# Variable Generation Contract Settlement with Day-Ahead Market

Presented to: FIT/RES/LRP Wind and Solar Contract Counterparties Prepared by: Contract Management

April 1<sup>st</sup>, 2019



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This information provided in this presentation is preliminary and is based on the information and design decisions that have been published by the IESO in connection with the Market Renewal Program (MRP) as of the date of the presentation. As the MRP progresses and as available information and decisions evolve, the IESO's proposed approach to addressing any contractual issues may also evolve.



## Purpose

- To present a proposed comprehensive solution to wind and solar market participant contract holders that addresses the introduction of a Day-Ahead market (DAM)
- To show that the solution results in the same total revenue outcome as before the introduction of DAM, if IESO forecasts are used
- To show that the solution allows deviation from IESO forecasts, which may lead to increased or reduced revenues to the extent of the deviation



## Context

- DAM stakeholder sessions and the high-level design document (HLD) contemplate voluntary participation by all resources
  - Market Power Mitigation applies
  - Caveat in the HLD notes that current Availability Declaration Envelope (ADE) offer obligation would be retained as a transitionary measure if incentives are not aligned
- The contract settlement solution presented previously, and further explained in this presentation, aligns contract incentives with market incentives, while retaining the production forecast risk with the IESO



# Previous Meeting Recap

- In October 2018, the mechanics of the contract settlement calculation were presented when comparing present-day real-time contract settlement to post-MRP contract settlement with DAM and real-time
- Two example calculations were previously provided showing:
  - When a generator offers the IESO forecast, revenues are the same post-MRP when compared to present-day settlement
  - When a generator deviates from the IESO forecast, the difference in revenues is solely attributable to the extent of the deviation
- The examples were simple (no curtailment, no deviation in offer price, no negative prices) in order to show that the solution works as intended
- It was requested that these examples be expanded upon, showing other scenarios with varying conditions, and that present-day and post-MRP settlement amounts would still remain the same



## Updates to the Formula

- The formula that was presented in October (and previously to that) is the same that is presented here
  - Contract revenue is equal to output multiplied by contract price, less market revenues at an assumed day ahead forecast
- The formula now includes a condition for negative pricing and separates curtailment compensation
- Condition for assumed day ahead forecast accounts for variation in both quantity and price
- This expanded formula accounts for all conditions and scenarios



## Terms and Variables

• The following represent the variables and terms that are used in the presentday and post-MRP revenue calculations, and the subsequent 18 scenarios

Forecast Quantities			
$F_{DA}$	IESO DA forecast quantity		
$\mathbf{F}_{\mathbf{RT}}$	IESO RT forecast quantity		
	Offer Prices		
$P_{DA}$	Generator's DA offer price		
$\mathbf{P}_{\mathrm{RT}}$	Generator's RT offer price		
Quantities			
Q <sub>OFFER</sub>	Generator's DA offer quantity @ P <sub>DA</sub>		
$Q_{\mathrm{DA}}^{*}$	DA scheduled quantity consistent with reference offer		
$Q_{DA}$	Actual DA schedule based on generator's offer		
$Q_{RT}$	Actual RT production		
$Q_X$	Quantity for curtailment compensation if past cap		
Market Prices			
\$ <sub>DA</sub>	Day Ahead LMP		
\$ <sub>RT</sub>	Real Time LMP		
\$ <sub>RT</sub> *	Real Time LMP adjusted to not less than zero		



## **Contract Settlement Conditions**

- There are two conditions that are used in the contract settlement formula
  - Day-ahead quantity to be used in contract settlement (only applies if quantity offered in day ahead is different from forecast or offer price in day ahead impacts the quantity)
  - Real-time price to account for negative pricing (only applies if offered below \$0)
- Q<sub>DA</sub>\* reflects the assumed day ahead quantity to be used for contract settlement

If \$ <sub>DA</sub> > \$0	$Q_{DA}^* = F_{DA}$	If reference offer is economic, then assume IESO forecast was scheduled
If $\$_{DA} = \$0$	$Q_{DA}^* = \min \text{ of } F_{DA \text{ and }} Q_{DA}$	If reference offer is on the margin then assume actual day ahead schedule up to IESO forecast
If \$ <sub>DA</sub> < \$0	$Q_{DA}^* = 0$	If not economic, then assume not scheduled in day-ahead

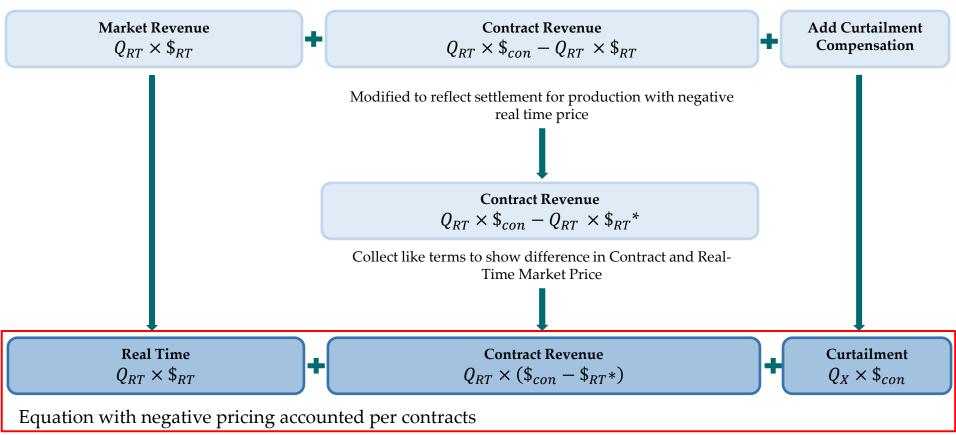
• \$\\$\_{RT}\$\* reflects the current contract parameter that real time price is assumed to be \$0 if it is negative

If $\$_{RT} \ge \$0$	$\$_{RT}^* = \$_{RT}$
If \$ <sub>RT</sub> < \$0	$\$_{RT}^* = \$0$



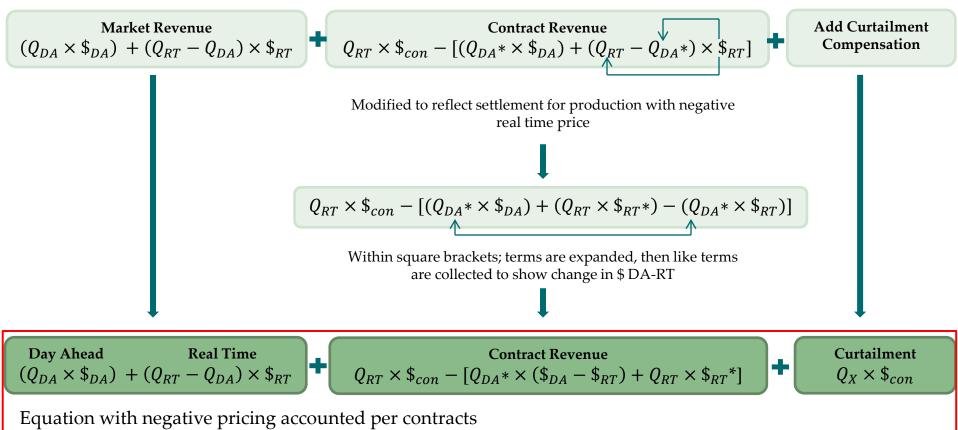
# General Formulas – Present Day Revenue

Equation shown in previous presentation



## General Formulas – Post MRP Revenue

Equation shown in previous presentation



## Scenario Overview

- 18 scenarios have been prepared in 5 different categories
  - Base case and 15 possible permutations, where IESO forecast is used are shown, including one scenario where the reference offer is on the margin
  - Two scenarios where the IESO forecast is not used are also shown to illustrate the differences
  - There are over 40 other permutations where IESO forecast is not used that are not shown, as they becomes repetitive of the 15 permutations where day-ahead price or quantity is varied
- Changes to each scenario are variations of the Base Case (Scenario 1 price and quantities in day-ahead equals price quantities Presented in Slide #23)

Category	Description	Reference
Basic examples Offer IESO forecast at \$0 in day-ahead and only real-time parameters change		Scenarios 2 to 9, Appendix 2
<b>Real-time curtailment</b> Same as basic examples with curtail real-time		Scenarios 10 to 11, Appendix 3
Negative prices in real- time	Same as basic examples with negatives prices in real-time	Scenarios 12 to 13, Appendix 4
Other examples if offering IESO forecast	Scenarios with day-ahead curtailment, negative prices in day-ahead, and marginal resource schedule	Scenarios 14 to 16, Appendix 5
Deviating from IESO forecasts	Scenarios where IESO forecast is not used	Scenarios 17 to 18, Appendix 6



## Summary of Results

- All scenarios show that the solution works as intended
  - When a generator offers the IESO forecast (scenarios 1 through 16), revenues are the same post-MRP when compared to present-day settlement
  - When a generator deviates from the IESO forecast (scenarios 17 and 18), the difference in revenues is solely attributable to the extent of the deviation
- The following slides show a summary table for each of the 5 categories of scenarios
- Each individual scenario is listed in greater detail with a full calculation in the appendices

# Results – Basic Examples (Scenarios 1-9)

#	Description	Pre-MRP Revenue (Market+Contract+Curtailment) (\$)	Post-MRP Revenue (Market+Contract+Curtailment) (\$)	Difference (\$)	<b>Slide</b> # (Complete Example)
1	RT Quantity, LMP = DA Quantity, LMP	500 + 4500 + 0 = 5000	500 + 4500 + 0 = 5000	0	23-24
2	RT Forecast Quantity ↑	700 + 6300 + 0 = $7000$	700 + 6300 + 0 = $7000$	0	25-26
3	RT Forecast Quantity ↓	300 + 2700 + 0 = 3000	300 + 2700 + 0 = 3000	0	27-28
4	RT LMP ↑	750 + 4250 + 0 = 5000	500 + 4500 + 0 = 5000	0	29-30
5	RT LMP ↓	250 + 4750 + 0 = 5000	500 + 4500 + 0 = 5000	0	31-32
6	RT Forecast Quantity $\uparrow$ , RT LMP $\uparrow$	1050 + 5950 + 0 = $7000$	800 + 6200 + 0 = 7000	0	33-34
7	RT Forecast Quantity $\uparrow$ , RT LMP $\downarrow$	350 + 6650 + 0 = 7000	600 + 6400 + 0 = 7000	0	35-36
8	RT Forecast Quantity ↓, RT LMP↑	450 + 2550 + 0 = 3000	200 + 2800 + 0 = 3000	0	37-38
9	RT Forecast Quantity $\downarrow$ , RT LMP $\downarrow$	150 + 2850 + 0 = 3000	400 + 2600 + 0 = 3000	0	39-40



# Results – Real-Time Curtailment (Scenarios 10-11)

#	Description	Pre-MRP Revenue (Market+Contract+Curtailment) (\$)	Post-MRP Revenue (Market+Contract+Curtailment) (\$)	Difference (\$)	<b>Slide</b> # (Complete Example)
10	RT Curtailment, RT Forecast Quantity ↑, RT LMP ↓	0 + 0 + 7000 = 7000	600 + (-600) + 7000 = 7000	0	42-43
11	RT Curtailment, RT Forecast Quantity ↓, RT LMP ↓	0 + 0 + 3000 = 3000	600 + (-600) + 3000 $= 3000$	0	44-45



# Results – Negative Prices in Real-Time (Scenarios 12-13)

#	Description	Pre-MRP Revenue (\$) (Market+Contract+Curtailment) (\$)	Post-MRP Revenue (\$) (Market+Contract+Curtailment) (\$)	Difference (\$)	Slide # (Complete Example)
12	RT Price < \$0, not curtailed, RT Forecast Quantity ↑, RT LMP ↓	(-140) + 7000 + 0 = 6860	460 + 6400 + 0 = 6860	0	47-48
13	RT Price < \$0, not curtailed, RT Forecast Quantity ↓, RT LMP ↓	(-60) + 3000 + 0 = 2940	540 + 2400 + 0 = 2940	0	49-50



# Results – Other Examples Offering IESO Forecast (Scenarios 14-16)

#	Description	Pre-MRP Revenue (Market+Contract+Curtailment) (\$)	Post-MRP Revenue (Market+Contract+Curtailment) (\$)	Difference (\$)	Slide # (Complete Example)
14	DA curtailment, RT LMP↑	750 + 4250 + 0 = 5000	750 + 4250 + 0 = 5000	0	52-53
15	DA curtailment, RT curtailment	0 + 0 + 5000 = 5000	0 + 0 + 5000 = 5000	0	54-55
16	RT Forecast Quantity ↑, RT LMP ↑, Marginal Resource	350 + 6650 + 0 = 7000	250 + 6750 + 0 = 7000	0	56-57

# Results – Deviating from IESO Forecasts (Scenarios 17-18)

#	Description	Pre-MRP Revenue (Market+Contract+Curtailment) (\$)	Post-MRP Revenue (Market+Contract+Curtailment) (\$)	Difference (\$)	Slide # (Complete Example)
17	DA Quantity Offer ↑, RT Forecast Quantity ↑, RT LMP ↓	350 + 6650 + 0 = 7000	700 + 6400 + 0 = $7100$	+100	59-60
18	DA Quantity Offer \(   RT \) Forecast Quantity \(   RT \) LMP \( \)	1050 + 5950 + 0 = $7000$	700 + 6200 + 0 = 6900	-100	61-62



## Conclusion

- If the Supplier's DA offer is consistent with the IESO's default offer (both price and quantity), the post-MRP settlement amount will equal that of present-day
  - This is the case regardless of RT conditions
  - Shown in Appendices 2-5 (Slides 23-57)
- If the Supplier choses to deviate from the IESO default offer, the post-MRP revenue may not equal present-day revenue
  - The Supplier assumes this risk if they choose to deviate, but only to the extent of the deviation
  - Shown in Appendix 6 (Slides 59-62)



## **Next Steps**

- Feedback, questions, and requests for further clarity are welcome
- IESO will publish a broader contracts and MRP document in the coming days
- Next step in the coming months will be to start the work on preliminary term sheets
- For questions/comments, contact: <u>mr.ContractManagement@ieso.ca</u>



# Appendix 1 – Introduction to Detailed Calculations



## Reading the Detailed Calculations

- Where expanded calculations are provided, present-day calculations are noted in blue, post-MRP are noted in green
- Numerical changes to conditions in each scenario are noted in red
- For each scenario, the same contract parameters are used as follows;

Contract Capacity =	<b>100</b> MW
Contract Price (\$ <sub>Con</sub> ) =	<b>100</b> \$ / MWh
Contract ref DA offer price	<b>0</b> \$ / MWh

- Both the Contract Capacity and Contract Price are defined in the contract
  - The Contract Price represents \$/MWh of electricity generated
  - These values are constant through each scenario



# Appendix 2 – Basic Examples (Scenarios 1-9)



## Scenario 1 – Base Case

- RT conditions mimic that of DA conditions
  - The market price is the same in DA vs. RT
  - The DA scheduled offer and quantity equal the RT production quantity

#### **Real Time**

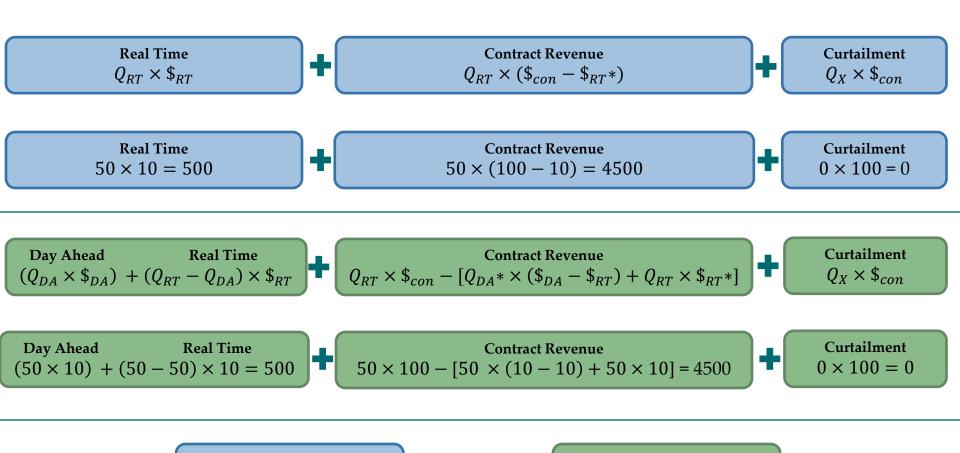
 $\begin{array}{ll} LMP \ (\$_{RT}): & \$10/MW \\ LMP \ adj. \ (\$_{RT}{}^*): & \$10/MW \\ Actual \ RT \ Production \ (Q_{RT}): & 50 \ MW \\ Curtailment \ Quantity \ (Q_x): & 0 \ MW \end{array}$ 

#### Day Ahead

 $LMP (\$_{DA}): $10/MW \\ IESO Forecast (F_{DA}): 50 MW \\ Scheduled Quantity (Q_{DA}^*): 50 MW \\ Actual Schedule (Q_{DA}): 50 MW$ 



### Scenario 1 - Calculations



Pre-MRP Total Revenue \$5000



Post-MRP Total Revenue \$5,000



# Scenario 2 – Single Parameter Adjustment

- RT forecast capability is increased by 20 MW
  - Actual RT production will match the new forecast capability
  - The DA and RT market prices are equal

#### **Real Time**

 $\begin{array}{lll} LMP \ (\$_{RT}): & \$10/MW \\ LMP \ adj. \ (\$_{RT}^*): & \$10/MW \\ IESO \ Forecast \ (F_{RT}): & 70 \ MW \\ Actual \ RT \ Production \ (Q_{RT}): & 70 \ MW \\ Curtailment \ Quantity \ (Q_x): & 0 \ MW \end{array}$ 

#### Day Ahead

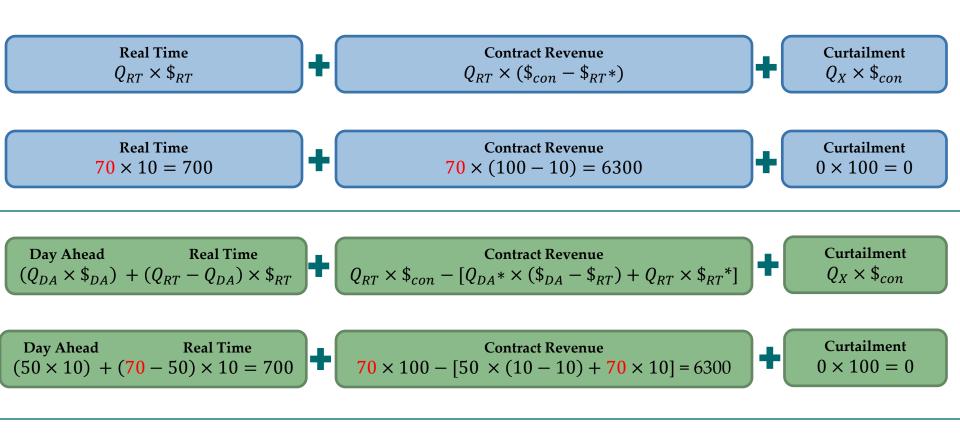
 $LMP (\$_{DA}): $10/MW \\ IESO Forecast (F_{DA}): 50 MW \\ Scheduled Quantity (Q_{DA}^*): 50 MW \\ Actual Schedule (Q_{DA}): 50 MW$ 



### Scenario 2 - Calculations

**Pre-MRP Total Revenue** 

\$7,000



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**Post-MRP Total Revenue** 

\$7,000

# Scenario 3 – Single Parameter Adjustment

- RT forecast capability is decreased by 20 MW
  - Actual RT production will match the new forecast capability
  - The DA and RT market prices are equal

#### **Real Time**

 $\begin{array}{lll} LMP \ (\$_{RT}): & \$10/MW \\ LMP \ adj. \ (\$_{RT}^*): & \$10/MW \\ IESO \ Forecast \ (F_{RT}): & 30 \ MW \\ Actual \ RT \ Production \ (Q_{RT}): & 30 \ MW \\ Curtailment \ Quantity \ (Q_x): & 0 \ MW \\ \end{array}$ 

#### Day Ahead

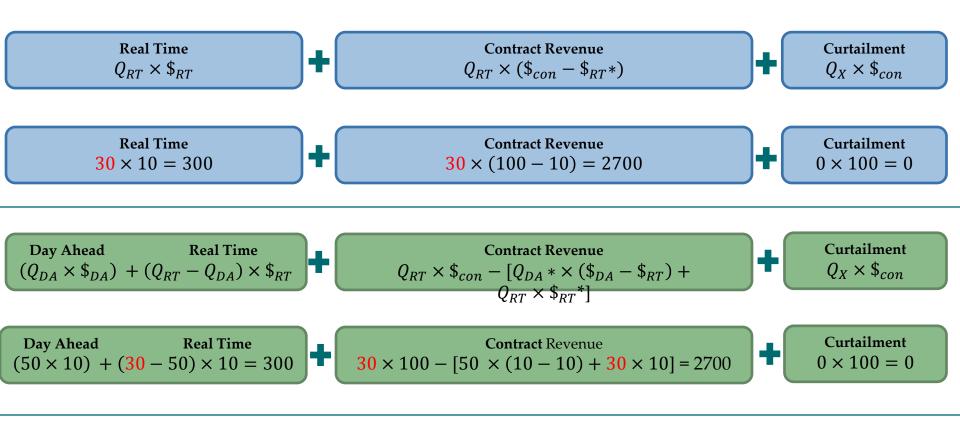
 $LMP (\$_{DA}): $10/MW \\ IESO Forecast (F_{DA}): 50 MW \\ Scheduled Quantity (Q_{DA}*): 50 MW \\ Actual Schedule (Q_{DA}): 50 MW$ 



### Scenario 3 - Calculations

**Pre-MRP Total Revenue** 

\$3,000



**Post-MRP Total Revenue** 

\$3,000

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# Scenario 4 – Single Parameter Adjustment

- The RT LMP is increased by \$5/MW, now higher than the DA LMP
  - The DA scheduled offer and quantity equal the RT production quantity

#### **Real Time**

 $\begin{array}{lll} LMP \ (\$_{RT}): & \$15/MW \\ LMP \ adj. \ (\$_{RT}^*): & \$15/MW \\ IESO \ Forecast \ (F_{RT}): & 50 \ MW \\ Actual \ RT \ Production \ (Q_{RT}): & 50 \ MW \\ Curtailment \ Quantity \ (Q_x): & 0 \ MW \\ \end{array}$ 

#### Day Ahead

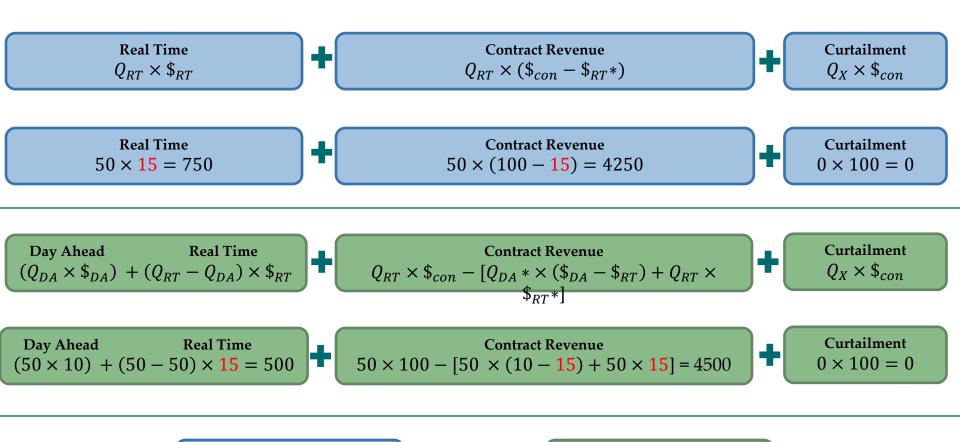
LMP ( $\$_{DA}$ ): \$10/MW IESO Forecast ( $F_{DA}$ ): 50 MW Scheduled Quantity ( $Q_{DA}^*$ ): 50 MW Actual Schedule ( $Q_{DA}$ ): 50 MW



## Scenario 4 - Calculations

**Pre-MRP Total Revenue** 

\$5,000



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Post-MRP Total Revenue

\$5,000

# Scenario 5 – Single Parameter Adjustment

- The RT LMP is reduced by \$5/MW, now lower than the DA LMP
  - The DA scheduled offer and quantity equal the RT production quantity

#### **Real Time**

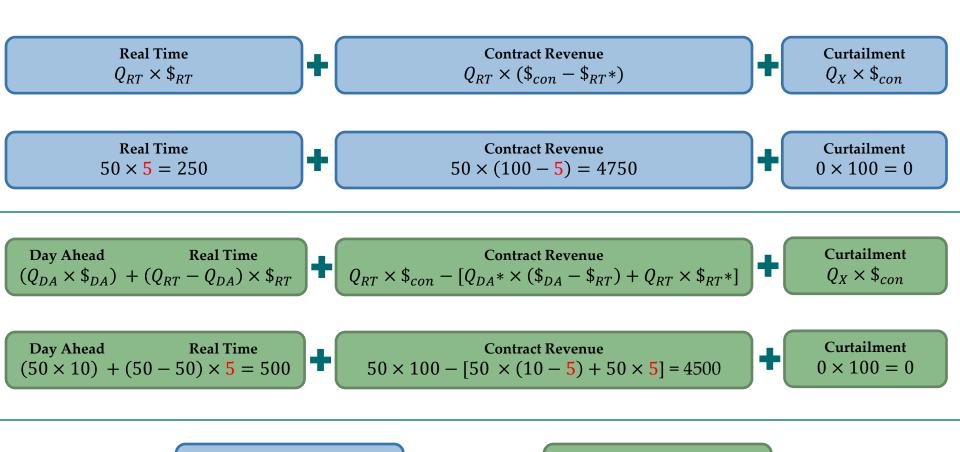
 $\begin{array}{lll} LMP \ (\$_{RT}): & \$5/MW \\ LMP \ adj. \ (\$_{RT}^*): & \$5/MW \\ IESO \ Forecast \ (F_{RT}): & 50 \ MW \\ Actual \ RT \ Production \ (Q_{RT}): & 50 \ MW \\ Curtailment \ Quantity \ (Q_x): & 0 \ MW \end{array}$ 

#### Day Ahead

 $LMP (\$_{DA}): $10/MW \\ IESO Forecast (F_{DA}): 50 MW \\ Scheduled Quantity (Q_{DA}*): 50 MW \\ Actual Schedule (Q_{DA}): 50 MW$ 



## Scenario 5 - Calculations



Pre-MRP Total Revenue \$5,000



Post-MRP Total Revenue \$5,000



# Scenario 6 – Two Parameter Adjustment

- IESO RT forecast capability is increased 20 MW and the RT LMP Price is increased \$5/MW
  - The actual RT production will equal the new RT forecast capability

#### **Real Time**

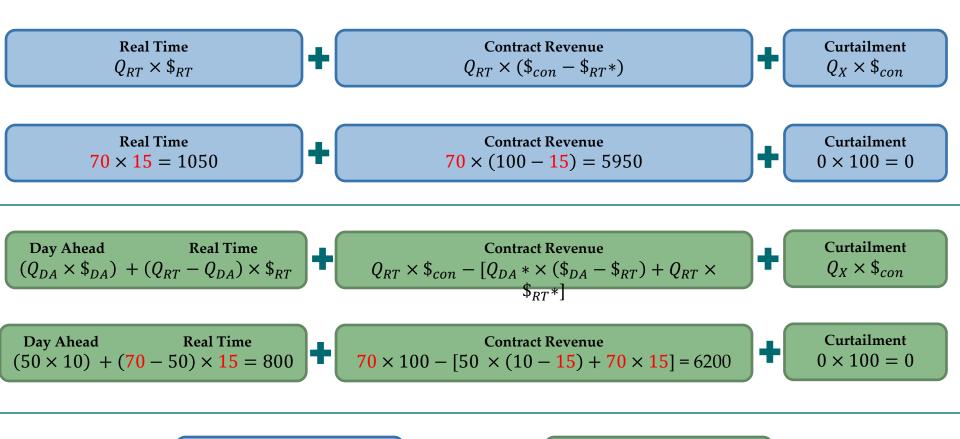
 $\begin{array}{lll} LMP \ (\$_{RT}): & \$15/MW \\ LMP \ adj. \ (\$_{RT}^*): & \$15/MW \\ IESO \ Forecast \ (F_{RT}): & 70 \ MW \\ Actual \ RT \ Production \ (Q_{RT}): & 70 \ MW \\ Curtailment \ Quantity \ (Q_x): & 0 \ MW \\ \end{array}$ 

#### Day Ahead

LMP ( $\$_{DA}$ ): \$10/MW IESO Forecast ( $F_{DA}$ ): 50 MW Scheduled Quantity ( $Q_{DA}^*$ ): 50 MW Actual Schedule ( $Q_{DA}$ ): 50 MW



## Scenario 6 - Calculations



Pre-MRP Total Revenue \$7,000



Post-MRP Total Revenue \$7,000



# Scenario 7 – Two Parameter Adjustment

- IESO RT forecast capability is increased 20 MW and the RT LMP Price is reduced \$5/MW
  - The actual RT production will equal the new RT forecast capability

#### **Real Time**

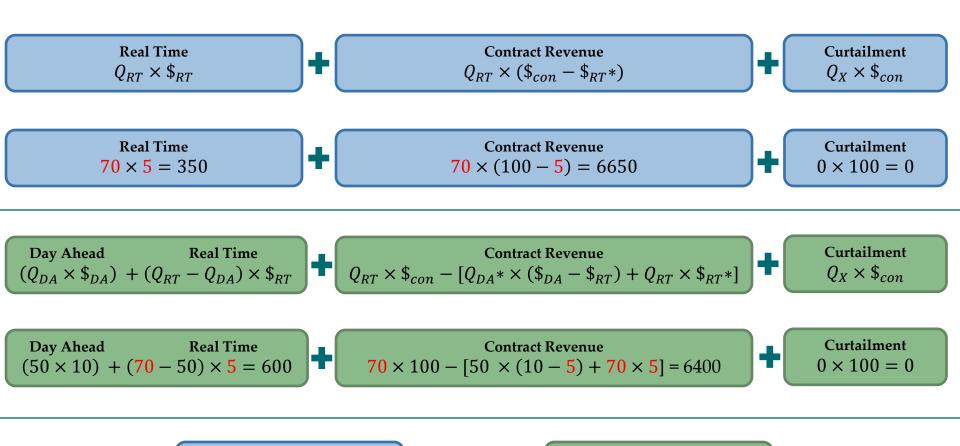
 $\begin{array}{lll} LMP \ (\$_{RT}): & \$5/MW \\ LMP \ adj. \ (\$_{RT}^*): & \$5/MW \\ IESO \ Forecast \ (F_{RT}): & 70 \ MW \\ Actual \ RT \ Production \ (Q_{RT}): & 70 \ MW \\ Curtailment \ Quantity \ (Q_{x}): & 0 \ MW \end{array}$ 

#### Day Ahead

 $LMP (\$_{DA}): $10/MW \\ IESO Forecast (F_{DA}): 50 MW \\ Scheduled Quantity (Q_{DA}*): 50 MW \\ Actual Schedule (Q_{DA}): 50 MW$ 



### Scenario 7 - Calculations



Pre-MRP Total Revenue \$7,000



Post-MRP Total Revenue \$7,000



## Scenario 8 – Two Parameter Adjustment

- IESO RT forecast capability is reduced 20 MW and the RT LMP Price is increased \$5/MW
  - The actual RT production will equal the new RT forecast capability

#### **Real Time**

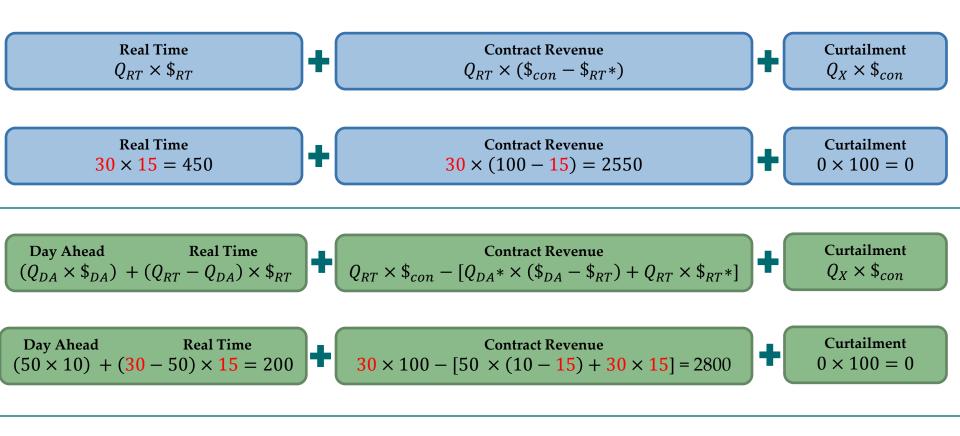
 $\begin{array}{lll} LMP \ (\$_{RT}): & \$15/MW \\ LMP \ adj. \ (\$_{RT}{}^*): & \$15/MW \\ IESO \ Forecast \ (F_{RT}): & 30 \ MW \\ Actual \ RT \ Production \ (Q_{RT}): & 30 \ MW \\ Curtailment \ Quantity \ (Q_v): & 0 \ MW \\ \end{array}$ 

### Day Ahead

LMP ( $\$_{DA}$ ): \$10/MW IESO Forecast ( $F_{DA}$ ): 50 MW Scheduled Quantity ( $Q_{DA}^*$ ): 50 MW Actual Schedule ( $Q_{DA}$ ): 50 MW



## Scenario 8 - Calculations



Pre-MRP Total Revenue \$3,000



Post-MRP Total Revenue \$3,000



## Scenario 9 – Two Parameter Adjustment

- IESO RT forecast capability is reduced 20 MW and the RT LMP Price is reduced \$5/MW
  - The actual RT production will equal the new RT forecast capability

#### **Real Time**

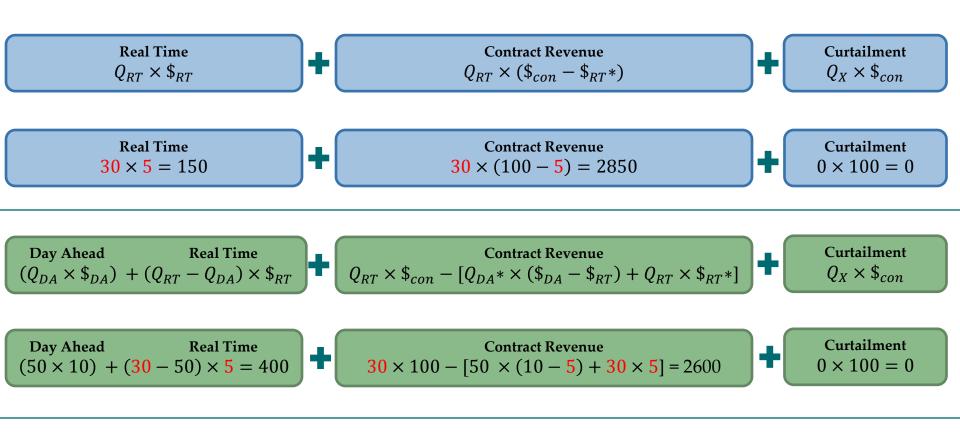
 $\begin{array}{lll} LMP \ (\$_{RT}): & \$5/MW \\ LMP \ adj. \ (\$_{RT}{}^*): & \$5/MW \\ IESO \ Forecast \ (F_{RT}): & 30 \ MW \\ Actual \ RT \ Production \ (Q_{RT}): & 30 \ MW \\ Curtailment \ Quantity \ (Q_x): & 0 \ MW \end{array}$ 

### Day Ahead

 $LMP (\$_{DA}): $10/MW \\ IESO Forecast (F_{DA}): 50 MW \\ Scheduled Quantity (Q_{DA}*): 50 MW \\ Actual Schedule (Q_{DA}): 50 MW$ 



### Scenario 9 - Calculations



Pre-MRP Total Revenue \$3,000



Post-MRP Total Revenue \$3,000



# Appendix 3 – With Real-Time Curtailment (Scenarios 10-11)



## Scenario 10 – Two Parameter Adjustment with RT curtailment

- IESO RT forecast capability is increased 20 MW and the RT LMP Price is now negative
  - Actual RT production is 0 due to LMP being lower than the generator's RT price offer

#### **Real Time**

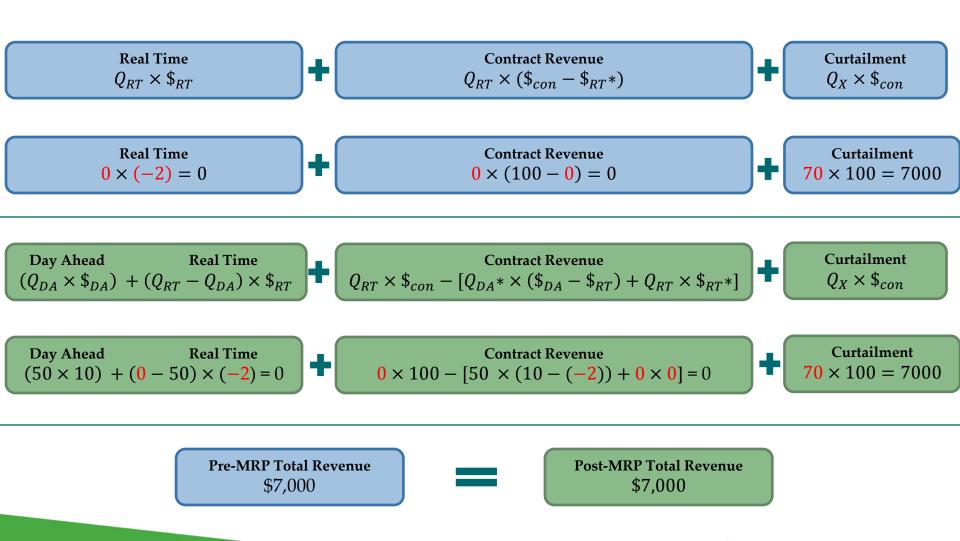
 $\begin{array}{lll} LMP \ (\$_{RT}): & \$-2/MW \\ LMP \ adj. \ (\$_{RT}^*): & \$0/MW \\ IESO \ Forecast \ (F_{RT}): & 70 \ MW \\ Actual \ RT \ Production \ (Q_{RT}): & 0 \ MW \\ Curtailment \ Quantity \ (Q_x): & 70 \ MW \\ \end{array}$ 

### Day Ahead

 $LMP (\$_{DA}): $10/MW \\ IESO Forecast (F_{DA}): 50 MW \\ Scheduled Quantity (Q_{DA}*): 50 MW \\ Actual Schedule (Q_{DA}): 50 MW$ 



## Scenario 10 - Calculations



## Scenario 11 – Two Parameter Adjustment with RT curtailment

- IESO RT forecast capability is reduced 20 MW and the RT LMP Price is now negative
  - Actual RT production is 0 due to LMP being lower than the generator's RT price offer

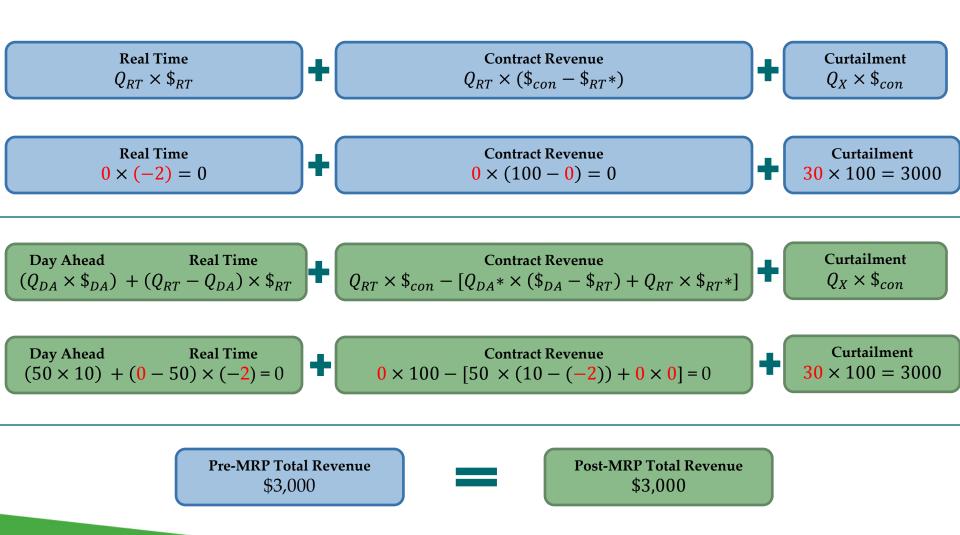
#### **Real Time**

 $\begin{array}{lll} LMP \ (\$_{RT}): & \$-2/MW \\ LMP \ adj. \ (\$_{RT}^*): & \$0/MW \\ IESO \ Forecast \ (F_{RT}): & 30 \ MW \\ Actual \ RT \ Production \ (Q_{RT}): & 0 \ MW \\ Curtailment \ Quantity \ (Q_x): & 30 \ MW \end{array}$ 

### Day Ahead

LMP ( $\$_{DA}$ ): \$10/MW IESO Forecast ( $F_{DA}$ ): 50 MW Scheduled Quantity ( $Q_{DA}^*$ ): 50 MW Actual Schedule ( $Q_{DA}$ ): 50 MW

## Scenario 11 - Calculations



# Appendix 4 – Negative Prices in Real-Time (Scenarios 12-13)



## Scenario 12 – Two Parameter Adjustment with RT price offer < \$0

- IESO RT forecast capability is increased 20 MW, the RT LMP Price is now negative, and the RT generator offer price is \$-5/ MW
  - Although RT production is negative, it is higher than the generator offer price, therefore RT production equals the IESO forecast capability

\$-2/MW
\$0/MW

LMP adj.  $(\$_{RT}^*)$ : \$0/MWIESO Forecast  $(F_{RT})$ : 70 MWActual RT Production  $(Q_{RT})$ : 70 MW

LMP ( $\$_{RT}$ ):

Real Time

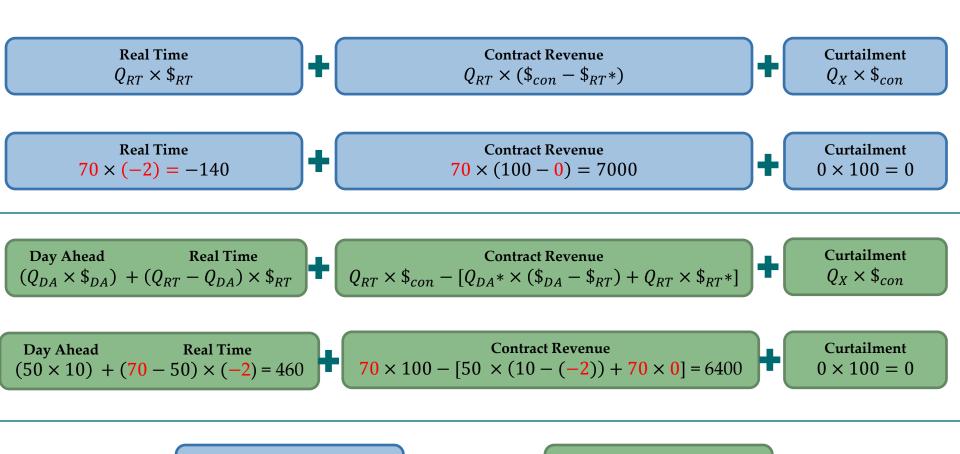
Curtailment Quantity  $(Q_x)$ : 0 MW

### Day Ahead

 $\begin{array}{ll} LMP \, (\$_{DA}): & \$10/MW \\ IESO \, Forecast \, (F_{DA}): & 50 \, MW \\ Scheduled \, Quantity \, (Q_{DA}^*): & 50 \, MW \\ Actual \, Schedule \, (Q_{DA}): & 50 \, MW \end{array}$ 



## Scenario 12 - Calculations



Pre-MRP Total Revenue \$6,860



Post-MRP Total Revenue \$6,860



## Scenario 13 – Two Parameter Adjustment with RT price offer < \$0

- IESO RT forecast capability is reduced 20 MW, the RT LMP Price is now negative, and the RT generator offer price is \$-5/ MW
  - Although RT production is negative, it is higher than the generator offer price, therefore RT production equals the IESO forecast capability

11001 111110	
LMP ( $\$_{RT}$ ):	\$-2/MW
LMP adj. (\$ <sub>RT</sub> *):	\$0/MW
IESO Forecast $(F_{RT})$ :	30 MW
Actual RT Production $(O_{PT})$ :	30 MW

Actual RT Production  $(Q_{RT})$ : 30 MV Curtailment Quantity  $(Q_x)$ : 0 MW

**Real Time** 

### Day Ahead

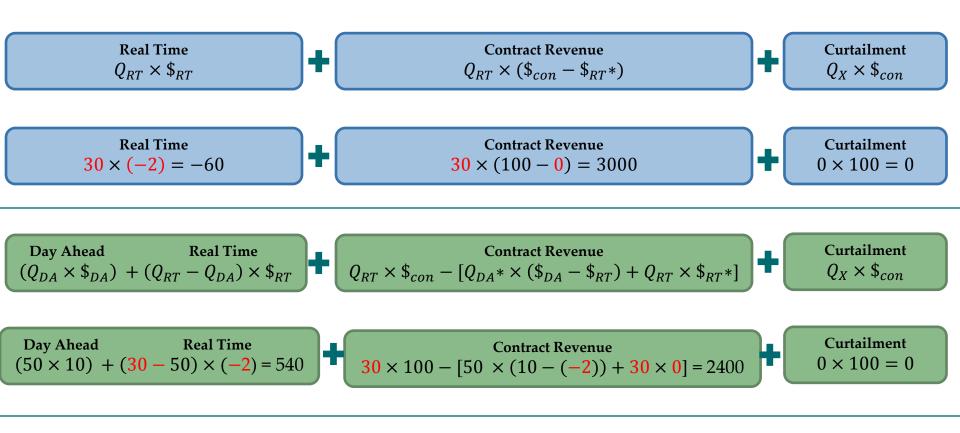
 $\begin{array}{ll} LMP \ (\$_{DA}): & \$10/MW \\ IESO \ Forecast \ (F_{DA}): & 50 \ MW \\ Scheduled \ Quantity \ (Q_{DA}^*): & 50 \ MW \\ Actual \ Schedule \ (Q_{DA}): & 50 \ MW \end{array}$ 



## Scenario 13 - Calculations

**Pre-MRP Total Revenue** 

\$2,940





Post-MRP Total Revenue

\$2,940

## Appendix 5 – Other Examples if Offering IESO Forecast (Scenarios 14-16)



## Scenario 14 – DA curtailment, RT production

- The DA LMP is negative in this case
  - This results in a DA scheduled quantity of 0
- RT LMP is increased to \$15/MW
  - Therefore there is RT production

#### **Real Time**

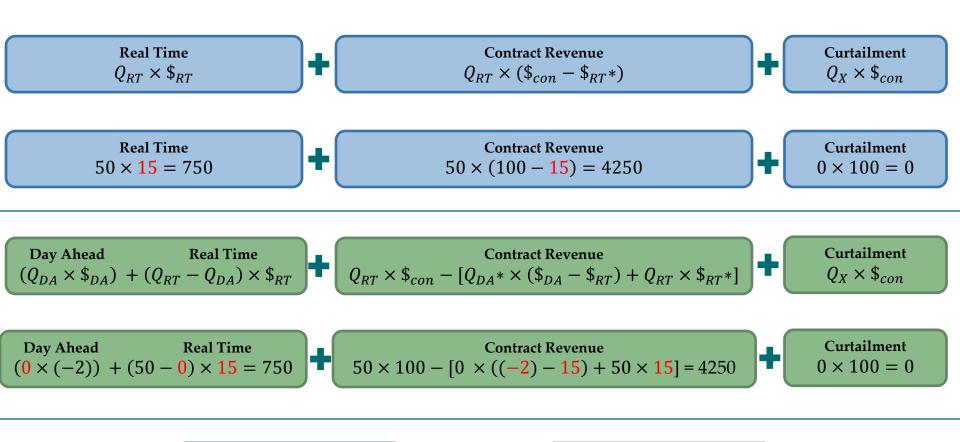
 $\begin{array}{lll} LMP \ (\$_{RT}): & \$15/MW \\ LMP \ adj. \ (\$_{RT}^*): & \$15/MW \\ IESO \ Forecast \ (F_{RT}): & 50 \ MW \\ Actual \ RT \ Production \ (Q_{RT}): & 50 \ MW \\ Curtailment \ Quantity \ (Q_x): & 0 \ MW \end{array}$ 

#### Day Ahead

 $\begin{array}{lll} LMP \, (\$_{DA}): & \$-2/MW \\ IESO \, Forecast \, (F_{DA}): & 50 \, MW \\ Scheduled \, Quantity \, (Q_{DA}{}^*): & 0 \, MW \\ Actual \, Schedule \, (Q_{DA}): & 0 \, MW \\ \end{array}$ 



## Scenario 14 - Calculations



Pre-MRP Total Revenue \$5,000



Post-MRP Total Revenue \$5,000



## Scenario 15 – DA and RT Curtailment

- The DA LMP is negative in this case
  - This results in a DA scheduled quantity of 0
- RT LMP is also negative in this case
  - Therefore there is also going to be RT curtailment

#### **Real Time**

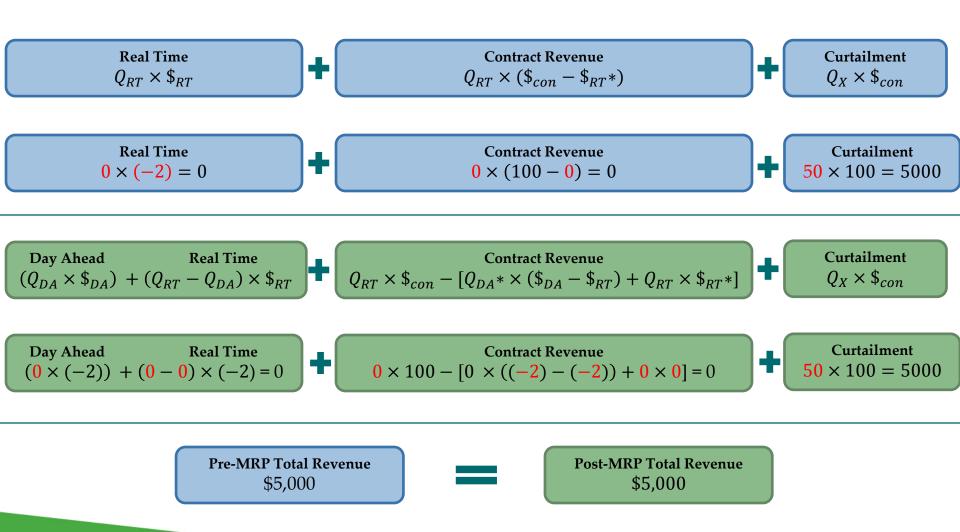
 $\begin{array}{lll} LMP \ (\$_{RT}): & \$-2/MW \\ LMP \ adj. \ (\$_{RT}^*): & \$0/MW \\ IESO \ Forecast \ (F_{RT}): & 50 \ MW \\ Actual \ RT \ Production \ (Q_{RT}): & 0 \ MW \\ Curtailment \ Quantity \ (Q_x): & 50 \ MW \\ \end{array}$ 

#### Day Ahead

 $\begin{array}{lll} LMP \, (\$_{DA}): & \$-2/MW \\ IESO \, Forecast \, (F_{DA}): & 50 \, MW \\ Scheduled \, Quantity \, (Q_{DA}{}^*): & 0 \, MW \\ Actual \, Schedule \, (Q_{DA}): & 0 \, MW \\ \end{array}$ 



## Scenario 15 - Calculations





# Scenario 16 – Marginal Resource, Forecast Capability and RT LMP are Increased

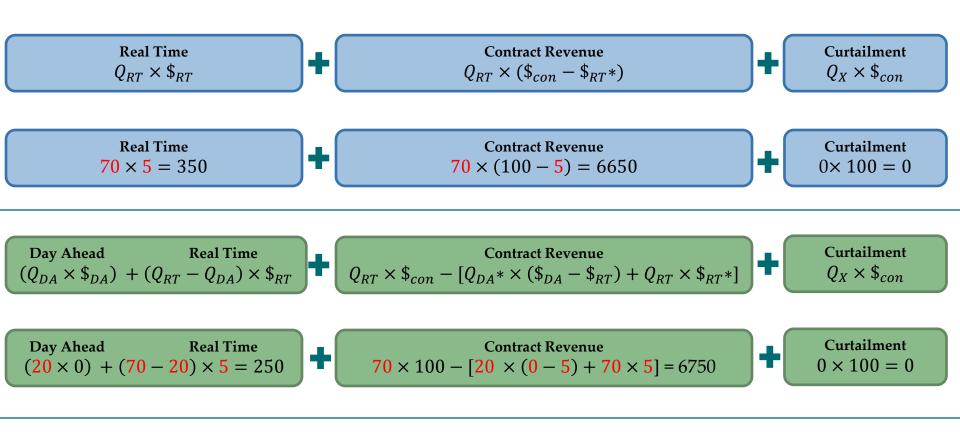
- As the DA LMP equals the DA offer price, only 20 MW of DA quantity is required vs the 50 MW that was forecast/offered (marginal)
- RT LMP is above RT price offer

- Therefore RT production quantity equals RT forecast

Real Time		
LMP ( $\$_{RT}$ ):	\$5/MW	
LMP adj. (\$ <sub>RT</sub> *):	\$5/MW	
IESO Forecast (F <sub>RT</sub> ):	70 MW	
Actual RT Production ( $Q_{RT}$ ):	70 MW	
Curtailment Quantity $(Q_x)$ :	0  MW	

Day Ahead		
LMP (\$ <sub>DA</sub> ):	\$0/MW	
IESO Forecast (F <sub>DA</sub> ):	50 MW	
Scheduled Quantity (Q <sub>DA</sub> *):	20 MW	
Actual Schedule (Q <sub>DA</sub> ):	20 MW	

### Scenario 16 - Calculations



Pre-MRP Total Revenue \$7,000



Post-MRP Total Revenue \$7,000



# Appendix 6 – Deviation from IESO Forecast (Scenarios 17-18)



## Scenario 17 – DA Offer Quantity Increased (Deviates from IESO Forecast)

- Deviation from passive operation
- RT forecast capability is increased by 20 MW
- RT LMP is reduced \$5/MW
  - Now lower than the DA LMP

#### **Real Time**

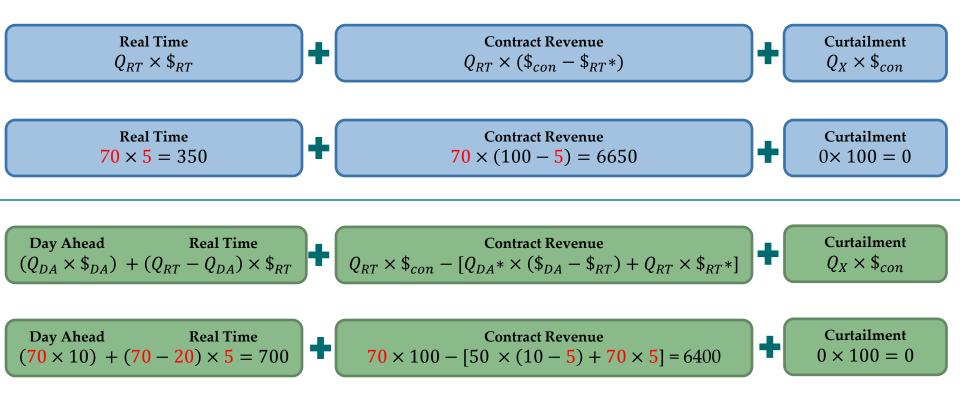
 $\begin{array}{lll} LMP \ (\$_{RT}): & \$5/MW \\ LMP \ adj. \ (\$_{RT}^*): & \$5/MW \\ IESO \ Forecast \ (F_{RT}): & 70 \ MW \\ Actual \ RT \ Production \ (Q_{RT}): & 70 \ MW \\ Curtailment \ Quantity \ (Q_x): & 0 \ MW \end{array}$ 

#### Day Ahead

 $LMP (\$_{DA}): $10/MW \\ IESO Forecast (F_{DA}): 50 MW \\ Scheduled Quantity (Q_{DA}^*): 50 MW \\ Actual Schedule (Q_{DA}): 70 MW$ 



## Scenario 17 - Calculations



Pre-MRP Total Revenue \$7,000



Post-MRP Total Revenue \$7,100



## Scenario 18 – DA Offer Quantity Increased (Deviates from IESO Forecast)

- Deviation from passive operation
- RT forecast capability is increased by 20 MW
- RT LMP is increased \$5/MW
  - Now higher than the DA LMP

#### **Real Time**

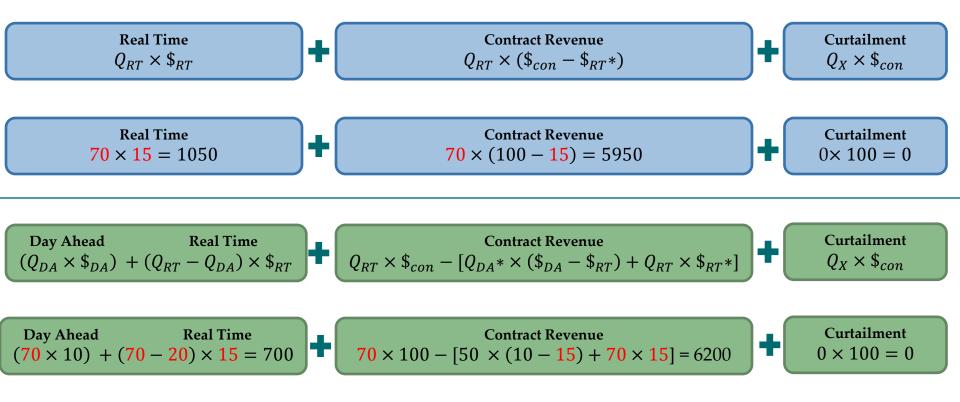
 $\begin{array}{lll} LMP \ (\$_{RT}): & \$15/MW \\ LMP \ adj. \ (\$_{RT}^*): & \$15/MW \\ IESO \ Forecast \ (F_{RT}): & 70 \ MW \\ Actual \ RT \ Production \ (Q_{RT}): & 70 \ MW \\ Curtailment \ Quantity \ (Q_x): & 0 \ MW \end{array}$ 

#### Day Ahead

 $LMP (\$_{DA}): $10/MW \\ IESO Forecast (F_{DA}): 50 MW \\ Scheduled Quantity (Q_{DA}^*): 50 MW \\ Actual Schedule (Q_{DA}): 70 MW$ 



## Scenario 18 - Calculations



Pre-MRP Total Revenue \$7,000



Post-MRP Total Revenue \$6,900

