

MRT=1 Hours Left	01DEC2009
4000	$ -
2000	$ -
500	$ -
100	$ 29.63
20	$ 76.60

Proposed Method

MRT=1 Hours Left	01DEC2009
4000	$ -
2000	$ -
500	$ -
100	$ 29.63
20	$ 76.60

The difference between the proposed method and the approved method for a unit with a minimum run time of one hour is the treatment of negative margins in the historical data. The approved language means that historical years with a negative margin will be set to zero before being averaged to calculate the final opportunity cost adder. The proposed method

uses the actual margin from each historical year, negative or positive, to calculate the final opportunity cost adder. In both methods, if the final adder is a negative value, it will be set to zero, as a unit may not have a negative opportunity cost. The results of testing indicate that this change has little or no effect on the final adder as shown in the example above. (There is no impact in the example because there were no negative margin hours in the top 4,000 hours.) The only time this change would have an impact on the final adder would be in a scenario where one or two historical years have negative margins in hours included in a unit's limited hours, while the other years have positive margins.

3. Results with Multiple Minimum Run Time Parameters

This example uses multiple minimum run time (MRT) parameters (3 hours, 8 hours, 24 hours), with a range of run hours (from 20 to 4,000) available under a unit's externally imposed limit, to calculate the opportunity cost at three different points in the 2009 calendar year, January 1, June 1 and December 1.

Opportunity Cost Calculated as of **January 1, 2009**

Approved Method		Proposed Method		Proposed Method		Proposed Method	
MRT=1		MRT=3		MRT=8		MRT=24	
Hours Left	01JAN2009	Hours Left	01JAN2009	Hours Left	01JAN2009	Hours Left	01JAN2009
4000	$ 16.78	4000	$ 16.86	4000	$ 17.84	4000	$ 21.45
2000	$ 41.20	2000	$ 40.00	2000	$ 39.41	2000	$ 38.55
500	$ 94.71	500	$ 88.87	500	$ 83.20	500	$ 66.79
100	$ 170.72	100	$ 157.48	100	$ 139.68	100	$ 112.70
20	$ 265.08	20	$ 250.07	20	$ 244.45	20	$ -

Opportunity Cost Calculated as of **June 1, 2009**

Approved Method		Proposed Method		Proposed Method		Proposed Method	
MRT=1		MRT=3		MRT=8		MRT=24	
Hours Left	01JUN2009	Hours Left	01JUN2009	Hours Left	01JUN2009	Hours Left	01JUN2009
4000	$ -	4000	$ -	4000	$ -	4000	$ -
2000	$ 13.05	2000	$ 12.97	2000	$ 13.96	2000	$ 15.82
500	$ 52.20	500	$ 50.35	500	$ 48.90	500	$ 39.53
100	$ 107.61	100	$ 100.72	100	$ 89.16	100	$ 64.89
20	$ 185.20	20	$ 187.28	20	$ 178.36	20	$ -

Opportunity Cost Calculated as of **December 1, 2009**

Approved Method		Proposed Method		Proposed Method		Proposed Method	
MRT=1		MRT=3		MRT=8		MRT=24	
Hours Left	01DEC2009	Hours Left	01DEC2009	Hours Left	01DEC2009	Hours Left	01DEC2009
4000	$ -	4000	$ -	4000	$ -	4000	$ -
2000	$ -	2000	$ -	2000	$ -	2000	$ -
500	$ -	500	$ -	500	$ -	500	$ -
100	$ 31.20	100	$ 28.65	100	$ 31.05	100	$ 25.13
20	$ 79.24	20	$ 76.50	20	$ 76.35	20	$ 71.82

The difference between the proposed method and the approved method in these examples is the modeling of the minimum run time parameter for units with minimum run times greater than 1 hour. As the calculations show, the minimum run time parameter limit has an impact, in some cases a substantial impact, on the opportunity cost adder.

Under the approved method, minimum run time restrictions are not accounted for. As a result, under the approved method, the calculated opportunity cost adder for a unit is the margin from the lowest value hour from the available run hours. Under the proposed method, the opportunity cost adder requires the calculation of the margins for all the blocks of contiguous hours equal to the minimum run time, up to a unit's available run hours. The opportunity cost adder is the average margin for the lowest minimum run time block of hours.

For example, the opportunity cost adder was calculated for January 1, 2009, having 4,000 hours left and a MRT restriction of 24 hours. Under the approved method, the opportunity cost adder is the minimum margin of the top 4000 margin hours, or $16.78. Under the proposed method, the opportunity cost adder is $21.45. The opportunity cost adder is higher, in this example, using the proposed method for minimum run times of 3, 8 and 24 hours, when the unit has 4,000 hours to run under its externally imposed cap. In this example, the final opportunity cost adder is higher using the proposed method because the contiguous block of 24 hours included higher margin hours. However, the opportunity cost adder is lower, in this example, using the proposed method for minimum run times of 3, 8 and 24 hours, when the unit has 2,000 hours, 500 hours or 100 hours to run under its externally imposed cap. Under these conditions, the final opportunity cost is lower using the proposed method because the contiguous block of 24 hours included lower margin hours.

The results indicate the importance of using units' actual minimum run time parameters in the opportunity cost calculation. Including the minimum run time parameter in the calculation improves the accuracy of the opportunity cost adder, and models units as they would actually operate in the real-time or day-ahead markets. The differences in the calculated opportunity costs show that the actual opportunity cost of a unit called on to run for a constraint is strongly influenced by a unit's flexibility in PJM dispatch. In particular, these calculations show that a unit with inflexible parameters (minimum run time) has a higher adder when it has more hours available under its environmental limit, and a unit with flexible parameters (minimum run time) has a higher adder when it has fewer hours available under its environmental limit.

4. Impact of Minimum Run Time on Opportunity Cost Calculation

This example shows the significance of using the minimum run time parameter in calculating opportunity costs. Using the approved calculation method, if a unit with an 8 hour minimum

run requirement has 500 hours remaining to run under its environmental limit, the 500th hour's highest margin is $40 and therefore the opportunity cost would be $40. However, because the unit has a minimum run time of 8 hours, the actual opportunity cost is the average margin of the example block, or $14.00, because the unit must run for the 8 hours in succession and this is the lowest value 8 hour block of all the 8 hour blocks included in the 500 remaining hours.

Example 8 hour block:

Hour	Margin
1	$ 40.00
2	$ 25.00
3	$ 4.00
4	$ 3.00
5	$ 15.00
6	$ 17.00
7	$ 6.00
8	$ 2.00