

A. F. Mensah, Inc. (AFM)
Solution Package for the
RMISTF

Our proposal

- AFM is generally accepting of the PJM/IMM Solution Package with one concern regarding the proposed Settlements calculation
- We are therefore suggesting a solution package which is identical to the PJM/IMM package, with the exception of a change to the Proposed Settlements formula
- We are proposing to settle the market based on the average RTS (ARTS) as opposed to the Marginal RTS (MRTS) using one of the following formulas
- $ARTS * P_{score}(RMCP)$ or $\frac{EffMWRegD}{ActMWRegD} * P_{score}(RMCP)$
- These two formulas are functionally equivalent

Basic assumptions

- We all want a market where there is consistency between market clearing and market settlement.
- This will result in fair compensation for the services provided by market participants and clear investment signals.
- We believe that all market participants should be paid the same per effective MW.
- Anything else will result in inconsistency between settlement and clearing
- All bids are converted to \$ per effective MW in order to clear RegA and RegD in a single stack.
- The RMCP upon which the market settles is expressed in \$ per effective MW.
- The only way to be consistent is to pay equally per effective MW

Old System

Today

- Settlements calculation with mileage ratio (MR)
- $\text{Credit} = \text{CCP} * \text{MW} * \text{PS} + \text{PCP} * \text{MR} * \text{MW} * \text{PS}$
- CCP = Capability Clearing Price
- PCP = Performance Clearing Price

- In the current system, Reg D is always paid slightly more than Reg A, regardless of the effective MW provided by the respective resource types
- We understood the goal of settlement changes being to ensure that resources were compensated equally per effective MW

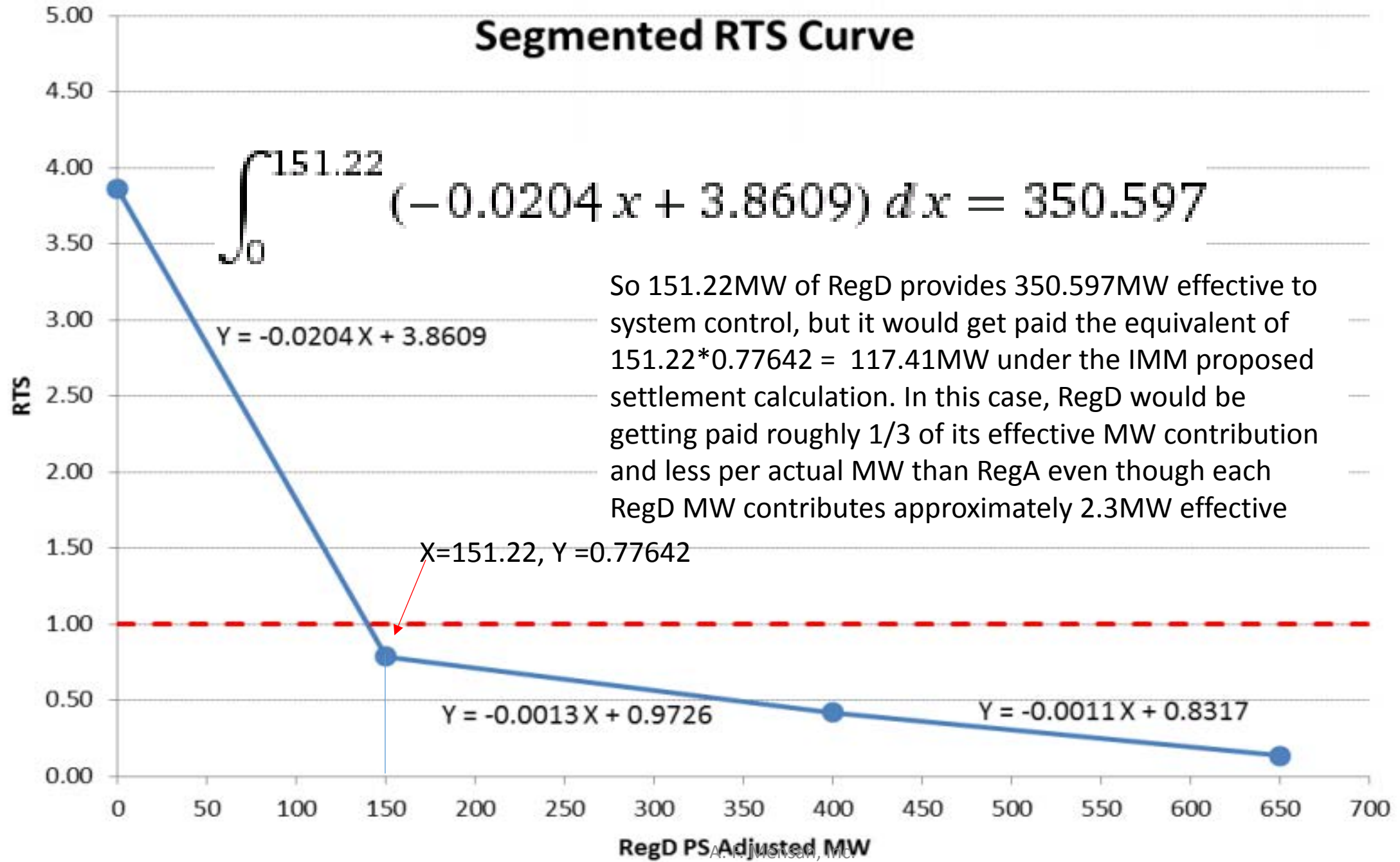
PJM/IMM Proposal

- Because effective MW are calculated in clearing as the area under the curve, but settlement is based on only the MRTS, which is the lowest RTS value at which any Reg D Resource cleared, RegD will be significantly under valued and under compensated in market settlement

Phase 1 Go-live - ongoing

- Settlements calculation with marginal rate of technical substitution (MRTS)
- $\text{Credit} = \text{CCP} * \text{MRTS} * \text{MW} * \text{PS} + \text{PCP} * \text{MRTS} * \text{MW} * \text{PS}$
- CCP = Capability Clearing Price
- PCP=Performance Clearing Price

Segmented RTS Curve



Our Proposal

- It is easy to show that the calculation of Effective MW in clearing using the area under the curve is equivalent to using the average value of the curve and multiplying the by the total Actual RegD MW cleared
- Since it can be shown that calculation of EffMW for RegD in clearing is based on the Average RTS, it is consistent to use the Average RTS in settlement

$$\text{ARTS} * \text{Pscore}(\text{RMCP})$$

or

$$\frac{\text{EffMWRegD}}{\text{ActMWRegD}} * \text{Pscore}(\text{RMCP})$$

Showing how Effective MW are calculated

- $RTS(x) = -0.0204x + 3.8609$
- The Effective MW of x MW of RegD is the integral of the RTS from 0 to x , which is equivalent to $x * (AverageRTS)$

$$\begin{aligned} & \bullet \int_0^x (-0.0204x + 3.8609) dx = -0.0204 \frac{x^2}{2} + 3.8609x \Big|_0^x \\ & = x \left(-0.0204 \frac{x}{2} + 3.8609 \right) = x \left(-0.0204 \frac{x}{2} + \frac{2}{2} 3.8609 \right) \\ & = x \left(\frac{-0.0204x + 2 * 3.8609}{2} \right) = x \left(\frac{(-0.0204x + 3.8609) + 3.8609}{2} \right) \\ & = x \left(\frac{RTS(x) + 3.8609}{2} \right) = x \left(\frac{RTS(x) + RTS(0)}{2} \right) = x(AverageRTS) \end{aligned}$$

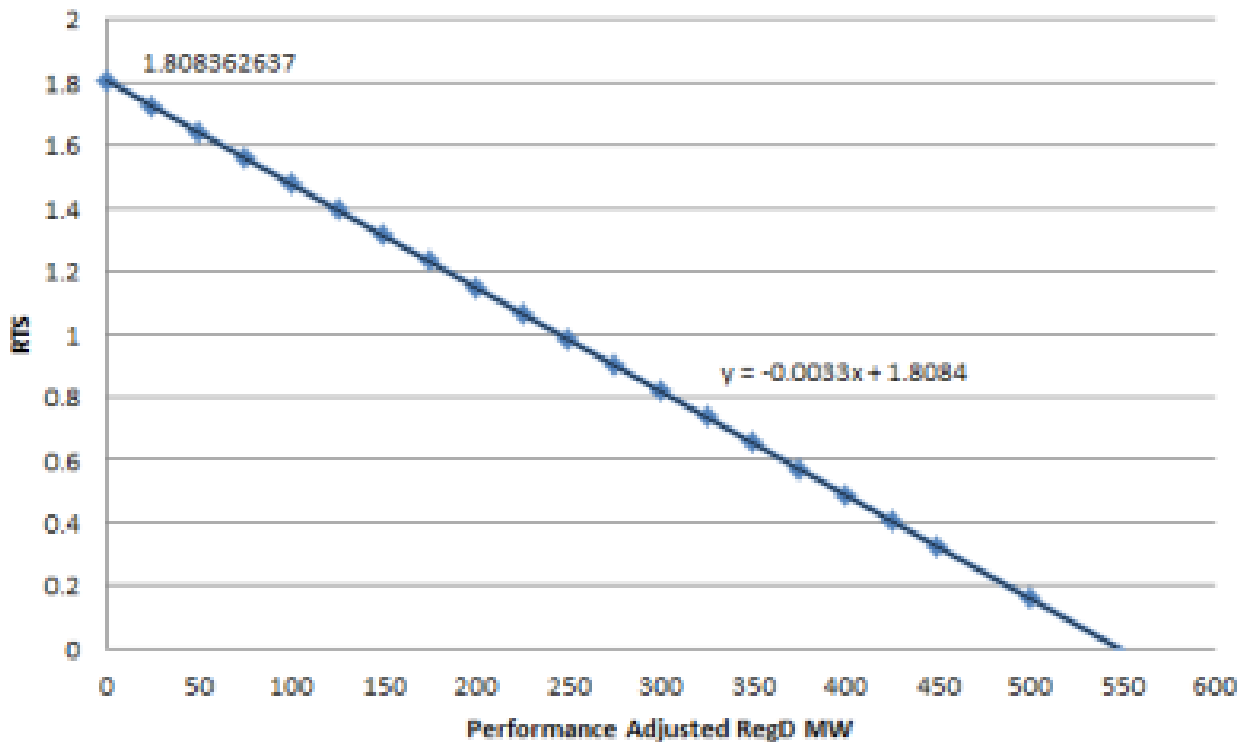
Conclusion

- It can be shown that the calculation of the effective MW of RegD in clearing can be expressed as the average of the two end points of a linear RTS curve (this definition can be easily expanded to a segmented curve and would be a weighted average of each line segment).
- Thus, the calculation of Effective MW provided by RegD in clearing is based on the Average RTS, not just the MRTS. To be consistent, settlement should also be based on the Average RTS.
- The MRTS represents the effectiveness of the last unit to enter the market, but does not represent the effectiveness of those units already cleared.
- Settling based on the MRTS punishes RegD assets by significantly under valuing them in market settlement. It is inconsistent with clearing, and will not result in fair market outcomes.

Additional thoughts

- Settling based on the average RTS will result in market costs that are less than or equal to a market of only RegA, hence it will not increase costs
- RegD inherently helps to reduce the overall market price by offsetting potential high LOCs generated by the RegA it replaces
- Settling based on the average will also incentivize more competition among RegD providers to have higher performance scores

Requirement: 800 Effective MW



- 30 minute energy storage modeled
- MRTS = 1
 - 35% Perf. Adj. MW of RegD make up total Regulation Requirement
 - 245 Perf. Adj. MW of RegD
- MRTS = 0
 - 64% Perf. Adj. MW of RegD make up total Regulation Requirement
 - 548 Perf. Adj. MW of RegD

Looking at the examples (PJM/IMM Proposal)

- 30 minute energy storage modeled
 - MRTS = 1
 - 35% Perf. Adj. MW of RegD make up total Regulation Requirement
 - 245 Perf. Adj. MW of RegD
 - MRTS = 0
 - 64% Perf. Adj. MW of RegD make up total Regulation Requirement
 - 548 Perf. Adj. MW of RegD
- For MRTS = 1
 - 35% of 800MW is 280MW effective provided by Reg D.
 - They would be paid the same as 245 MW RegA under the proposed method (30.625%)
 - For MRTS = 0
 - 64% of 800MW is 512MW effective provided by Reg D
 - They would be paid nothing under the proposed method

Our suggestion

- 30 minute energy storage modeled
- MRTS = 1
 - 35% Perf. Adj. MW of RegD make up total Regulation Requirement
 - 245 Perf. Adj. MW of RegD
- MRTS = 0
 - 64% Perf. Adj. MW of RegD make up total Regulation Requirement
 - 548 Perf. Adj. MW of RegD
- All Reg gets paid per effective MW.
- For the MRTS = 1 example, 1MW of Reg D is $280/245 = 1.143$ MW effective and should be paid as such.
- For MRTS = 0, 1 MW of Reg D is $512/548 = 0.934$ MW effective and should be paid as such