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Independent System Operator

Hybrid Storage: Participation Examples and Energy Market Tariff Revisions for Co-located Storage Resources (CSR)

Reposted with corrections discussed at the September 22 2020 ICAPWG/MIWG meeting included in red text

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September 22, 2020; Revised 9/29/2020
WebEx

Agenda

- Project Background
- CSR participation option examples
  - Example Scenario 4
- Proposed tariff revisions to Market Administration and Control Area Services Tariff (MST)
- Next Steps
- Appendix
  - Example Scenarios 1 through 12 (except 4)

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Previous Presentations on Market Design Proposal and Tariff revisions

Date	Working Group	Discussion Points and Links to Materials
01-13-20	ICAPWG/MIWG	Hybrid Storage Model Project Kick-Off https://www.nyiso.com/documents/20142/10252714/Hybrid%20Storage%20Model_MIWG_Jan%2013%202019.pdf/caf29abe-a431-a2d1-358d-43326153824a
04-14-20	ICAPWG/MIWG	Hybrid Storage Model – Initial Market Design Concept Overview https://www.nyiso.com/documents/20142/11904936/Hybrid%20Storage%20Model%20MIWG%2004142020%20Final.pdf/08841944-5251-4497-c52b-105151f150ad
05-11-20	ICAPWG/MIWG	Hybrid Storage Interconnection Proposal https://www.nyiso.com/documents/20142/12465245/Hybrid%20Storage%20Interconnection_0511%20MIWG_ICAPWG_FINAL.pdf/0740db02-ac07-e7f4-42b4-0b17da0e82eb
06-30-20	ICAPWG/MIWG	Hybrid Storage: Proposal for participation options https://www.nyiso.com/documents/20142/13434223/Hybrid%20Storage%206.30.2020%20ICAPWG_MIWG%20draft%20v5_final.pdf/176a272a-cc21-08ef-749a-c4a157fe2bc3
07-22-20	ICAPWG/MIWG	Hybrid Storage: Energy Market Participation rules for Co-located Storage Resources https://www.nyiso.com/documents/20142/13960166/Hybrid%20Storage%20ICAPWG%20MIWG%2007.22.20%20Energy%20Market%20Rules%20%20final.pdf/89700275-108e-8002-1e44-aaffe1712f0e
07-22-20	ICAPWG/MIWG	Hybrid Storage Model: Interconnection and Capacity https://www.nyiso.com/documents/20142/13960166/Hybrid%20Storage%20Interconnection%20and%20Capacity_07222020%20MIWG_FINAL.pdf/e3ba434d-a7ac-21d2-855d-c9cb249da614

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Previous Presentations on Market Design Proposal and Tariff revisions(cont'd)

Date	Working Group	Discussion Points and Links to Materials
08-10-20	ICAPWG/MIWG	Hybrid Storage: Market Design for Co-located Storage Resources https://www.nyiso.com/documents/20142/14404876/Hybrid%20Storage%20ICAPWG%20MIWG%20081020%20final.pdf/f414f66a-eee0-3a3c-393d-6b075fe5a1ba
08-19-20	ICAPWG/MIWG	Hybrid Storage: Proposed Energy market tariff revisions for Co-located Storage Resources (CSR) https://www.nyiso.com/documents/20142/14617012/02_Hybrid%20Storage%20Energy%20tariff%20ICAPWG%20MIWG%2008.19.20%20draft%20final.pdf/a6b81cb1-fe9a-72cd-2a8f-75befefc4afa
08-19-20	ICAPWG/MIWG	Hybrid Storage: Proposed CRIS and Interconnections tariff revisions for Co-located Storage Resources (CSR) https://www.nyiso.com/documents/20142/14617012/03_Hybrid%20Storage%20Interconnection%20tariff%20ICAPWG%20MIWG%2008.19.20_FINAL.pdf/dbae9003-8314-e5c0-d0c3-55a7d6384cec
08-25-20	ICAPWG/MIWG	Hybrid Storage: Proposed Market design updates and energy market tariff revisions for Co-located Storage Resources (CSR) https://www.nyiso.com/documents/20142/14757023/Hybrid%20Storage_Market%20Design%20Updates%20%20Energy%20tariff%20ICAPWG%20MIWG%2008.25.20%20draft%20final.pdf/ffb01347-c4bd-24a1-6549-91cda42d8cb3
08-25-20	ICAPWG/MIWG	Hybrid Storage: Proposed Tariff Revisions for Co-located Storage Resources (CSR) https://www.nyiso.com/documents/20142/14757023/CSR%20ICAP%20Tariff%20Revisions.pdf/01796e6b-d1d8-ba86-9ab8-12c7bdf1d6f6
09-08-20	ICAPWG/MIWG	Hybrid Storage: Proposed Market design updates and energy market tariff revisions for Co-located Storage Resources (CSR) https://www.nyiso.com/documents/20142/15078529/Hybrid%20Storage_Market%20Design%20Updates%20%20Energy%20tariff%20ICAPWG%20MIWG%2009.08.20%20final.pdf/fcbb65d6-71d1-c1ac-52e9-8ecb6efb20f7

Project Background

A Grid in Transition – The Plan

- Carbon Pricing
- Comprehensive Mitigation Review
- DER Participation Model
- Energy Storage Participation Model
- Hybrid Storage Model

Aligning Competitive Markets and New York State Clean Energy Objectives

- Enhancing Energy & Shortage Pricing
  - Ancillary Services Shortage Pricing
  - Constraint Specific Transmission Shortage Pricing
  - Enhanced Fast Start Pricing
- Review Energy & Ancillary Services Product Design
  - More Granular Operating Reserves
  - Reserve Enhancements for Constrained Areas
  - Reserves for Resource Flexibility

Valuing Resource & Grid Flexibility

- Enhancements to Resource Adequacy Models
- Revise Resource Capacity Ratings to Reflect Reliability Contribution
  - Expanding Capacity Eligibility
  - Tailored Availability Metric
- Capacity Demand Curve Adjustments

Improving Capacity Market Valuation

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Project Background

- **This project seeks to explore market participation option(s) for co-located front-of-the-meter generators and energy storage resources**
  - Incentives along with improvements in flexibility and availability are motivating developers to couple generation resources with storage resources
- **Modifications to existing market rules will be developed to accommodate Co-Located Storage Resources (CSR) by the end of 2020**

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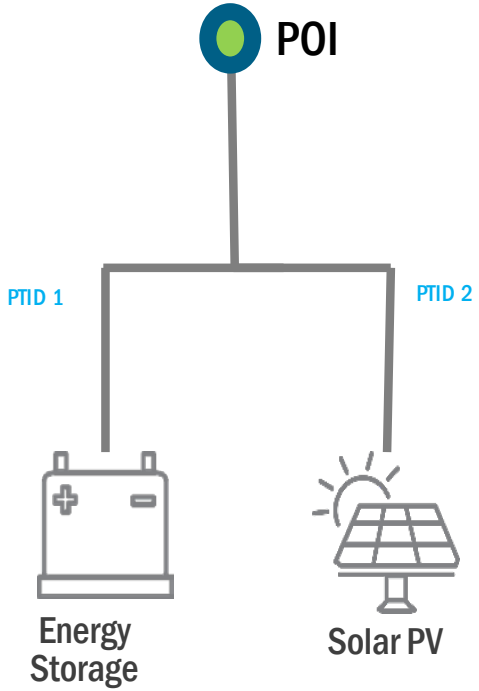
CSR Participation Examples

CSR: Market Design Overview

- Each unit within a CSR will have a distinct PTID/bid/schedule/settlement
- The NYISO proposes to require a CSR to be represented by a single Billing Organization and to have a single bidding agent
- Units will participate under their own participation model. In the illustrative example shown here, Solar PV will participate as an Intermittent Power Resource(IPR) and Energy Storage will participate under Energy Storage Resource (ESR) model
  - Only the ESR unit will be eligible to provide Reserves and Regulation
- The NYISO plans to utilize a CSR scheduling constraint to determine feasible energy and reserve schedule for units within the CSR
- All units within a CSR will be settled at the same LBMP at the Point of Injection (POI)

In today's presentation, the NYISO intends to walk through an example on how this participation option would work; additional examples are available in the Appendix



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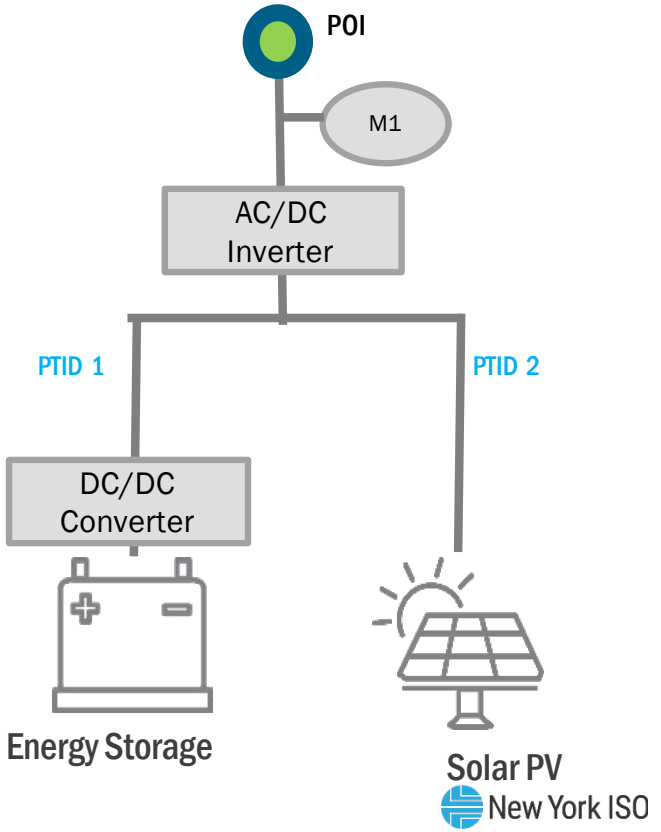
CSR Participation Examples

- **Participation Examples Scenarios**
  - Example Scenario 4 is discussed in the main presentation and other are available in Appendix):

Example Scenarios	ESR	IPR	CSR	CSR Scheduling Limit
1	Injection	Injection	Net Injection	Not Limiting
2	Injection	Injection	Net Injection	Limiting
3	Withdrawal	Injection	Net Injection	Not Limiting
4	Withdrawal	Injection	Net Injection	Limiting
5	Withdrawal	Injection	Net Withdrawal	Not Limiting
6	Withdrawal	Injection	Net Withdrawal	Limiting
7	Example 1 + Reserves and/or Regulation Schedule on ESR			
8	Example 2 + Reserves and/or Regulation Schedule on ESR			
9	Example 3 + Reserves and/or Regulation Schedule on ESR			
10	Example 4 + Reserves and/or Regulation Schedule on ESR			
11	Example 5 + Reserves and/or Regulation Schedule on ESR			
12	Example 6 + Reserves and/or Regulation Schedule on ESR			

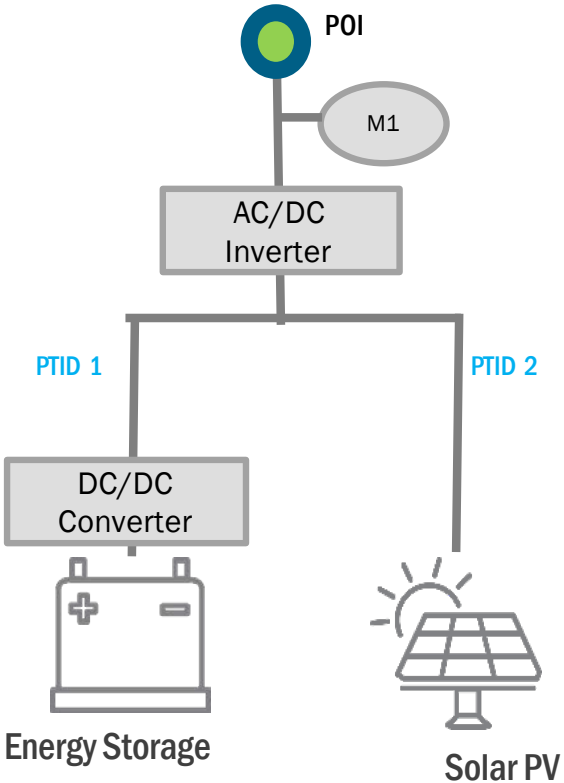
CSR Participation Examples

- **Assumptions:**
  - CSR comprised of a Solar PV and an ESR in a DC coupled configuration
  - Solar PV panel nameplate rating = 100 MW (DC)
  - ESR nameplate rating = 50 MW (DC)
  - Inverter rating = 80 MW (AC);
    - The conversion efficiency of Inverter is 95% (assumed to be constant for example purpose), both in charging and discharging mode
  - Inverter is the most limiting element in the CSR facility, so CSR facility output at POI can never exceed 80 MW



CSR Participation Examples

- **CSR units' capabilities and Scheduling Limits:**
  - CSR Units' capabilities will be limited to their equivalent AC output at the POI
  - Solar PV Capability (max AC) = PV nameplate (DC)* Inverter Efficiency = 100 *0.95 = 95 MW
  - ESR Injection Capability (max AC) = ESR nameplate (DC)* Inverter Efficiency = 50*0.95 = 47.5 MW
  - ESR Withdrawal Capability (max AC) = ESR nameplate (DC)/Inverter Efficiency = -50/0.95 = -52.6 MW
  - CSR Injection Scheduling Limit (AC) = 80 MW
  - CSR Withdrawal Scheduling Limit (AC) = - 52.6 MW



CSR Participation Examples

- **CSR Bidding:**
  - Each unit will be able to bid up to its full capability in the market
    - For the example assumptions, full capability would be
      - 95 MW for Solar PV
      - + 47.5 MW / - 52.6 MW for ESR
  - All injections/withdrawal from ESR and Solar PV should be reflected through the NYISO market

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CSR Participation Examples

CSR Scheduling

- Schedules from NYISO's market software will be based on:
  - Units' bids
  - Forecasted output for intermittent Solar PV unit,
  - Limitations imposed by CSR Injection and Withdrawal Scheduling Limits
- The schedules provided by the NYISO to CSR unit(s) will reflect their equivalent AC output at the POI
  - The MP would take into account the inverter efficiency losses and other applicable conversion losses to convert the dispatch schedule in terms of MWs on the DC side of the inverter
  - E.g.: NYISO dispatch for Solar PV (AC) = 21 MW; Inverter efficiency = 0.95; Equivalent dispatch schedule (DC)= 21/0.95 = 22.1 MW

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CSR Participation Examples

CSR Scheduling

- Scheduling assumptions/simplifications for examples:
  - Assuming low priced bids for Solar PV, their schedules are based upon their expected output and the CSR scheduling limits
  - ESR schedules are assumed to be based on its bid, CSR Scheduling limits and the System LBMP at the POI
    - The energy level constraints and inter-temporal dependencies within the look-ahead window of the dispatch run have not been included
  - If CSR injection Scheduling limit is binding and both resources are economic to inject, these examples assume that Solar PV is the more economic among of the two, so the market software will schedule Solar PV up to its full capability in the interval and limit ESR injection schedules to manage the injection limit
    - If Solar PV is economic to inject and ESR is economic to withdraw, these examples assume that market software schedules ESR to withdraw in accordance with the bid, and limit Solar PV injections, if needed, to manage the injection limit
  - When the CSR withdrawal Scheduling Limit is binding, the total of ESR and solar PV Schedules will be subjected to this limit
  - The threshold value for setting the Wind and Solar Output Limit is assumed to be 95 % of the CSR Scheduling Limit

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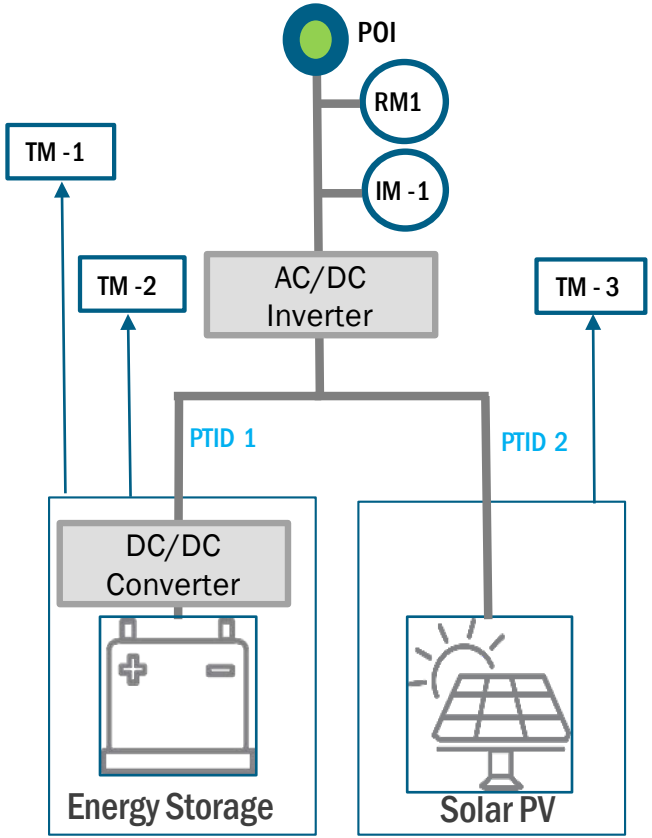
CSR Participation Examples

- ## CSR Metering and Telemetry

Meter Designation	Meter Requirements	Data flows
RM1	Revenue grade; dual – channel meter; reported by a Meter Authority	Hourly data
IM -1	Instantaneous meter	6 second aggregated output telemetry from CSR
TM - 1	SCADA data	ESR State of Charge (SOC) telemetry
TM -2	SCADA data	6-second aggregated output telemetry from ESR (telemetry should be compensated to the equivalent AC output at the POI)
TM -3	SCADA data	6 second aggregated output telemetry from Solar PV (telemetry should be compensated to the AC equivalent output at the POI)



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CSR Participation Examples

CSR Metering and Telemetry

- Hourly injection (MWh) and withdrawal (MWh) will be determined from the revenue grade meter RM1 at the POI
  - Telemetered output from POI and unit(s) will be used to determine the injections and withdrawals (MWh) for allocation to ESR and the intermittent renewable unit.
  - Adjustments to RM1 data are needed to capture the hourly injections (or withdrawals) that have not been captured due to simultaneous withdrawals (or injections) in the hour as shown in the table below

	Hourly Integrated Telemetry (MWh)
Solar PV	60
ESR Injection	30
ESR Withdrawals	-15

	Revenue Grade hourly data from RM 1 (MWh)
CSR Injections	74
CSR Withdrawals	0

RM1 would not be able to capture the ESR withdrawals as well as total injections that will be needed for settlements purposes

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CSR Participation Examples

CSR Metering and Telemetry

- To adjust for these “missing” injections and withdrawals from RM1, Adjusted Hourly Revenue data is calculated based on RM1 data and hourly integrated telemetry

	Hourly Integrated Telemetry (MWh)
Solar PV (A)	60
ESR Injection (B)	30
ESR Withdrawals (C)	-15

	Revenue Grade hourly data from RM 1 (MWh)
CSR Injections (D)	74
CSR Withdrawals (E)	0

	Adjusted Hourly revenue data	
	Calculation formula	Value (MWh)
CSR Withdrawals (F)	= min(C,E)	-15
CSR Injections (G)	= D – (F – E)	89

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CSR Participation Examples

- **CSR Metering and Telemetry**
  - CSR Injections from Adjusted Hourly Revenue data are allocated to Solar PV and ESR Injection based on proportional ratio from hourly integrated telemetry
  - CSR Withdrawals from Adjusted Hourly Revenue data are allocated to ESR Withdrawals

	Hourly Integrated Telemetry (MWh)
Solar PV (A)	60
ESR Injection (B)	30
ESR Withdrawals (C)	-15

	Adjusted hourly revenue data(MWh)
CSR Withdrawals (F)	-15
CSR Injections (G)	89

	Adjusted hourly revenue data allocation using Hourly Integrated Telemetry	
	Calculation formula	Value (MWh)
Solar PV (H)	= (A/(A+B))*G	59.3
ESR Injection (I)	= (B/(A+B))*G	29.7
ESR Withdrawals (J)	= F	-15

- Adjusted hourly revenue data for units is used in conjunction with the units' telemetered date to calculate settlement MWs for the RTD interval. The RTD 5 minute settlement MWs calculation is illustrated in the Example Scenarios slides later

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CSR Participation Examples

CSR RT Balancing Energy Market Settlement

- Adjusted MW for each RTD interval, determined using adjusted CSR hourly data and NYISO's existing real time meter data profiling process, will be used for settlements
- Assumptions/simplifications for settlement calculation for examples:
  - Settlement calculation captures Real Time (balancing) market energy settlements only and do not include any Day-Ahead schedules
  - Under-generation, over-generation or over-withdrawal charges have not been included
  - Market participation charges have not been included
  - Transmission charges that may be applicable to ESR while charging have not been included
  - The balancing energy settlements calculation reflect the current/proposed rules for Solar PV and ESR units
    - Solar PV will get paid for all output; except when Solar Output Limit is in effect. When Solar Output Limit is in effect, the Solar PV will get compensated for up to Schedules + 3% Tolerance
    - When injecting, ESR gets paid for - lesser of actual output and Schedule + 3% Tolerance
    - When withdrawing, ESR gets charged for - lesser of actual withdrawal and Withdrawal schedule + 3 % Tolerance
    - Examples do not account for scenarios including : OOM dispatch, reserve pickup, negative RT LBMP, or intervals where unit is scheduled to provide regulation service

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Example Scenario 4 :

ESR is withdrawing, Solar PV is injecting; CSR is net injecting; CSR Scheduling Limit is limiting

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Example Scenario 4 : ESR is withdrawing, Solar PV is injecting; CSR is net injecting; CSR injection Scheduling Limit is limiting

- For the examples all assumptions and inputs are in black and calculations/outputs are in blue
  - Calculated outputs are rounded up to one decimal place

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar expected output (MW)	95	95	94	93	92	94	95	95	95	94	93	92

ESR Bid						
Bid mode:	ISO committed flexible	MW	-30	-10	0	25	47.5
UOL:	47.5	$/MW	$5	$8	$10	$20	$30
LOL:	- 52.6						

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Example Scenario 4 (cont'd)

- Scheduling based on bids and Solar forecast

CSR Scheduling Injection limit (MW)	80
CSR Scheduling withdrawal limit (MW)	- 52.6

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
LBMP ($/MW)	$10	$10	$11	$12	$8	$6	$11	$12	$10	$6	$8	$10
Solar PV Schedule (MW)	85.0	85.0	80.0	80.0	92.0	94.0	80.0	80.0	85.0	94.0	93.0	85.0
ESR Energy Schedule(MW)	-5.0	-5.0	0.0	0.0	-20.0	-30.0	0.0	0.0	-5.0	-30.0	-20.0	-5.0
Total Schedules (MW)	80.0	80.0	80.0	80.0	72.0	64.0	80.0	80.0	80.0	64.0	73.0	80.0
Wind/Solar Output Limit Set	No	No	No	No	No	No	No	No	No	No	No	No

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Example Scenario 4 (cont'd)

- Metering and Telemetry

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	85.2	85.2	80.2	80.2	92.2	94.2	80.2	80.2	85.2	94.2	93.2	85.2	**86.3 (A)**
TM – 2 (ESR) Injections	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0 (B)**
TM -2 (ESR) Withdrawals	-5.1	-5.1	0.0	0.0	-20.1	-30.1	0.0	0.0	-5.1	-30.1	-20.1	-5.1	**-10.1 (C)**

Hourly Revenue Grade data (MWh)	Injections (D)	Withdrawals (E)
RM1	74.9	0.0

Adjusted hourly Revenue data (MWh)	Injections (G) = D – (F - E)	Withdrawals (F) = min (C,E)
CSR	84.9	-10.1

Adjusted hourly revenue data allocation using Telemetry data (MWh)	
Solar PV (H) = A*G/(A+B)	84.9
ESR Injection (I) = B*G/(A+B)	0.0
ESR Withdrawal (J) = F	-10.1

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Example Scenario 4 (cont'd)

- Metering and Telemetry

Adjusted hourly revenue data allocation using Hourly PTS/Telemetry metering (MWh)	
Solar PV (H)	84.9
ESR Injection (I)	0.0
ESR Withdrawal (J)	-10.1

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	85.2	85.2	80.2	80.2	92.2	94.2	80.2	80.2	85.2	94.2	93.2	85.2	**86.3 (A)**
TM – 2 (ESR) Injections	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0 (B)**
TM -2 (ESR) Withdrawals	-5.1	-5.1	0.0	0.0	-20.1	-30.1	0.0	0.0	-5.1	-30.1	-20.1	-5.1	**-10.1 (C)**
Adjusted Output using the Adjusted CSR revenue data (MW)													**Total**
Solar PV (=TM3*H/A)	83.9	83.9	78.9	78.9	90.8	92.7	78.9	78.9	83.9	92.7	91.7	83.9	84.9
ESR Injection (=TM2 injections*I/B)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESR Withdrawal (=TM2 withdrawals*J/C)	-5.1	-5.1	0.0	0.0	-20.1	-30.1	0.0	0.0	-5.1	-30.1	-20.1	-5.1	-10.1

Example Scenario 4 (cont'd)

- **RT Balancing Energy Market Settlement**
  - Solar PV will get paid for all output; except when Wind and Solar Output Limit is in effect. If Wind and Solar Output Limit is in effect, the Solar PV will get compensated for Schedules + 3% Tolerance
    - When Wind and Solar Output Limit not in effect, Solar PV settlement = Adjusted Output * LBMP
    - When Wind and Solar Output Limit not in effect, Solar PV settlement = min(Adjusted Output, RT Schedule +3% Tolerance) *LBMP
  - ESR gets paid for - lesser of Adjusted Output and Schedule + 3% Tolerance
    - ESR settlement = min (Adjusted Output, RT Schedule + 3% Tolerance)* LBMP
  - Settlement calculations are time weighted to the interval length, 5-minutes for this example

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Example Scenario 4 (cont'd)

	Timestamps											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
RT Schedules												
Solar PV Schedule (MW)	85.0	85.0	80.0	80.0	92.0	94.0	80.0	80.0	85.0	94.0	93.0	85.0
ESR Energy Schedule(MW)	-5.0	-5.0	0.0	0.0	-20.0	-30.0	0.0	0.0	-5.0	-30.0	-20.0	-5.0
Adjusted Output using the Adjusted CSR revenue data (MW)												
Solar PV	83.9	83.9	78.9	78.9	90.8	92.7	78.9	78.9	83.9	92.7	91.7	83.9
ESR Injection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESR Withdrawal	-5.1	-5.1	0.0	0.0	-20.1	-30.1	0.0	0.0	-5.1	-30.1	-20.1	-5.1
Wind/Solar Output Limit Set	No	No	No	No	No	No	No	No	No	No	No	No
RT Balancing Energy Market Settlements ($)												
LBMP ($/MW)	$10	$10	$11	$12	$8	$6	$11	$12	$10	$6	$8	$10
Solar PV	$70	$70	$72	$79	$61	$46	$72	$79	$70	$46	$61	$70
ESR	($4)	($4)	$0	$0	($13)	($15)	$0	$0	($4)	($15)	($13)	($4)

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Proposed Energy Market Tariff Revisions

Partial Set of Proposed Energy Market Tariff Revisions

- Redlined version of Tariff revisions to reflect market participation rules of CSR proposal are posted with today's meeting materials
- Tariff sheets with DER revisions have been used to draft the CSR rules
  - CSR rules are red lined
- Revisions include changes based on Stakeholder's feedback received on initial drafts at September 08, 2020 ICAPWG/MIWG
- Revised sections pertains to
  - MST 2 Definitions
  - MST 4 Market Services: Rights and Obligations
  - MST 13 Metering
  - MST 15 Rate Schedules

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MST 2 - Definitions

- **The NYISO proposes revisions to these sections**
  - 2.3
- **Proposed changes from draft presented at September 8 ICAPWG/MIWG are :**
  - Substitution of term “Generator” for “resource” in the definition of CSR
  - Wind and Solar Output Limit Rules for CSRs were moved from MST 2.23 to MST 2.3
    - To address the real-time variability of Energy deliveries from wind and solar Intermittent Power Resources that participate as Co-Located Storage Resources, when the participating Energy Storage Resource has a non-zero Regulation and/or Operating Reserves schedule or is dispatched to inject Energy, and the sum of the participating Energy Storage Resource’s and the participating wind or solar Intermittent Power Resource’s Energy, Regulation Service and Operating Reserves Schedules is greater than or equal to a specified percentage of the CSR injection Scheduling Limit, then the ISO will issue a Wind and Solar Output Limit to the Intermittent Power Resource to not exceed its Base Point Signal. The specified percentage that is ordinarily used will be posted on the ISO’s website.

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MST 4 Market Services: Rights and Obligations

- **The NYISO proposes revisions to these sections**
  - 4.2.1.3; 4.2.1.7; 4.4.1.2; 4.4.2.1
- **Proposed changes from draft presented at September 8 ICAPWG/MIWG are :**
  - Energy Storage Resource within a CSR shall not submit Day-Ahead and Real Time Market Bids that would Self-Commit the Generator to inject or to withdraw a quantity of Energy that exceeds an applicable CSR Scheduling Limit

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MST 13: Metering

- Minor revisions to metering and telemetry requirements to integrate CSRs
- NYISO also intends to make certain revisions accepted by FERC in Docket No. ER19-2276 (the NYISO's DER filing) effective at the same time as CSR
  - Revisions are to Section 13.2

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MST 15 Rate Schedules

- **The NYISO proposes revisions to these sections**
  - 15.4.2; 15.4.3
- **Proposed changes from draft presented at September 8 ICAPWG/MIWG are :**
  - The net amount of Energy that the CSR Generators are scheduled to withdraw, plus the amount of Regulation Service the Energy Storage Resource is scheduled to provide, shall not exceed the CSR withdrawal Scheduling Limit

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Next Steps

Next Steps

- The NYISO will continue to review its proposed Energy and Ancillary Services Market Tariff revisions with stakeholders as they are developed
- NYISO will return to future working groups to discuss Tariff revisions to other sections

Please submit any questions/comments to Debbie Eckels, Member Relations NYISO by September 30, 2020

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Questions?

Our mission, in collaboration with our stakeholders, is to serve the public interest and provide benefit to consumers by:

- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policymakers, stakeholders and investors in the power system

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Appendix

Example Scenario 1 :

ESR and Solar PV both injecting; CSR injection Scheduling limit is not limiting

Example Scenario 1 : ESR and Solar PV both injecting; CSR injection Scheduling limit is not limiting

- For the examples all assumptions and inputs are in black and calculations/outputs are in blue
  - Calculated outputs are rounded up to one decimal place

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar expected output (MW)	50	52	55	65	60	45	50	52	54	55	58	60

ESR Bid							
Bid mode:	ISO committed flexible	MW	-25	0	10	25	47.5
UOL:	47.5	$/MW	$5	$10	$15	$20	$30
LOL:	- 52.6						

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Example Scenario 1 (cont'd)

- Scheduling based on bids and Solar forecast

CSR Scheduling Injection limit (MW)	80
CSR Scheduling withdrawal limit (MW)	- 52.6

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
LBMP ($/MW)	$18	$19	$20	$17	$15	$16	$14	$15	$12	$18	$19	$20
Solar PV Schedule (MW)	50.0	52.0	55.0	65.0	60.0	45.0	50.0	52.0	54.0	55.0	58.0	60.0
ESR Energy Schedule(MW)	10.0	10.0	17.5	10.0	5.0	10.0	0.0	5.0	0.0	10.0	10.0	17.5
Total Schedules (MW)	60.0	62.0	72.5	75.0	65.0	55.0	50.0	57.0	54.0	65.0	68.0	77.5
Wind/Solar Output Limit Set	No	No	No	No	No	No	No	No	No	No	No	Yes

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Example Scenario 1 (cont'd)

- Metering and Telemetry

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	50.2	52.2	55.2	65.2	60.2	45.2	50.2	52.2	54.2	55.2	58.2	60.2	**54.9 (A)**
TM – 2 (ESR) Injections	9.9	9.9	17.4	9.9	4.9	9.9	0.0	4.9	0.0	9.9	9.9	17.4	**8.7 (B)**
TM -2 (ESR) Withdrawals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0 (C)**

Hourly Revenue Grade data (MWh)	Injections (D)	Withdrawals (E)
RM1	62.2	0.0

Adjusted hourly Revenue data (MWh)	Injections (G) = D – (F - E)	Withdrawals (F) = min (C,E)
CSR	62.2	0.0

Adjusted hourly revenue data allocation using Telemetry data (MWh)	
Solar PV (H) = A*G/(A+B)	53.7
ESR Injection (I) = B*G/(A+B)	8.5
ESR Withdrawal (J) = F	0

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Example Scenario 1 (cont'd)

- Metering and Telemetry

Adjusted hourly revenue data allocation using Hourly PTS/Telemetry metering (MWh)	
Solar PV (H)	53.7
ESR Injection (I)	8.5
ESR Withdrawal (J)	0

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	50.2	52.2	55.2	65.2	60.2	45.2	50.2	52.2	54.2	55.2	58.2	60.2	**54.9 (A)**
TM – 2 (ESR) Injections	9.9	9.9	17.4	9.9	4.9	9.9	0.0	4.9	0.0	9.9	9.9	17.4	**8.7 (B)**
TM -2 (ESR) Withdrawals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0 (C)**
Adjusted Output using the Adjusted CSR revenue data (MW)													**Total**
Solar PV (=TM3*H/A)	49.1	51.1	54.0	63.8	58.9	44.2	49.1	51.1	53.0	54.0	57.0	58.9	53.7
ESR Injection (=TM2 injections*I/B)	9.7	9.7	17.0	9.7	4.8	9.7	0.0	4.8	0.0	9.7	9.7	17.0	8.5
ESR Withdrawal (=TM2 withdrawals*J/C)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Example Scenario 1 (cont'd)

- **RT Balancing Energy Market Settlement**
  - Solar PV will get paid for all output; except when Wind and Solar Output Limit is in effect. If Wind and Solar Output Limit is in effect, the Solar PV will get compensated for Schedules + 3% Tolerance
    - When Do Not Exceed flag is No, Solar PV settlement = Adjusted Output * LBMP
    - When Do Not Exceed flag is Yes, Solar PV settlement = min(Adjusted Output, RT Schedule +3% Tolerance) * LBMP
  - ESR gets paid for - lesser of actual output and Schedule + 3% Tolerance
    - ESR settlement = min (Adjusted Output, RT Schedule + 3% Tolerance)* LBMP
  - Settlement calculations are time weighted to the interval length, 5-minutes for this example

	Adjusted Output using the Adjusted CSR revenue data (MW)											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar PV	49.1	51.1	54.0	63.8	58.9	44.2	49.1	51.1	53.0	54.0	57.0	58.9
ESR Injection	9.7	9.7	17.0	9.7	4.8	9.7	0.0	4.8	0.0	9.7	9.7	17.0
ESR Withdrawal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wind/Solar Output Limit Set	49.1	51.1	54.0	63.8	58.9	44.2	49.1	51.1	53.0	54.0	57.0	58.9
RT Settlements ($)												
LBMP ($/MW)	$18	$19	$20	$17	$15	$16	$14	$15	$12	$18	$19	$20
Solar PV	$74	$81	$90	$90	$74	$59	$57	$64	$53	$81	$90	$98
ESR	$15	$15	$28	$14	$6	$13	$0	$6	$0	$15	$15	$28

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Example Scenario 2 :

ESR and Solar PV both injecting; CSR injection Scheduling limit is limiting

Example Scenario 2 : ESR and Solar PV both injecting; CSR injection Scheduling limit is limiting

- For the examples all assumptions and inputs are in black and calculations/outputs are in blue
  - Calculated outputs are rounded up to one decimal place

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar expected output (MW)	50	52	55	65	60	45	50	52	54	55	58	60

ESR Bid							
Bid mode:	ISO committed flexible	MW	-25	0	10	25	47.5
UOL:	47.5	$/MW	$5	$10	$15	$20	$30
LOL:	- 52.6						

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Example Scenario 2 (cont'd)

- Scheduling based on bids and Solar forecast

CSR Scheduling Injection limit (MW)	80
CSR Scheduling withdrawal limit (MW)	- 52.6

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
LBMP ($/MW)	$32	$30	$29	$37	$40	$32	$33	$35	$20	$40	$39	$36
Solar PV Schedule (MW)	50.0	52.0	55.0	65.0	60.0	45.0	50.0	52.0	54.0	55.0	58.0	60.0
ESR Energy Schedule(MW)	30.0	28.0	25.0	15.0	20.0	35.0	30.0	28.0	17.5	25.0	22.0	20.0
Total Schedules (MW)	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	71.5	80.0	80.0	80.0
Wind/Solar Output Limit Set	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes

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Example Scenario 2 (cont'd)

- Metering and Telemetry

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	50.2	52.2	55.2	65.2	60.2	45.2	50.2	52.2	54.2	55.2	58.2	60.2	**54.9 (A)**
TM – 2 (ESR) Injections	29.9	27.9	24.9	14.9	19.9	34.9	29.9	27.9	17.4	24.9	21.9	19.9	**24.5 (B)**
TM -2 (ESR) Withdrawals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0 (C)**

Hourly Revenue Grade data (MWh)	Injections (D)	Withdrawals (E)
RM1	78.0	0.0

Adjusted hourly Revenue data (MWh)	Injections (G) = D – (F - E)	Withdrawals (F) = min (C,E)
CSR	78.0	0.0

Adjusted hourly revenue data allocation using Telemetry data (MWh)	
Solar PV (H) = A*G/(A+B)	53.9
ESR Injection (I) = B*G/(A+B)	24.1
ESR Withdrawal (J) = F	0.0

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Example Scenario 2 (cont'd)

- Metering and Telemetry

Adjusted hourly revenue data allocation using Hourly PTS/Telemetry metering (MWh)	
Solar PV (H)	53.9
ESR Injection (I)	24.1
ESR Withdrawal (J)	0.0

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	50.2	52.2	55.2	65.2	60.2	45.2	50.2	52.2	54.2	55.2	58.2	60.2	**54.9 (A)**
TM – 2 (ESR) Injections	29.9	27.9	24.9	14.9	19.9	34.9	29.9	27.9	17.4	24.9	21.9	19.9	**24.5 (B)**
TM -2 (ESR) Withdrawals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0 (C)**
Adjusted Output using the Adjusted CSR revenue data (MW)													**Total**
Solar PV (=TM3*H/A)	49.3	51.3	54.3	64.1	59.2	44.4	49.3	51.3	53.3	54.3	57.2	59.2	53.9
ESR Injection (=TM2 injections*I/B)	29.4	27.4	24.5	14.6	19.6	34.3	29.4	27.4	17.1	24.5	21.5	19.6	24.1
ESR Withdrawal (=TM2 withdrawals*J/C)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Example Scenario 2 (cont'd)

- **RT Balancing Energy Market Settlement**
  - Solar PV will get paid for all output; except when Wind and Solar Output Limit is in effect. If Wind and Solar Output Limit is in effect, the Solar PV will get compensated for Schedules + 3% Tolerance
    - When Do Not Exceed flag is No, Solar PV settlement = Adjusted Output * LBMP
    - When Do Not Exceed flag is Yes, Solar PV settlement = min(Adjusted Output, RT Schedule +3% Tolerance) * LBMP
  - ESR gets paid for - lesser of actual output and Schedule + 3% Tolerance
    - ESR settlement = min (Adjusted Output, RT Schedule + 3% Tolerance)* LBMP
  - Settlement calculations are time weighted to the interval length, 5-minutes for this example

	Adjusted Output using the Adjusted CSR revenue data (MW)											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar PV	49.3	51.3	54.3	64.1	59.2	44.4	49.3	51.3	53.3	54.3	57.2	59.2
ESR Injection	29.4	27.4	24.5	14.6	19.6	34.3	29.4	27.4	17.1	24.5	21.5	19.6
ESR Withdrawal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wind/Solar Output Limit Set	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
RT Settlements ($)												
LBMP ($/MW)	$32	$30	$29	$37	$40	$32	$33	$35	$20	$40	$39	$36
Solar PV	$132	$128	$131	$198	$197	$118	$136	$150	$89	$181	$186	$178
ESR	$78	$69	$59	$45	$65	$91	$81	$80	$29	$82	$70	$59

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Example Scenario 3 :

ESR is withdrawing, Solar PV is injecting; CSR is net injecting; CSR Scheduling limit is not limiting

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Example Scenario 3 : ESR is withdrawing, Solar PV is injecting; CSR is net injecting; CSR Scheduling limit is not limiting

- For the examples all assumptions and inputs are in black and calculations/outputs are in blue
  - Calculated outputs are rounded up to one decimal place

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar expected output (MW)	50	52	55	65	60	45	50	52	54	55	58	60

ESR Bid						
Bid mode:	ISO committed flexible	MW	-25	0	10	25	47.5
UOL:	47.5	$/MW	$5	$10	$15	$20	$30
LOL:	- 52.6						

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Example Scenario 3 (cont'd)

- Scheduling based on bids and Solar forecast

CSR Scheduling Injection limit (MW)	80
CSR Scheduling withdrawal limit (MW)	- 52.6

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
LBMP ($/MW)	$6	$8	$9	$12	$10	$6	$11	$12	$10	$6	$8	$10
Solar PV Schedule (MW)	50.0	52.0	55.0	65.0	60.0	45.0	50.0	52.0	54.0	55.0	58.0	60.0
ESR Energy Schedule(MW)	-25.0	-25.0	-25.0	0.0	-12.5	-25.0	0.0	0.0	-12.5	-25.0	-25.0	-12.5
Total Schedules (MW)	25.0	27.0	30.0	65.0	47.5	20.0	50.0	52.0	41.5	30.0	33.0	47.5
Wind/Solar Output Limit Set	No	No	No	No	No	No	No	No	No	No	No	No

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Example Scenario 3 (cont'd)

- Metering and Telemetry

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	50.2	52.2	55.2	65.2	60.2	45.2	50.2	52.2	54.2	55.2	58.2	60.2	**54.9 (A)**
TM – 2 (ESR) Injections	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0 (B)**
TM -2 (ESR) Withdrawals	-25.1	-25.1	-25.1	0.0	-12.6	-25.1	0.0	0.0	-12.6	-25.1	-25.1	-12.6	**-15.7 (C)**

Hourly Revenue Grade data (MWh)	Injections (D)	Withdrawals (E)
RM1	37.8	0.0

Adjusted hourly Revenue data (MWh)	Injections (G) = D – (F - E)	Withdrawals (F) = min (C,E)
CSR	53.5	-15.7

Adjusted hourly revenue data allocation using Telemetry data (MWh)	
Solar PV (H) = A*G/(A+B)	53.5
ESR Injection (I) = B*G/(A+B)	0
ESR Withdrawal (J) = F	-15.7

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Example Scenario 3 (cont'd)

- Metering and Telemetry

Adjusted hourly revenue data allocation using Hourly PTS/Telemetry metering (MWh)	
Solar PV (H)	53.5
ESR Injection (I)	0
ESR Withdrawal (J)	-15.7

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	50.2	52.2	55.2	65.2	60.2	45.2	50.2	52.2	54.2	55.2	58.2	60.2	**54.9 (A)**
TM – 2 (ESR) Injections	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0 (B)**
TM -2 (ESR) Withdrawals	-25.1	-25.1	-25.1	0.0	-12.6	-25.1	0.0	0.0	-12.6	-25.1	-25.1	-12.6	**-15.7 (C)**
Adjusted Output using the Adjusted CSR revenue data (MW)													**Total**
Solar PV (=TM3*H/A)	49.0	50.9	53.8	63.6	58.7	44.1	49.0	50.9	52.9	53.8	56.8	58.7	53.5
ESR Injection (=TM2 injections*I/B)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESR Withdrawal (=TM2 withdrawals*J/C)	-25.1	-25.1	-25.1	0.0	-12.6	-25.1	0.0	0.0	-12.6	-25.1	-25.1	-12.6	-15.7

Example Scenario 3 (cont'd)

- **RT Balancing Energy Market Settlement**
  - Solar PV will get paid for all output; except when Wind and Solar Output Limit is in effect. If Wind and Solar Output Limit is in effect, the Solar PV will get compensated for Schedules + 3% Tolerance
    - When Do Not Exceed flag is No, Solar PV settlement = Adjusted Output * LBMP
    - When Do Not Exceed flag is Yes, Solar PV settlement = min(Adjusted Output, RT Schedule +3% Tolerance) * LBMP
  - ESR gets paid for - lesser of actual output and Schedule + 3% Tolerance
    - ESR settlement = min (Adjusted Output, RT Schedule + 3% Tolerance)* LBMP
  - Settlement calculations are time weighted to the interval length, 5-minutes for this example

	Adjusted Output using the Adjusted CSR revenue data (MW)											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar PV	49.0	50.9	53.8	63.6	58.7	44.1	49.0	50.9	52.9	53.8	56.8	58.7
ESR Injection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESR Withdrawal	-25.1	-25.1	-25.1	0.0	-12.6	-25.1	0.0	0.0	-12.6	-25.1	-25.1	-12.6
Wind/Solar Output Limit Set	No	No	No	No	No	No	No	No	No	No	No	No
RT Settlements ($)												
LBMP ($/MW)	$6	$8	$9	$12	$10	$6	$11	$12	$10	$6	$8	$10
Solar PV	$24	$34	$40	$64	$49	$22	$45	$51	$44	$27	$38	$49
ESR	($13)	($17)	($19)	$0	($11)	($13)	$0	$0	($11)	($13)	($17)	($11)

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Example Scenario 5 :

ESR is withdrawing, Solar PV is injecting; CSR is net withdrawing; CSR Scheduling limit is not limiting

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Example Scenario 5 : ESR is withdrawing, Solar PV is injecting; CSR is net withdrawing; CSR Scheduling limit is not limiting

- For the examples all assumptions and inputs are in black and calculations/outputs are in blue
  - Calculated outputs are rounded up to one decimal place

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar expected output (MW)	2	2	5	10	4	9	7	8	9	4	6	2

ESR Bid						
Bid mode:	ISO committed flexible	MW	-30	-10	0	25	47.5
UOL:	47.5	$/MW	$5	$8	$10	$20	$30
LOL:	- 52.6						

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Example Scenario 5 (cont'd)

- Scheduling based on bids and Solar forecast

CSR Scheduling Injection limit (MW)	80
CSR Scheduling withdrawal limit (MW)	- 52.6

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
LBMP ($/MW)	$8	$8	$9	$10	$7	$5	$8	$9	$10	$7	$8	$10
Solar PV Schedule (MW)	2.0	2.0	5.0	10.0	4.0	9.0	7.0	8.0	9.0	4.0	6.0	2.0
ESR Energy Schedule(MW)	-20.0	-20.0	-10.0	-5.0	-30.0	-41.3	-20.0	-10.0	-5.0	-30.0	-20.0	-5.0
Total Schedules (MW)	-18.0	-18.0	-5.0	5.0	-26.0	-32.3	-13.0	-2.0	4.0	-26.0	-14.0	-3.0
Wind/Solar Output Limit Set	No	No	No	No	No	No	No	No	No	No	No	No

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Example Scenario 5 (cont'd)

- Metering and Telemetry

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	2.2	2.2	5.2	10.2	4.2	9.2	7.2	8.2	9.2	4.2	6.2	2.2	**5.9 (A)**
TM – 2 (ESR) Injections	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0 (B)**
TM -2 (ESR) Withdrawals	-20.1	-20.1	-10.1	-5.1	-30.1	-41.4	-20.1	-10.1	-5.1	-30.1	-20.1	-5.1	**-18.1 (C)**

Hourly Revenue Grade data (MWh)	Injections (D)	Withdrawals (E)
RM1	0	-13.6

Adjusted hourly Revenue data (MWh)	Injections (G) = D – (F - E)	Withdrawals (F) = min (C,E)
CSR	4.5	-18.1

Adjusted hourly revenue data allocation using Telemetry data (MWh)	
Solar PV (H) = A*G/(A+B)	4.5
ESR Injection (I) = B*G/(A+B)	0.0
ESR Withdrawal (J) = F	-18.1

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Example Scenario 5 (cont'd)

- Metering and Telemetry

Adjusted hourly revenue data allocation using Hourly PTS/Telemetry metering (MWh)	
Solar PV (H)	4.5
ESR Injection (I)	0.0
ESR Withdrawal (J)	-18.1

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	2.2	2.2	5.2	10.2	4.2	9.2	7.2	8.2	9.2	4.2	6.2	2.2	**5.9 (A)**
TM – 2 (ESR) Injections	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0 (B)**
TM -2 (ESR) Withdrawals	-20.1	-20.1	-10.1	-5.1	-30.1	-41.4	-20.1	-10.1	-5.1	-30.1	-20.1	-5.1	**-18.1 (C)**
Adjusted Output using the Adjusted CSR revenue data (MW)													**Total**
Solar PV (=TM3*H/A)	1.7	1.7	4.0	7.9	3.2	7.1	5.5	6.3	7.1	3.2	4.8	1.7	4.5
ESR Injection (=TM2 injections*I/B)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESR Withdrawal (=TM2 withdrawals*J/C)	-20.1	-20.1	-10.1	-5.1	-30.1	-41.4	-20.1	-10.1	-5.1	-30.1	-20.1	-5.1	-18.1

Example Scenario 5 (cont'd)

- **RT Balancing Energy Market Settlement**
  - Solar PV will get paid for all output; except when Wind and Solar Output Limit is in effect. If Wind and Solar Output Limit is in effect, the Solar PV will get compensated for Schedules + 3% Tolerance
    - When Do Not Exceed flag is No, Solar PV settlement = Adjusted Output * LBMP
    - When Do Not Exceed flag is Yes, Solar PV settlement = min(Adjusted Output, RT Schedule +3% Tolerance) * LBMP
  - ESR gets paid for - lesser of actual output and Schedule + 3% Tolerance
    - ESR settlement = min (Adjusted Output, RT Schedule + 3% Tolerance)* LBMP
  - Settlement calculations are time weighted to the interval length, 5-minutes for this example

	Adjusted Output using the Adjusted CSR revenue data (MW)											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar PV	1.7	1.7	4.0	7.9	3.2	7.1	5.5	6.3	7.1	3.2	4.8	1.7
ESR Injection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESR Withdrawal	-20.1	-20.1	-10.1	-5.1	-30.1	-41.4	-20.1	-10.1	-5.1	-30.1	-20.1	-5.1
Wind/Solar Output Limit Set	No	No	No	No	No	No	No	No	No	No	No	No
RT Settlements ($)												
LBMP ($/MW)	$8	$8	$9	$10	$7	$5	$8	$9	$10	$7	$8	$10
Solar PV	$1	$1	$3	$7	$2	$3	$4	$5	$6	$2	$3	$1
ESR	($13)	($13)	($8)	($4)	($18)	($16)	($13)	($8)	($4)	($18)	($13)	($4)

New York ISO

Example Scenario 6 :

ESR is withdrawing, Solar PV is injecting; CSR is net withdrawing; CSR Scheduling limit is limiting

New York ISO

Example Scenario 6 : ESR is withdrawing, Solar PV is injecting; CSR is net withdrawing; CSR Scheduling limit is limiting

- For the examples all assumptions and inputs are in black and calculations/outputs are in blue
  - Calculated outputs are rounded up to one decimal place

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar expected output (MW)	0	0	2	3	4	3	4	1	0.5	2	4	6

ESR Bid						
Bid mode:	ISO committed flexible	MW	-30	-10	0	25	47.5
UOL:	47.5	$/MW	$5	$8	$10	$20	$30
LOL:	- 52.6						

New York ISO

Example Scenario 6 (cont'd)

- Scheduling based on bids and Solar forecast

CSR Scheduling Injection limit (MW)	80
CSR Scheduling withdrawal limit (MW)	- 30

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
LBMP ($/MW)	$6	$3	$2	$6	$10	$6	$4	$2	$6	$6	$8	$10
Solar PV Schedule (MW)	0.0	0.0	2.0	3.0	4.0	3.0	4.0	1.0	0.5	2.0	4.0	6.0
ESR Energy Schedule(MW)	-30.0	-30.0	-30.0	-30.0	-5.0	-30.0	-30.0	-30.0	-30.0	-30.0	-20.0	-5.0
Total Schedules (MW)	-30.0	-30.0	-28.0	-27.0	-1.0	-27.0	-26.0	-29.0	-29.5	-28.0	-16.0	1.0
Wind/Solar Output Limit Set	No	No	No	No	No	No	No	No	No	No	No	No

New York ISO

Example Scenario 6 (cont'd)

- Metering and Telemetry

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	0.2	0.2	2.2	3.2	4.2	3.2	4.2	1.2	0.7	2.2	4.2	6.2	**2.7 (A)**
TM – 2 (ESR) Injections	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0 (B)**
TM -2 (ESR) Withdrawals	-30.1	-30.1	-30.1	-30.1	-5.1	-30.1	-30.1	-30.1	-30.1	-30.1	-20.1	-5.1	**-25.1 (C)**

Hourly Revenue Grade data (MWh)	Injections (D)	Withdrawals (E)
RM1	0	-23.8

Adjusted hourly Revenue data (MWh)	Injections (G) = D – (F - E)	Withdrawals (F) = min (C,E)
CSR	1.3	-25.1

Adjusted hourly revenue data allocation using Telemetry data (MWh)	
Solar PV (H) = A*G/(A+B)	1.3
ESR Injection (I) = B*G/(A+B)	0.0
ESR Withdrawal (J) = F	-25.1

New York ISO

Example Scenario 6 (cont'd)

- Metering and Telemetry

Adjusted hourly revenue data allocation using Hourly PTS/Telemetry metering (MWh)	
Solar PV (H)	1.3
ESR Injection (I)	0.0
ESR Withdrawal (J)	-25.1

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	0.2	0.2	2.2	3.2	4.2	3.2	4.2	1.2	0.7	2.2	4.2	6.2	**2.7 (A)**
TM – 2 (ESR) Injections	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0 (B)**
TM -2 (ESR) Withdrawals	-30.1	-30.1	-30.1	-30.1	-5.1	-30.1	-30.1	-30.1	-30.1	-30.1	-20.1	-5.1	**-25.1 (C)**
Adjusted Output using the Adjusted CSR revenue data (MW)													**Total**
Solar PV (=TM3*H/A)	0.1	0.1	1.1	1.6	2.1	1.6	2.1	0.6	0.3	1.1	2.1	3.1	1.3
ESR Injection (=TM2 injections*I/B)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESR Withdrawal (=TM2 withdrawals*J/C)	-30.1	-30.1	-30.1	-30.1	-5.1	-30.1	-30.1	-30.1	-30.1	-30.1	-20.1	-5.1	-25.1

Example Scenario 6 (cont'd)

- **RT Balancing Energy Market Settlement**
  - Solar PV will get paid for all output; except when Wind and Solar Output Limit is in effect. If Wind and Solar Output Limit is in effect, the Solar PV will get compensated for Schedules + 3% Tolerance
    - When Do Not Exceed flag is No, Solar PV settlement = Adjusted Output * LBMP
    - When Do Not Exceed flag is Yes, Solar PV settlement = min(Adjusted Output, RT Schedule +3% Tolerance) * LBMP
  - ESR gets paid for - lesser of actual output and Schedule + 3% Tolerance
    - ESR settlement = min (Adjusted Output, RT Schedule + 3% Tolerance)* LBMP
  - Settlement calculations are time weighted to the interval length, 5-minutes for this example

	Adjusted Output using the Adjusted CSR revenue data (MW)											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar PV	0.1	0.1	1.1	1.6	2.1	1.6	2.1	0.6	0.3	1.1	2.1	3.1
ESR Injection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESR Withdrawal	-30.1	-30.1	-30.1	-30.1	-5.1	-30.1	-30.1	-30.1	-30.1	-30.1	-20.1	-5.1
Wind/Solar Output Limit Set	No	No	No	No	No	No	No	No	No	No	No	No
RT Settlements ($)												
LBMP ($/MW)	$6	$3	$2	$6	$10	$6	$4	$2	$6	$6	$8	$10
Solar PV	$0	$0	$0	$1	$2	$1	$1	$0	$0	$1	$1	$3
ESR	($15)	($8)	($5)	($15)	($4)	($15)	($10)	($5)	($15)	($15)	($13)	($4)

New York ISO

Example Scenario 7 :

Example Scenario 1 + Reserves and/or Regulation Schedule on ESR

New York ISO

Example Scenario 7 : Example Scenario 1 + Reserves and/or Regulation Schedule on ESR

- For the examples all assumptions and inputs are in black and calculations/outputs are in blue
  - Calculated outputs are rounded up to one decimal place

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar expected output (MW)	50	52	55	65	60	45	50	52	54	55	58	60

ESR Bid							
Bid mode:	ISO committed flexible	MW	-25	0	10	25	47.5
UOL:	47.5	$/MW	$5	$10	$15	$20	$30
LOL:	- 52.6						

New York ISO

Example Scenario 7 (cont'd)

- **Scheduling based on bids and Solar forecast**
  - Reserves and/or regulation schedules are made-up values

CSR Scheduling Injection limit (MW)	80
CSR Scheduling withdrawal limit (MW)	- 52.6

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
LBMP ($/MW)	$18	$19	$20	$17	$15	$16	$14	$15	$12	$18	$19	$20
Solar PV Schedule(MW)	50.0	52.0	55.0	64.0	60.0	45.0	50.0	52.0	54.0	55.0	58.0	56.5
ESR Energy Schedule(MW)	10.0	10.0	17.5	10.0	5.0	10.0	0.0	5.0	0.0	10.0	10.0	17.5
ESR Reserves Schedule(MW)	5.0	10.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
ESR Regulation Schedule(MW)	2.0	3.0	2.0	1.0	2.0	3.0	2.0	1.0	2.0	3.0	2.0	1.0
Total Schedules (MW)	67.0	75.0	79.5	80.0	72.0	63.0	57.0	63.0	61.0	73.0	75.0	80.0
Wind/Solar Output Limit Set	No	No	Yes	Yes	No	No	No	No	No	No	No	Yes

New York ISO

Example Scenario 7 (cont'd)

- Metering and Telemetry

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	50.2	52.2	55.2	64.2	60.2	45.2	50.2	52.2	54.2	55.2	58.2	56.7	**54.5 (A)**
TM – 2 (ESR) Injections	9.9	9.9	17.4	9.9	4.9	9.9	0.0	4.9	0.0	9.9	9.9	17.4	**8.7 (B)**
TM -2 (ESR) Withdrawals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0 (C)**

Hourly Revenue Grade data (MWh)	Injections (D)	Withdrawals (E)
RM1	61.8	0

Adjusted hourly Revenue data (MWh)	Injections (G) = D – (F - E)	Withdrawals (F) = min (C,E)
CSR	61.8	0

Adjusted hourly revenue data allocation using Telemetry data (MWh)	
Solar PV (H) = A*G/(A+B)	53.3
ESR Injection (I) = B*G/(A+B)	8.5
ESR Withdrawal (J) = F	0.0

New York ISO

Example Scenario 7 (cont'd)

- Metering and Telemetry

Adjusted hourly revenue data allocation using Hourly PTS/Telemetry metering (MWh)	
Solar PV (H)	53.3
ESR Injection (I)	8.5
ESR Withdrawal (J)	0.0

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	50.2	52.2	55.2	64.2	60.2	45.2	50.2	52.2	54.2	55.2	58.2	56.7	**54.5 (A)**
TM – 2 (ESR) Injections	9.9	9.9	17.4	9.9	4.9	9.9	0.0	4.9	0.0	9.9	9.9	17.4	**8.7 (B)**
TM -2 (ESR) Withdrawals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0 (C)**
Adjusted Output using the Adjusted CSR revenue data (MW)													**Total**
Solar PV (=TM3*H/A)	49.1	51.1	54.0	62.8	58.9	44.2	49.1	51.1	53.0	54.0	57.0	55.5	53.3
ESR Injection (=TM2 injections*I/B)	9.7	9.7	17.0	9.7	4.8	9.7	0.0	4.8	0.0	9.7	9.7	17.0	8.5
ESR Withdrawal (=TM2 withdrawals*J/C)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Example Scenario 8 :

Example Scenario 2 + Reserves and/or Regulation Schedule on ESR

New York ISO

Example Scenario 8 : Example Scenario 2 + Reserves and/or Regulation Schedule on ESR

- For the examples all assumptions and inputs are in black and calculations/outputs are in blue
  - Calculated outputs are rounded up to one decimal place

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar expected output (MW)	50	52	55	65	60	45	50	52	54	55	58	60

ESR Bid							
Bid mode:	ISO committed flexible	MW	-25	0	10	25	47.5
UOL:	47.5	$/MW	$5	$10	$15	$20	$30
LOL:	- 52.6						

New York ISO

Example Scenario 8 (cont'd)

- **Scheduling based on bids and Solar forecast**
  - Reserves and/or regulation schedules are made-up values

CSR Scheduling Injection limit (MW)	80
CSR Scheduling withdrawal limit (MW)	- 52.6

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
LBMP ($/MW)	$32	$30	$29	$37	$40	$32	$33	$35	$20	$40	$39	$36
Solar PV Schedule(MW)	50.0	52.0	55.0	65.0	60.0	45.0	50.0	52.0	54.0	55.0	58.0	60.0
ESR Energy Schedule(MW)	23.0	15.0	18.0	9.0	13.0	27.0	28.0	22.0	17.5	17.0	15.0	14.0
ESR Reserves Schedule(MW)	5.0	10.0	5.0	5.0	5.0	5.0	0.0	5.0	5.0	5.0	5.0	5.0
ESR Regulation Schedule(MW)	2.0	3.0	2.0	1.0	2.0	3.0	2.0	1.0	2.0	3.0	2.0	1.0
Total Schedules (MW)	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	78.5	80.0	80.0	80.0
Wind/Solar Output Limit Set	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

New York ISO

Example Scenario 8 (cont'd)

- Metering and Telemetry

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	50.2	52.2	55.2	65.2	60.2	45.2	50.2	52.2	54.2	55.2	58.2	60.2	**54.9 (A)**
TM – 2 (ESR) Injections	22.9	14.9	17.9	8.9	12.9	26.9	27.9	21.9	17.4	16.9	14.9	13.9	**18.1 (B)**
TM -2 (ESR) Withdrawals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0 (C)**

Hourly Revenue Grade data (MWh)	Injections (D)	Withdrawals (E)
RM1	71.6	0.0

Adjusted hourly Revenue data (MWh)	Injections (G) = D – (F - E)	Withdrawals (F) = min (C,E)
CSR	71.6	0.0

Adjusted hourly revenue data allocation using Telemetry data (MWh)	
Solar PV (H) = A*G/(A+B)	53.9
ESR Injection (I) = B*G/(A+B)	17.8
ESR Withdrawal (J) = F	0.0

New York ISO

Example Scenario 8 (cont'd)

- Metering and Telemetry

Adjusted hourly revenue data allocation using Hourly PTS/Telemetry metering (MWh)	
Solar PV (H)	53.9
ESR Injection (I)	17.8
ESR Withdrawal (J)	0.0

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	50.2	52.2	55.2	65.2	60.2	45.2	50.2	52.2	54.2	55.2	58.2	60.2	**54.9 (A)**
TM – 2 (ESR) Injections	22.9	14.9	17.9	8.9	12.9	26.9	27.9	21.9	17.4	16.9	14.9	13.9	**18.1 (B)**
TM -2 (ESR) Withdrawals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0 (C)**
Adjusted Output using the Adjusted CSR revenue data (MW)													**Total**
Solar PV (=TM3*H/A)	49.3	51.2	54.2	64.0	59.1	44.4	49.3	51.2	53.2	54.2	57.1	59.1	53.9
ESR Injection (=TM2 injections*I/B)	22.5	14.6	17.6	8.7	12.7	26.4	27.4	21.5	17.1	16.6	14.6	13.6	17.8
ESR Withdrawal (=TM2 withdrawals*J/C)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Example Scenario 9 :

Example Scenario 3 + Reserves and/or Regulation Schedule on ESR

New York ISO

Example Scenario 9 : Example Scenario 3 + Reserves and/or Regulation Schedule on ESR

- For the examples all assumptions and inputs are in black and calculations/outputs are in blue
  - Calculated outputs are rounded up to one decimal place

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar expected output (MW)	50	52	55	65	60	45	50	52	54	55	58	60

ESR Bid							
Bid mode:	ISO committed flexible	MW	-25	0	10	25	47.5
UOL:	47.5	$/MW	$5	$10	$15	$20	$30
LOL:	- 52.6						

New York ISO

Example Scenario 9 (cont'd)

- **Scheduling based on bids and Solar forecast**
  - Reserves and/or regulation schedules are made-up values

CSR Scheduling Injection limit (MW)	80
CSR Scheduling withdrawal limit (MW)	- 52.6

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
LBMP ($/MW)	$6	$8	$9	$12	$10	$6	$11	$12	$10	$6	$8	$10
Solar PV Schedule(MW)	50.0	52.0	55.0	65.0	60.0	45.0	50.0	52.0	54.0	55.0	58.0	60.0
ESR Energy Schedule(MW)	-25.0	-25.0	-25.0	0.0	-12.5	-25.0	0.0	0.0	-12.5	-25.0	-25.0	-12.5
ESR Reserves Schedule(MW)	5.0	10.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
ESR Regulation Schedule(MW)	2.0	3.0	2.0	1.0	2.0	3.0	2.0	1.0	2.0	3.0	2.0	1.0
Total Schedules (MW)	32.0	40.0	37.0	71.0	54.5	28.0	57.0	58.0	48.5	38.0	40.0	53.5
Wind/Solar Output Limit Set	No	No	No	No	No	No	No	No	No	No	No	No

New York ISO

Example Scenario 9 (cont'd)

- Metering and Telemetry

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	50.2	52.2	55.2	65.2	60.2	45.2	50.2	52.2	54.2	55.2	58.2	60.2	**54.9 (A)**
TM – 2 (ESR) Injections	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0 (B)**
TM -2 (ESR) Withdrawals	-25.1	-25.1	-25.1	0.0	-12.6	-25.1	0.0	0.0	-12.6	-25.1	-25.1	-12.6	**-15.7 (C)**

Hourly Revenue Grade data (MWh)	Injections (D)	Withdrawals (E)
RM1	37.8	0

Adjusted hourly Revenue data (MWh)	Injections (G) = D – (F - E)	Withdrawals (F) = min (C,E)
CSR	53.8	-15.7

Adjusted hourly revenue data allocation using Telemetry data (MWh)	
Solar PV (H) = A*G/(A+B)	53.5
ESR Injection (I) = B*G/(A+B)	0.0
ESR Withdrawal (J) = F	-15.7

New York ISO

Example Scenario 9 (cont'd)

- Metering and Telemetry

Adjusted hourly revenue data allocation using Hourly PTS/Telemetry metering (MWh)	
Solar PV (H)	53.5
ESR Injection (I)	0.0
ESR Withdrawal (J)	-15.7

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	50.2	52.2	55.2	65.2	60.2	45.2	50.2	52.2	54.2	55.2	58.2	60.2	**54.9 (A)**
TM – 2 (ESR) Injections	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0 (B)**
TM -2 (ESR) Withdrawals	-25.1	-25.1	-25.1	0.0	-12.6	-25.1	0.0	0.0	-12.6	-25.1	-25.1	-12.6	**-15.7 (C)**
Adjusted Output using the Adjusted CSR revenue data (MW)													**Total**
Solar PV (=TM3*H/A)	49.0	50.9	53.8	63.6	58.7	44.1	49.0	50.9	52.9	53.8	56.8	58.7	53.5
ESR Injection (=TM2 injections*I/B)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESR Withdrawal (=TM2 withdrawals*J/C)	-25.1	-25.1	-25.1	0.0	-12.6	-25.1	0.0	0.0	-12.6	-25.1	-25.1	-12.6	-15.7

Example Scenario 10 :

Example Scenario 4 + Reserves and/or Regulation Schedule on ESR

New York ISO

Example Scenario 10 : Example Scenario 4 + Reserves and/or Regulation Schedule on ESR

- For the examples all assumptions and inputs are in black and calculations/outputs are in blue
  - Calculated outputs are rounded up to one decimal place

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar expected output (MW)	95	95	94	93	92	94	95	95	95	94	93	92

ESR Bid							
Bid mode:	ISO committed flexible	MW	-30	-10	0	25	47.5
UOL:	47.5	$/MW	$5	$10	$15	$20	$30
LOL:	- 52.6						

New York ISO

Example Scenario 10 (cont'd)

- **Scheduling based on bids and Solar forecast**
  - Reserves and/or regulation schedules are made-up values

CSR Scheduling Injection limit (MW)	80
CSR Scheduling withdrawal limit (MW)	- 52.6

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
LBMP ($/MW)	$10	$10	$11	$12	$8	$6	$11	$12	$10	$6	$8	$10
Solar PV Schedule(MW)	78.0	72.0	73.0	74.0	92.0	94.0	73.0	74.0	78.0	94.0	93.0	79.0
ESR Energy Schedule(MW)	-5.0	-5.0	0.0	0.0	-20.0	-30.0	0.0	0.0	-5.0	-30.0	-20.0	-5.0
ESR Reserves Schedule(MW)	5.0	10.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
ESR Regulation Schedule(MW)	2.0	3.0	2.0	1.0	2.0	3.0	2.0	1.0	2.0	3.0	2.0	1.0
Total Schedules (MW)	80.0	80.0	80.0	80.0	79.0	72.0	80.0	80.0	80.0	72.0	80.0	80.0
Wind/Solar Output Limit Set	No	No	No	No	No	No	No	No	No	No	No	No

New York ISO

Example Scenario 10 (cont'd)

- Metering and Telemetry

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	78.2	72.2	73.2	74.2	92.2	94.2	73.2	74.2	78.2	94.2	93.2	79.2	**81.4 (A)**
TM – 2 (ESR) Injections	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0 (B)**
TM -2 (ESR) Withdrawals	-5.1	-5.1	0.0	0.0	-20.1	-30.1	0.0	0.0	-5.1	-30.1	-20.1	-5.1	**-10.1 (C)**

Hourly Revenue Grade data (MWh)	Injections (D)	Withdrawals (E)
RM1	70.0	0.0

Adjusted hourly Revenue data (MWh)	Injections (G) = D – (F - E)	Withdrawals (F) = min (C,E)
CSR	80.0	-10.1

Adjusted hourly revenue data allocation using Telemetry data (MWh)	
Solar PV (H) = A*G/(A+B)	80.0
ESR Injection (I) = B*G/(A+B)	0.0
ESR Withdrawal (J) = F	-10.1

New York ISO

Example Scenario 10 (cont'd)

- Metering and Telemetry

Adjusted hourly revenue data allocation using Hourly PTS/Telemetry metering (MWh)	
Solar PV (H)	80.0
ESR Injection (I)	0.0
ESR Withdrawal (J)	-10.1

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	78.2	72.2	73.2	74.2	92.2	94.2	73.2	74.2	78.2	94.2	93.2	79.2	**81.4 (A)**
TM – 2 (ESR) Injections	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0 (B)**
TM -2 (ESR) Withdrawals	-5.1	-5.1	0.0	0.0	-20.1	-30.1	0.0	0.0	-5.1	-30.1	-20.1	-5.1	**-10.1 (C)**
Adjusted Output using the Adjusted CSR revenue data (MW)													**Total**
Solar PV (=TM3*H/A)	76.9	71.0	72.0	73.0	90.7	92.6	72.0	73.0	76.9	92.6	91.7	77.9	80.0
ESR Injection (=TM2 injections*I/B)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESR Withdrawal (=TM2 withdrawals*J/C)	-5.1	-5.1	0.0	0.0	-20.1	-30.1	0.0	0.0	-5.1	-30.1	-20.1	-5.1	-10.1

Example Scenario 11 :

Example Scenario 5 + Reserves and/or Regulation Schedule on ESR

New York ISO

Example Scenario 11 : Example Scenario 5 + Reserves and/or Regulation Schedule on ESR

- For the examples all assumptions and inputs are in black and calculations/outputs are in blue
  - Calculated outputs are rounded up to one decimal place

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar expected output (MW)	2	2	5	10	4	9	7	8	9	4	6	2

ESR Bid						
Bid mode:	ISO committed flexible	MW	-30	-10	0	25	47.5
UOL:	47.5	$/MW	$5	$10	$15	$20	$30
LOL:	- 52.6						

New York ISO

Example Scenario 11 (cont'd)

- **Scheduling based on bids and Solar forecast**
  - Reserves and/or regulation schedules are made-up values

CSR Scheduling Injection limit (MW)	80
CSR Scheduling withdrawal limit (MW)	- 52.6

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
LBMP ($/MW)	$8	$8	$9	$10	$7	$5	$8	$9	$10	$7	$8	$10
Solar PV Schedule(MW)	2.0	2.0	5.0	10.0	4.0	9.0	7.0	8.0	9.0	4.0	6.0	2.0
ESR Energy Schedule(MW)	-20.0	-20.0	-10.0	-5.0	-30.0	-41.3	-20.0	-10.0	-5.0	-30.0	-20.0	-5.0
ESR Reserves Schedule(MW)	5.0	10.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
ESR Regulation Schedule(MW)	2.0	3.0	2.0	1.0	2.0	3.0	2.0	1.0	2.0	3.0	2.0	1.0
Total Schedules (MW)	-11.0	-5.0	2.0	11.0	-19.0	-24.3	-6.0	4.0	11.0	-18.0	-7.0	3.0
Wind/Solar Output Limit Set	No	No	No	No	No	No	No	No	No	No	No	No

New York ISO

Example Scenario 11 (cont'd)

- Metering and Telemetry

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	2.2	2.2	5.2	10.2	4.2	9.2	7.2	8.2	9.2	4.2	6.2	2.2	**5.9 (A)**
TM – 2 (ESR) Injections	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0 (B)**
TM -2 (ESR) Withdrawals	-20.1	-20.1	-10.1	-5.1	-30.1	-41.4	-20.1	-10.1	-5.1	-30.1	-20.1	-5.1	**-18.1 (C)**

Hourly Revenue Grade data (MWh)	Injections (D)	Withdrawals (E)
RM1	0	- 13.6

Adjusted hourly Revenue data (MWh)	Injections (G) = D – (F - E)	Withdrawals (F) = min (C,E)
CSR	4.5	-18.1

Adjusted hourly revenue data allocation using Telemetry data (MWh)	
Solar PV (H) = A*G/(A+B)	4.5
ESR Injection (I) = B*G/(A+B)	0.0
ESR Withdrawal (J) = F	-18.1

New York ISO

Example Scenario 11 (cont'd)

- Metering and Telemetry

Adjusted hourly revenue data allocation using Hourly PTS/Telemetry metering (MWh)	
Solar PV (H)	4.5
ESR Injection (I)	0.0
ESR Withdrawal (J)	-18.1

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	2.2	2.2	5.2	10.2	4.2	9.2	7.2	8.2	9.2	4.2	6.2	2.2	**5.9 (A)**
TM – 2 (ESR) Injections	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0 (B)**
TM -2 (ESR) Withdrawals	-20.1	-20.1	-10.1	-5.1	-30.1	-41.4	-20.1	-10.1	-5.1	-30.1	-20.1	-5.1	**-18.1 (C)**
Adjusted Output using the Adjusted CSR revenue data (MW)													**Total**
Solar PV (=TM3*H/A)	1.7	1.7	4.0	7.9	3.2	7.1	5.5	6.3	7.1	3.2	4.8	1.7	4.5
ESR Injection (=TM2 injections*I/B)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESR Withdrawal (=TM2 withdrawals*J/C)	-20.1	-20.1	-10.1	-5.1	-30.1	-41.4	-20.1	-10.1	-5.1	-30.1	-20.1	-5.1	-18.1

Example Scenario 12:

Example Scenario 6 + Reserves and/or Regulation Schedule on ESR

New York ISO

Example Scenario 12 : Example Scenario 6 + Reserves and/or Regulation Schedule on ESR

- For the examples all assumptions and inputs are in black and calculations/outputs are in blue
  - Calculated outputs are rounded up to one decimal place

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
Solar expected output (MW)	0	0	2	3	4	3	4	1	0.5	2	4	6

ESR Bid							
Bid mode:	ISO committed flexible	MW	-30	-10	0	25	47.5
UOL:	47.5	$/MW	$5	$10	$15	$20	$30
LOL:	- 52.6						

New York ISO

Example Scenario 12 (cont'd)

- **Scheduling based on bids and Solar forecast**
  - Reserves and/or regulation schedules are made-up values

CSR Scheduling Injection limit (MW)	80
CSR Scheduling withdrawal limit (MW)	- 30

	Timestamp											
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55
LBMP ($/MW)	$8	$8	$9	$10	$7	$5	$8	$9	$10	$7	$8	$10
Solar PV Schedule(MW)	0.0	0.0	2.0	3.0	4.0	3.0	4.0	1.0	0.5	2.0	4.0	6.0
ESR Energy Schedule(MW)	-30.0	-43.0	-39.0	-30.0	-5.0	-30.0	-41.0	-37.0	-30.0	-30.0	-20.0	-5.0
ESR Reserves Schedule(MW)	5.0	10.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
ESR Regulation Schedule(MW)	2.0	3.0	2.0	1.0	2.0	3.0	2.0	1.0	2.0	3.0	2.0	1.0
Total Schedules (MW)	-23.0	-30.0	-30.0	-21.0	6.0	-19.0	-30.0	-30.0	-22.5	-20.0	-9.0	7.0
Wind/Solar Output Limit Set	No	No	No	No	No	No	No	No	No	No	No	No

New York ISO

Example Scenario 12 (cont'd)

- Metering and Telemetry

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	0.2	0.2	2.2	3.2	4.2	3.2	4.2	1.2	0.7	2.2	4.2	6.2	**2.7 (A)**
TM – 2 (ESR) Injections	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0 (B)**
TM -2 (ESR) Withdrawals	-30.1	-52.7	-52.7	-30.1	-5.1	-30.1	-52.7	-52.7	-30.1	-30.1	-20.1	-5.1	**-32.6 (C)**

Hourly Revenue Grade data (MWh)	Injections (D)	Withdrawals (E)
RM1	0.0	- 31.3

Adjusted hourly Revenue data (MWh)	Injections (G) = D – (F - E)	Withdrawals (F) = min (C,E)
CSR	1.3	- 32.6

Adjusted hourly revenue data allocation using Telemetry data (MWh)	
Solar PV (H) = A*G/(A+B)	1.3
ESR Injection (I) = B*G/(A+B)	0.0
ESR Withdrawal (J) = F	-32.6

New York ISO

Example Scenario 12 (cont'd)

- Metering and Telemetry

Adjusted hourly revenue data allocation using Hourly PTS/Telemetry metering (MWh)	
Solar PV (H)	1.3
ESR Injection (I)	0.0
ESR Withdrawal (J)	-32.6

	Telemetered Output (MW)												Integrated Hourly Telemetry (MWh)
	:00	:05	:10	:15	:20	:25	:30	:35	:40	:45	:50	:55	
TM – 3 (PV)	0.2	0.2	2.2	3.2	4.2	3.2	4.2	1.2	0.7	2.2	4.2	6.2	**2.7 (A)**
TM – 2 (ESR) Injections	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0 (B)**
TM -2 (ESR) Withdrawals	-30.1	-52.7	-52.7	-30.1	-5.1	-30.1	-52.7	-52.7	-30.1	-30.1	-20.1	-5.1	**-32.6 (C)**
Adjusted Output using the Adjusted CSR revenue data (MW)													**Total**
Solar PV (=TM3*H/A)	0.1	0.1	1.1	1.6	2.1	1.6	2.1	0.6	0.3	1.1	2.1	3.1	1.3
ESR Injection (=TM2 injections*I/B)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESR Withdrawal (=TM2 withdrawals*J/C)	-30.1	-52.7	-52.7	-30.1	-5.1	-30.1	-52.7	-52.7	-30.1	-30.1	-20.1	-5.1	-32.6