Opportunity Cost Calculator

Cost Development Subcommittee

10/30/2025

IMM

Monitoring Analytics

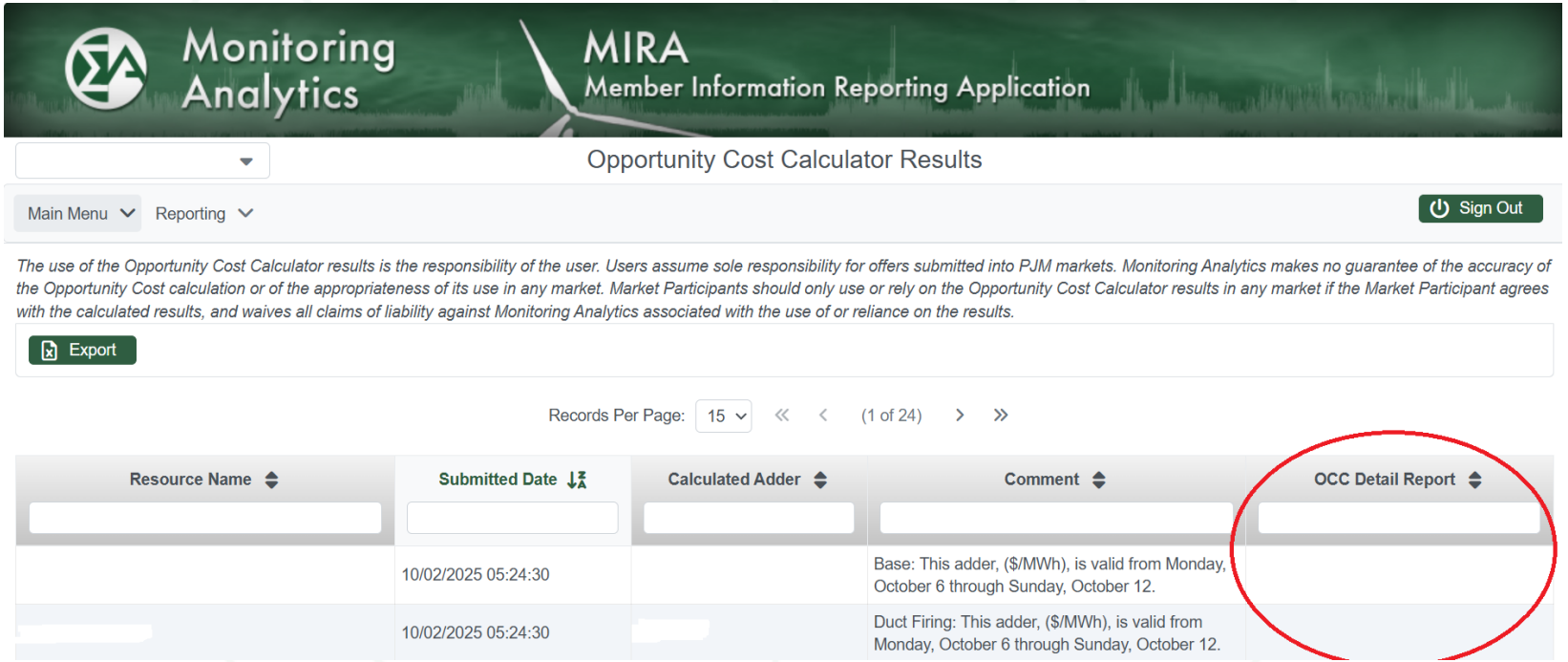
FERC Order

- Order 192 FERC ¶61,149 (August 14, 2025)
- Order directs that the Operating Agreement be amended to require:
  - Unit specific inputs, results, and assumptions, and intermediate results be shared with the market seller
  - A public posting that describes the models, algorithms and material assumptions, the software used and examples that demonstrate how the models and algorithms work
  - PJM and/or the IMM meet with market sellers to discuss specific modeling assumptions and results

Results and Intermediate Results

- **Opportunity cost adders posted to MIRA**
- **Intermediate Results**
  - **IMM will post in MIRA a summary of the results that includes:**
    - Number of starts
    - Hours run
    - Binding elements

Intermediate Results Report



Intermediate Results Report Example

- **Opportunity cost base component adder is $24.15**
- **Intermediate results report for base component adder**

Component	Scenario	Opportunity_Cost	Starts	Hours_run	Binding_Period_End	Binding_Element
BASE	1	19.25928272	2	7	31-Dec-25	CO2
BASE	2	9.445966377	15	36	30-Apr-26	CO2
BASE	3	43.74713999	3	7	31-Dec-25	CO2

Intermediate Results Report Example

- **Opportunity cost duct/peak firing component adder is $17.50**
- **Intermediate results report for duct/peak firing component adder**

Component	Scenario	Opportunity_Cost	Base_Unit Starts	Hours_run	Binding_Period_End	Binding_Element
DUCT_FIRING	1	22.49767613	141	50	31-Aug-26	HOURS
DUCT_FIRING	2	0	104	38		
DUCT_FIRING	3	30.00040248	152	50	31-Aug-26	HOURS

Unit Specific Assumptions

- **Manual 15, Section 12.7.4**
  - **“hourly operating cost or operating parameters may be adjusted in cases where the unit’s historical offer behavior deviates from the short run marginal cost or the commitment and dispatch of the generator has historically differed from expected economic outcomes”**
- **IMM will update MIRA to inform the market seller if a unit specific assumption is being used and will provide a document detailing the assumption in the documents section of MIRA**
- **No resources currently receiving OC adders have a unit specific assumption**

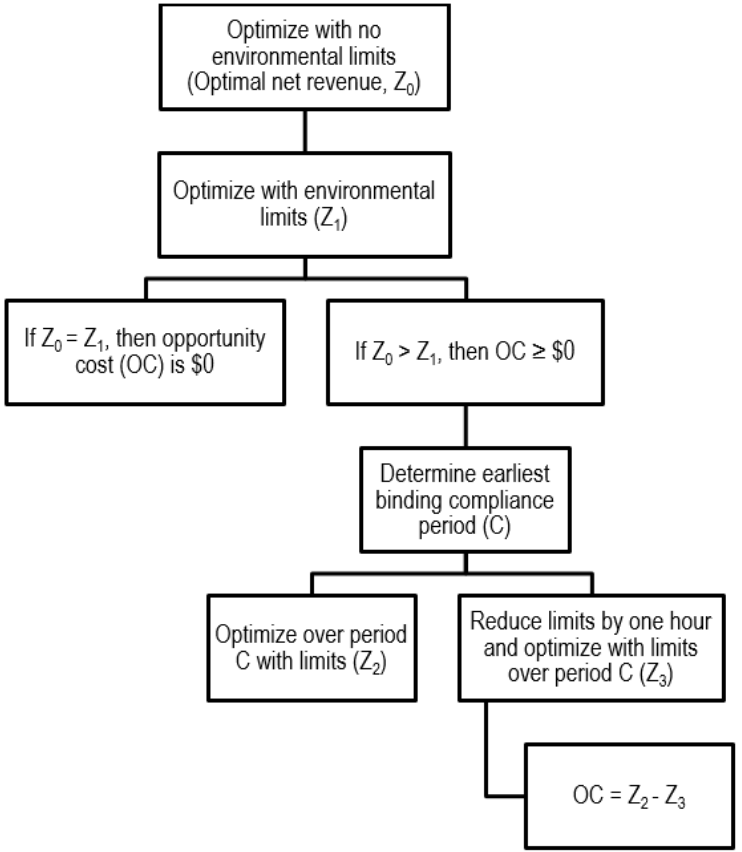
Unit Specific Assumptions

- **MIRA currently has the flexibility to add information regarding any unit specific assumptions**
  - **In the case that it necessary to include a unit specific assumption, the IMM will use the Manage Inputs capability in MIRA to add an additional input.**
  - **The additional input will be visible to the Market Seller on the resource input screen.**

Public Posting of OCC Details

- **Manual 15, Sections 12.5 and 12.7, has a description of the IMM Opportunity Cost Calculator**
- **IMM will create and post a new document to the Monitoring Analytics website. The document will include:**
  - **Description of the assumptions, algorithm and implementation**
  - **Examples**
  - **A description of the software**

OCC Overview



Model Parameters

$ECOMIN$ – economic minimum for the unit (MW).

$ECOMAX$ – economic maximum for the unit (MW).

$DFMW$ – duct or peak firing maximum capability (MW).

$MINRUN$ – minimum runtime for the unit (hours).

$MINDOWN$ – minimum downtime for the unit (hours).

$MARGIN(h)$ – forward LMP net the forward energy and variable operating and maintenance cost for hour h ($ per MWh).

$DFMARGIN(h)$ – forward LMP net the duct or peak firing forward energy and variable operating and maintenance cost for hour h ($ per MWh).

$NOLOAD$ – no load cost ($ per hour).

$STARTCOST$ – start up cost ($ per start).

C_k – Compliance period k.

$EMISSION\_RATE_i$ – emission rate for monitored element i (tons per MWh).

$START\_EMISSIONS_i$ – emissions per start for monitored element i (tons per start).

$EMISSIONS(i, C_k)$ – historical emissions for monitored element i during compliance period C_k (tons).

Decision Variables

Decision variables are variables whose values are determined by the optimization engine. Decision variables may have a prescribed range but otherwise the optimization assigns values that maximize net revenue while satisfying all constraints. The Opportunity Cost Calculator uses the following decision variables.

$HOURON(h)$ – a binary variable that equals 1 if the unit is operating during hour h; otherwise equals 0.

$START(h)$ – a binary variable that equals 1 if the unit starts during hour h; otherwise equals 0.

$XTRAHR(h)$ – a binary variable that equals 1 if the unit is to remain on for hour h, surpassing the minimum runtime; equals 0 otherwise.

$XTRAHR2(h)$ – a binary variable that equals 1 if the unit is to remain on for hour h, surpassing the minimum runtime; otherwise equals 0.

$DFON(h)$– a binary variable that equals 1 if the duct or peak firing component is on for hour h; otherwise equals 0.

$OUTPUT(h)$ – a nonnegative variable representing the MWh output during hour h.

Objective Function

Each optimization in the Opportunity Cost Calculator finds the commitment and dispatch that maximizes the net revenue. Net revenue is the total energy revenue less the start up and operating cost over the forward period. The following equation states the objective function in terms of the decision variables and model parameters.

$$Z = \sum_{h} OUTPUT(h) \cdot MARGIN(h) + DFMW \cdot DFMARGIN(h) \cdot DFON(h) - STARTCOST \cdot START(h) - NOLOAD \cdot HOURON(h)$$

Operating Constraints

ECONOMIC MINIMUM / ECOMINIC MAXIMUM – restricts $OUTPUT(h)$ to be between the economic minimum and economic maximum when the unit is operating.

MINIMUM RUNTIME – prevents shutdown of the unit prior to the completion of the minimum runtime period.

MINIMUM DOWNTIME – prevents the start up of the unit prior to the completion of the minimum downtime period.

DUCT FIRING OPERATION – requires the base unit to be operating in any hour the duct firing capability is dispatched.

START UP LOOK AHEAD – requires the start up decision variable to be based on economic data for the current hour and the next hour for a unit with a one hour minimum runtime. Requires the start up decision variable to be based on economic data for the duration of the minimum runtime beginning in the current hour for a unit with a minimum runtime exceeding one hour.

SHUTDOWN LOOK AHEAD – requires that the decision to remain on after the completion of the minimum runtime be based on economic data for the current hour and the next hour.

Environmental Constraints

Environmental limits are typically imposed on a calendar year, 12 month rolling or 365 day rolling basis. A constraint for each compliance period ending within the forward looking year must be incorporated into the Opportunity Cost Calculator. A calendar year limit is modeled with a single constraint. A 12 month rolling limit is modeled with 12 constraints, one for each 12 month period ending in the forward looking year. A 365 day rolling limit is modeled with 365 constraints, one for each 365 day period ending in the forward looking year. Environmental emissions constraints in the Opportunity Cost Calculator have the following format.

CALENDAR YEAR:

$$(Historical\ Emissions\ during\ Year) + (Emissions\ from\ model\ dispatch\ during\ Year) \leq Limit$$

12 MONTH ROLLING:

$$(Historical\ Emissions\ during\ C_k) + (Emissions\ from\ model\ dispatch\ during\ C_k) \leq Limit$$

for $k = 1,\ldots,12$ where C_k is the 12 month compliance period ending in the k^{th} month in the forward year.

365 DAY ROLLING:

$$(Historical\ Emissions\ during\ C_k) + (Emissions\ from\ model\ dispatch\ during\ C_k) \leq Limit$$

for $k = 1,\ldots,365$ where C_k is the 365 day compliance period ending on the k^{th} day in the forward year.

Monitoring Analytics, LLC
2621 Van Buren Avenue
Suite 160
Eagleville, PA
19403
(610) 271-8050

MA@monitoringanalytics.com
www.MonitoringAnalytics.com