

**Disclaimer for Customer Training:** ISO New England (ISO) provides training to enhance participant and stakeholder understanding. Not all issues and requirements are addressed by the training. Consult the effective [Transmission, Markets and Services Tariff](#) and the relevant [Market Manuals](#), [Operating Procedures](#) and [Planning Procedures](#) for detailed information. In case of a discrepancy between training provided by ISO and the Tariff or Procedures, the meaning of the Tariff and Procedures shall govern.



*Presentation updated on 4/8/2022;  
impacted slides are 23 and 27.*

April 2020  
Webex

# Market Participation Options for Combined Intermittent/Electric Storage Facilities

*FCM Resource and Energy/Reserve/Regulation Asset Registration Configuration Options*

**Shahab Rastegar**

Engineer, Resource Qualification

**Doug Smith**

Technical Manager, Market and Resource Administration



# Acronyms Used in Today's Presentation

Acronym	Term
AC	Alternating current
AGC	Automatic Generation Control
ATRR	Alternative technology regulation resource
CSF	Continuous storage facility
CSO	Capacity Supply Obligation
DARD	Dispatchable asset-related demand
DC	Direct current
DDP	Desired dispatch point
DNE	Do Not Exceed
FCM	Forward Capacity Market
PV	Photovoltaic
QC	Qualified capacity
SCC	Seasonal claimed capability
SOG	Settlement Only Generator
SOI	Show of Interest

# Disclaimer

- Extensive participation of facilities that are comprised of both storage and intermittent generation is a new phenomenon in the New England markets. As the ISO and Market Participants gain experience with the logistical, operational, and economic considerations of such facilities, the rules governing co-located facility participation are likely to evolve. The ISO intends to work closely with Market Participants to gather feedback on all aspects of the existing constructs, which will facilitate the evaluation of their effectiveness and may eventually lead to further changes in Governing Documents and enhancement or elimination of existing participation options.
- The ISO believes that the options described herein are consistent with the currently effective [Transmission, Markets, and Services Tariff](#), though for the reasons described above, the Tariff may not describe these options specifically or in detail (as is the case with numerous other areas of the Tariff). As always, in the event of a conflict between the Tariff and any presentation such as this, the Tariff governs, and it is the Market Participant's responsibility to understand the applicable provisions of the Tariff.

# Objectives

## This training:

- Describes the current participation options for storage devices co-located with intermittent generation
- Summarizes the available operating configurations for co-located facilities, given the ISO's current Governing Documents and software systems
- Provides observations on each option for Participant consideration

This presentation **does not** address co-located storage and generation at end-use customer facilities, which can participate in New England markets as part of a(n):

- On-Peak Demand Resource
- Seasonal Peak Demand Resource
- Demand Response Resource

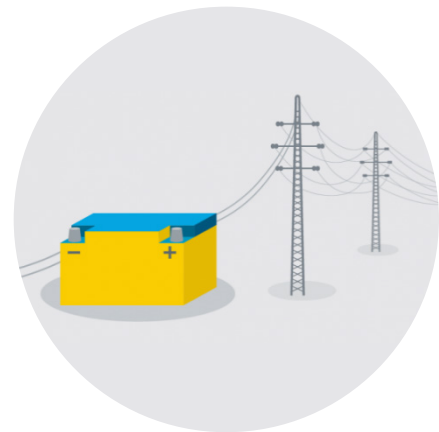
Storage



*Note: We refer to the electric storage component of a co-located facility as a “battery” in this presentation for simplicity. It need not be a battery.*

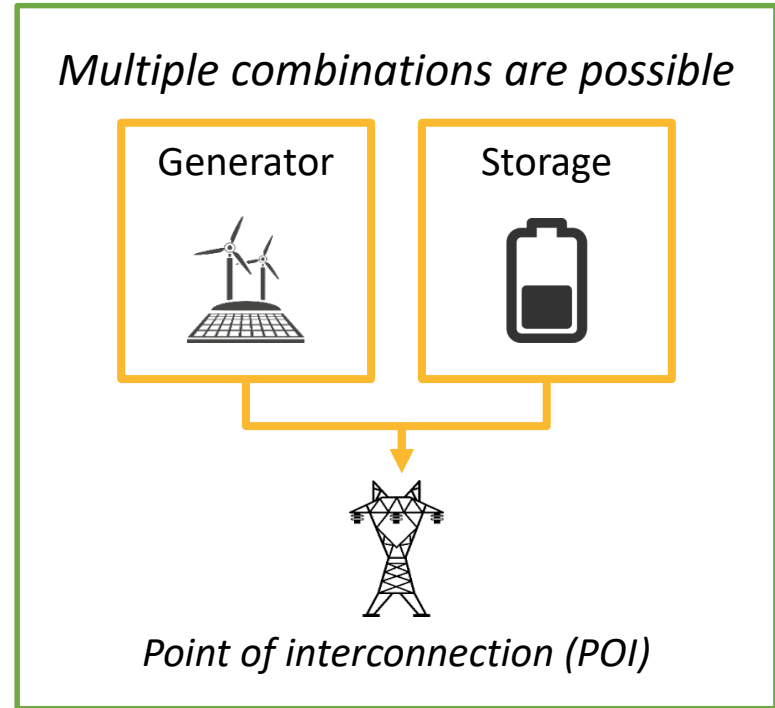
# Contents

- FCM Participation Options
  - As two FCM resources (with & without facility constraint)
  - As a single FCM resource (non-intermittent or intermittent)
- Energy Market Participation Options
  - As two separate assets
    - Storage device as one asset; intermittent generator as another
    - Continuous Storage Facility (CSF) reserves issue
    - DC vs AC coupled
  - As a single “hybrid” asset
- Observations
- Summary of Options



# What do we mean by co-located facilities?

- Storage and generator devices share the same point of interconnection with the electric grid
- There may or may not be a shared constraint that limits the maximum output of the facility to a level below the sum of each component's capability
- Facility characteristics and the participation option selected will determine which wholesale market services a co-located facility can provide



# Generating Capacity Resources Vs. Registered Assets

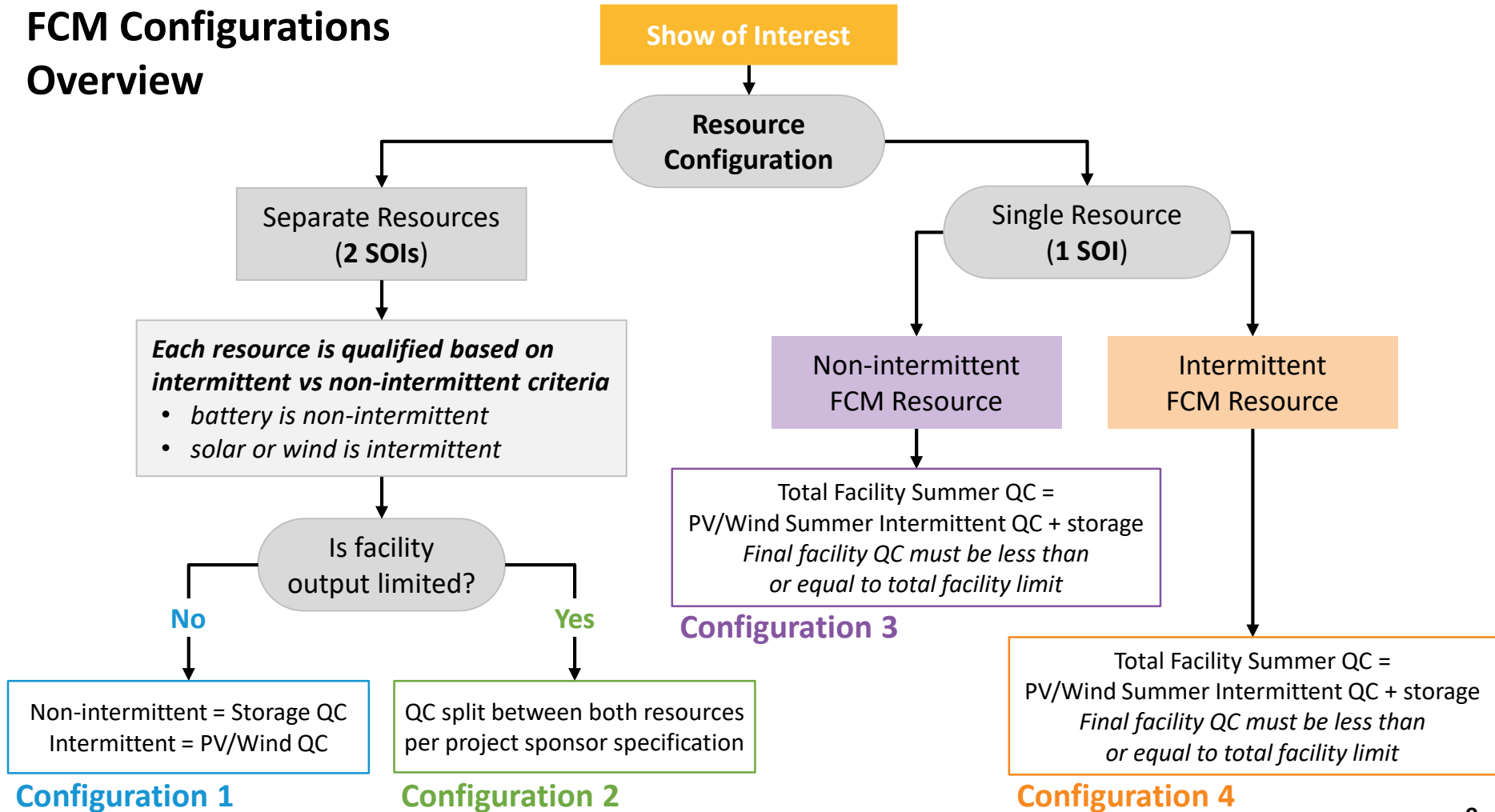
## *Market Structure and Terminology Review*

- **Generating Capacity Resources participate in the Forward Capacity Market**
  - These **resources** must be associated with one or more **assets** that participate in the energy market
  - Capacity for the resource is delivered by its associated assets in the form of energy and/or reserves
  - Generating Capacity Resources may be qualified as intermittent or non-intermittent
- **Assets participating in the energy market as generators may or may not be associated with Generating Capacity Resources**
  - Generator asset types include settlement only generators, dispatchable generators, non-dispatchable generators, and DNE dispatchable generators
  - A CSF consists of a dispatchable generator (for output), dispatchable asset related demand (for input), and an ATRR
- **In this presentation, “resource” will refer to the Generating Capacity Resource participating in the FCM, and “asset” will refer to the generator asset participating in the energy market**

# Forward Capacity Market (FCM) Participation



# FCM Configurations Overview



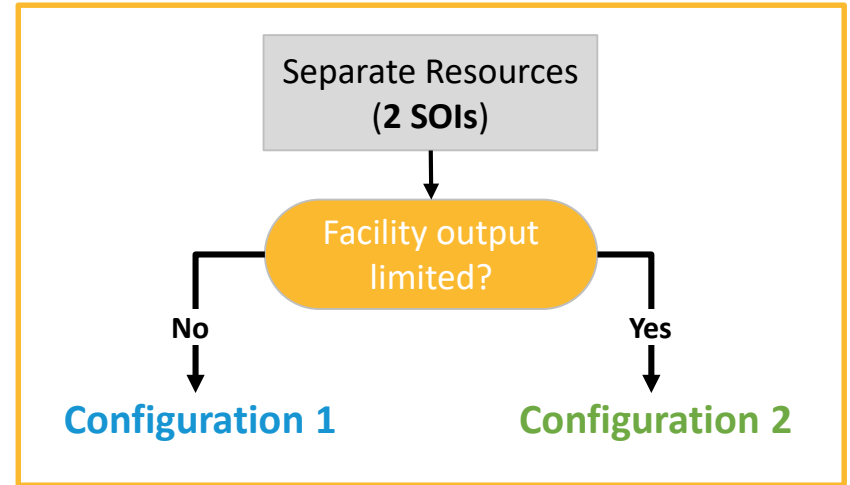
# Co-located facility qualifies as two separate FCM resources

*Configuration 1 & Configuration 2*

# Two FCM Resources

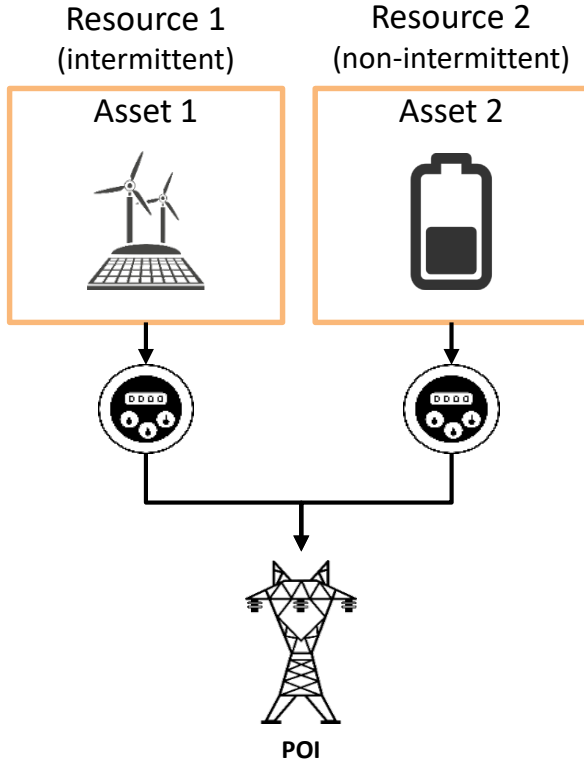
- Co-located facility qualifies as two separate FCM resources:
  1. Battery component qualifies in FCM as non-intermittent Generating Capacity Resource
    - Registered in energy market as CSF or Settlement Only Generator
  2. Intermittent component qualifies in FCM as Intermittent Power Resource
    - Registered in energy market as Settlement Only Generator, non-dispatchable PV, or DNE dispatchable generator
- Is there a facility limitation?

*Note: Settlement Only Generator qualification is an option only for facilities with a combined output below 5 MW and connected below 115 kV.*



# Two FCM Resources With No Facility Limitation

## Qualified Capacity (*Configuration #1*)



### Intermittent (Solar)

Solar AC Nameplate: Example - 10 MW

- Solar qualified as intermittent FCM Resource
- Intermittent data submitted with the New Capacity Qualification Package is used to determine qualified capacity
- Solar Summer Qualified Capacity (QC) = ~4.0 MW
- Solar Winter QC = 0.0 MW



### Battery

Usable AC Energy: Example - 3 MWh

Max AC Discharge Rate: Example - 1.5 MW

- Battery qualified as non-intermittent FCM Resource
- Battery QC =  $\text{Min}(\text{Max AC Discharge Rate}, \text{Useable Energy}/2) = 1.5 \text{ MW}$

### Summer QC

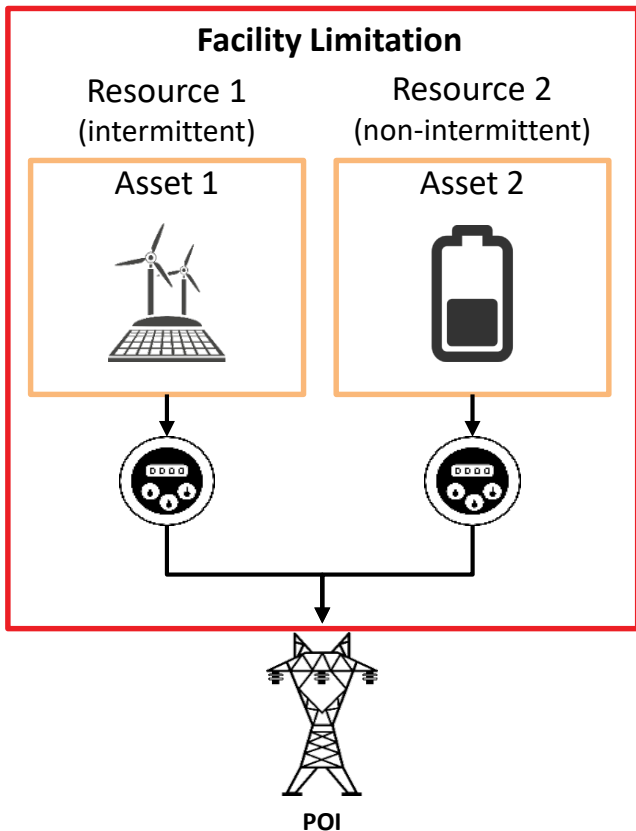
- Battery will be issued a QC of 1.5 MW
- Solar will be issued a QC of 4.0 MW

### Winter QC

- Battery will be issued a QC of 1.5 MW
- Solar will be issued a QC of 0 MW

# Two FCM Resources With Facility Limitation

## Qualified Capacity (*Configuration #2*)



### Intermittent (Solar)

Solar AC Nameplate: 10 MW  
Solar Summer QC = ~4.0 MW

### Facility Output Limitation

*Total facility limitation = 3 MW*



### Battery

Usable AC Energy: 3 MWh  
Max AC Discharge Rate: 1.5 MW

- Battery QC =  $\text{Min}(\text{Max AC Discharge Rate}, \text{Usable Energy}/2) = 1.5 \text{ MW}$

### Total Facility QC can not exceed Total Facility Limitation

### Project Sponsor will select how to allocate the QC:

- Summer QC (example allocation)
  - Battery issued a QC of 1.0 MW
  - Solar issued a QC of 2.0 MW
- Winter QC
  - Battery issued a QC of 1.5 MW
  - Solar issued a QC of 0 MW

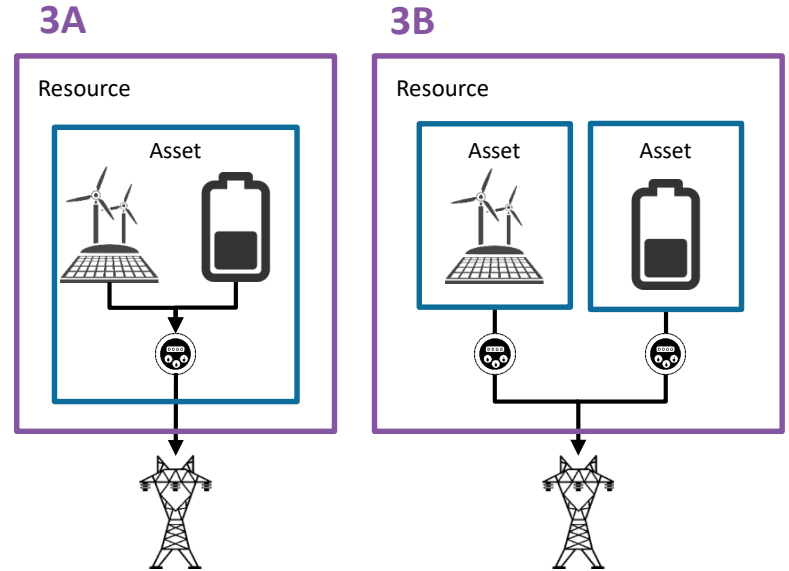
# Co-located facility qualifies as a single FCM resource

*Configuration 3 & Configuration 4*

# Single FCM Resource (*Configuration #3*)

## *Non-intermittent Generating Capacity Resource*

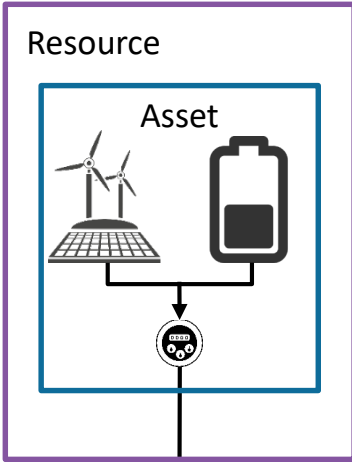
- Co-located facility qualifies in the FCM as a single *non-intermittent* Generating Capacity Resource
- Facility may register in energy market as either
  - A single non-intermittent “hybrid” asset (*Configuration #3A*)
    - CSF or Settlement Only Generator
  - Two separate assets (*Configuration #3B*)
    - Battery component as
      - CSF
      - Settlement Only Generator
    - Intermittent component as
      - Settlement Only Generator
      - non-dispatchable PV
      - DNE dispatchable



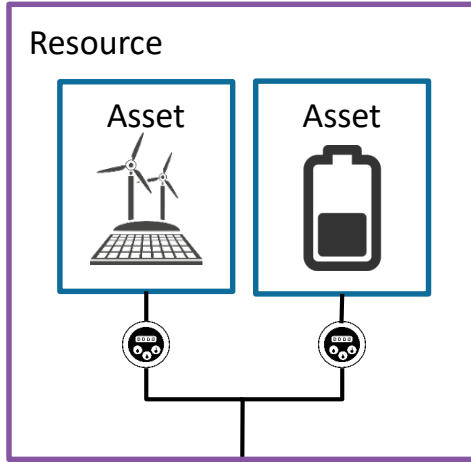
# Single Non-Intermittent Generating Capacity Resource

Qualified Capacity (Configuration #3)

## 3A



## 3B



### Intermittent (Solar)

Solar AC Nameplate: 10 MW

Solar QC = ~4.0 MW



### Battery

Usable AC Energy: 3 MWh

Max AC Discharge Rate: 1.5 MW

Battery QC = 1.5 MW

### Facility Limitation

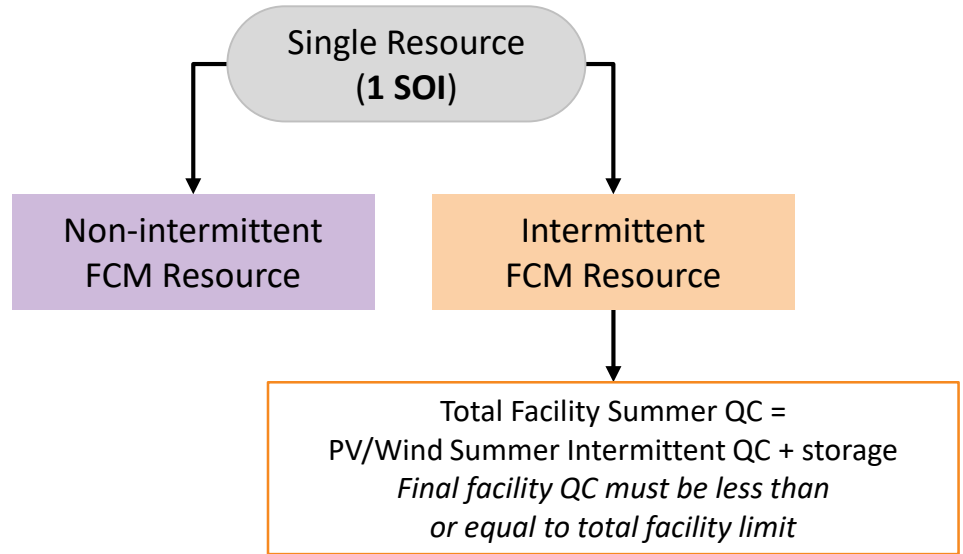
*Total facility limitation = 5.5 MW*

- Facility qualified as non-intermittent
- Total facility Summer QC = Intermittent QC + [Min(Max AC Discharge Rate, Usable Energy/2)]
- Total facility Summer QC = 4.0 + 1.5
- Total Facility Summer QC = 5.5 MW (but could not be above any facility constraint)
- Total Facility Winter QC = Battery QC = 1.5 MW



# Single Intermittent Power Resource (*Configuration #4*)

- Co-located facility qualifies in the FCM as *a single* Intermittent Power Resource
- Facility must be predominately intermittent
- Facility registers in energy market a single intermittent “hybrid” asset
  - Settlement Only Generator
  - Non-dispatchable PV
  - DNE dispatchable

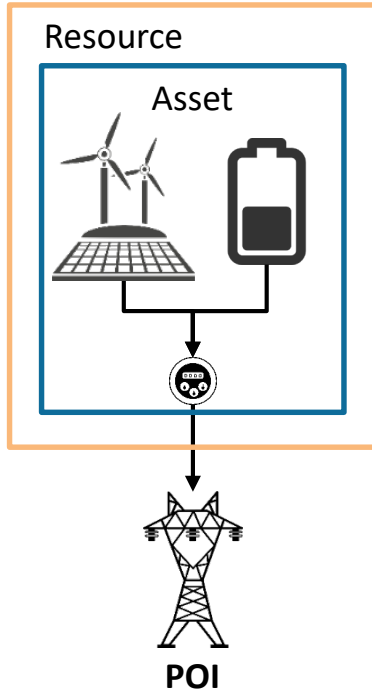


**Configuration 4**

# Single Intermittent Power Resource

## Qualified Capacity (*Configuration #4*)

The intermittent component is the predominant portion of the asset



### Intermittent (Solar)

Solar AC Nameplate: 10 MW

Solar QC = ~4.0 MW



### Battery

Usable AC Energy: 3 MWh

Max AC Discharge Rate: 1.5 MW

Battery QC = 1.5 MW

### Facility Limitation

*Total facility limitation = 3 MW*

- Facility qualified as intermittent
- Total facility Summer QC = Intermittent QC + [Min(Max AC Discharge Rate, Useable Energy/2)]
- Total facility Summer QC = 4.0 + 1.5 = 5.5 MW (if no facility limitation)
- Total facility Summer QC = 3 MW (due to facility limitation)
- Total Facility Winter QC = Battery QC = 1.5 MW

# Energy Market Registration Options

*Note: FCM Participation is Not Required to Participate in Energy and/or Ancillary Service Markets*

Co-located devices register as *two separate* Energy Market assets

# Asset Registration Options For Intermittent Component

Configuration 1, Configuration 2, and Configuration 3B

Co-located devices registering as two separate Energy Market assets

## Intermittent component may register as:

Option	Applies to	Notes
Settlement Only Generator*	Any, if facility is eligible	<ul style="list-style-type: none"><li>No telemetry required</li><li>Participates in Real-Time Energy Market as price taker</li><li>Cannot provide reserves or regulation</li></ul>
Non-dispatchable generator	PV	} <ul style="list-style-type: none"><li>Telemetry required</li><li>Participates in Day-Ahead and Real-Time Energy Markets</li><li>Cannot provide reserves or regulation</li></ul>
DNE dispatchable generator	Wind, intermittent hydro	

\* Option only for facilities with a combined output below 5 MW and connected below 115 kV

# Asset Registration Options For Battery Component

Configuration 1, Configuration 2, and Configuration 3B

Co-located devices registering as two separate Energy Market assets

## Non-intermittent component may participate as:

Option	Notes
Settlement Only Generator	<ul style="list-style-type: none"><li>• No telemetry required</li><li>• Participates in Real-Time Energy Market as price taker</li><li>• Cannot provide reserves</li><li>• May also be registered as an ATRR and provide regulation, with required telemetry</li></ul>
Continuous Storage Facility	<ul style="list-style-type: none"><li>• Telemetry required, AGC SetPoint/DDP for battery only</li><li>• Participates in Day-Ahead and Real-Time Energy Markets</li><li>• Eligible to provide reserves* and regulation</li></ul>

*\* Caveat: With current systems, cannot be designated for reserves in cases where there is a common limiting element (see slides 24-25)*

# Separate Energy Market Assets

*DC-Coupled vs. AC-Coupled*

Co-located devices registering as *two separate Energy Market assets*

**If intermittent generator and battery do not share inverter(s), they are AC-coupled**

- Standard AC metering and telemetry may be used in this case

**If intermittent generator and battery share the same inverter(s), then they are DC-coupled**

- Governing Document changes were made in 2020 to allow for the DC metering and telemetry required for separate asset treatment:
  - [OP-18](#) Sections IV.B.9, V.A.1.i, VII.B.7, and IX.D.3
  - [OP-18 Appendix C](#)
  - [OP-18 Appendix D](#), Figure 7
  - [Manual M-28](#), Section 5.3(b)i
  - [Manual M-RPA](#), Sections 1.1.2(7)(f) and 1.8



Slide updated on 4/8/2022.

# Separate Energy Market Assets

## Battery Component Registered as CSF – Reserves Issue

Co-located devices registering as *two separate Energy Market assets*

- Issue arises if there is a common limiting element that is rated for less than the maximum output of the intermittent generator
  - This situation is especially common with DC-coupled assets sharing an inverter, and can also occur if the interconnection agreement limits the facility output to below the maximum output of the intermittent component
  - See example on next slide
- Existing ISO software may designate an inaccurately high amount of reserves on a CSF in cases where a shared constraint is more limiting than the intermittent output plus the charging load
- ISO is studying possible ways to solve this issue
- Given the ISO's requirements for accurate reserves accounting, ISO must disallow reserves designation for these facilities if they participate as separate assets
- This issue may apply to *Configuration 2* and *Configuration 3B*



# Separate Energy Market Assets

## Battery Component Registered as CSF - Reserves Issue Example

Co-located devices registering as *two separate Energy Market assets*

- DC-Coupled Facility
  - 5 MW shared inverter
  - 8 MW PV as Intermittent Generator
  - 4 MW/8 MWh CSF
- Assume that the PV is producing more than 5 MW and that the excess is stored in the CSF (otherwise it would be lost (spilled))
- If the CSF is charging, ISO systems presume the ISO can dispatch it at any time to stop charging and provide energy
  - The charging load, which could go to zero, is the reserves designation on the DARD component of the CSF given current ISO software
- However, due to the 5 MW facility limit, if the CSF stops charging no additional energy can be provided to the grid (it would be spilled) – so in this case the charging load is not providing reserves

# Co-located facility registers as single “HYBRID” Energy Market asset

# Entire Facility Asset Registration Options (*Configuration 3A* & *Configuration 4*)

Entire facilities may register as:

Option	Notes
Settlement Only Generator <i>Configuration 3A and Configuration 4</i>	<ul style="list-style-type: none"> <li>No telemetry required; not dispatchable</li> <li>Participates in Real-Time Energy Market as price taker</li> <li>Cannot provide reserves</li> <li>May also be registered as an ATRR and provide regulation, with required telemetry</li> </ul>
Continuous Storage Facility <i>Configuration 3A only (Facility must meet the requirements in Section III.1.10.6(c) of Market Rule 1 to register as a CSF)</i>	<ul style="list-style-type: none"> <li>Telemetry required, AGC SetPoint/DDP for the entire facility</li> <li>Full participation in all markets: Energy (Day-Ahead and Real-Time), Reserves, Regulation, and FCM</li> <li>Will need to adjust Available Energy and Available Storage to account for combined intermittent plus battery capability</li> </ul>
Intermittent generator: <b>non-dispatchable PV or DNE dispatchable</b> (if wind or intermittent hydro) <i>Configuration 4 Only</i>	<ul style="list-style-type: none"> <li>Facility must be predominately intermittent</li> <li>Generator Asset telemetry is required</li> <li>Cannot provide regulation or reserves</li> <li>Dispatch point for entire facility; DNE dispatch requirements if wind or intermittent hydro</li> <li>Under this option, Energy Market offers and Dispatch Instructions exclude charging load</li> <li>Any charging load must be included as part of a Load Asset if the facility will charge from the grid</li> </ul>

 Slide updated on 4/8/2022.

# Observations on the Configurations

# General Observations for CSFs at Co-Located Facilities

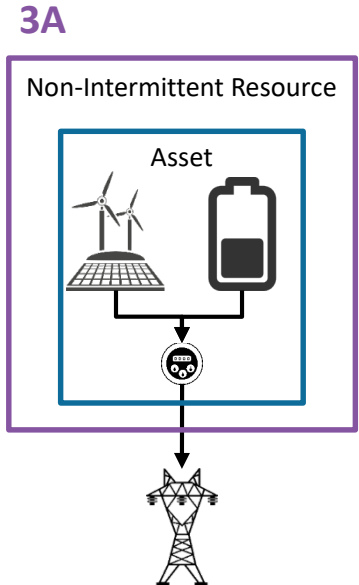
- **Participants and Designated Entities will have to carefully manage their offers and limits associated with a CSF at a co-located facility to account for things like:**
  - The existence of any shared facility constraints (both physical and/or contractual)
  - Any special operational requirements, such as charging the battery only from the intermittent component
  - The variability of the intermittent component
  - Periods when the intermittent output does not match what was forecasted
- **Such offer and limit management will be critical to avoiding any potential for an infeasible AGC SetPoint/DDP**

## **Configuration 1** and **Configuration 2** - Separate Resources/Assets

- May have separate Lead Market Participants
- Any required Designated Entities must be the same for all assets at a co-located facility
- Due to separate treatment, each component will be settled independently
- It is anticipated that, in case of DC-coupled assets:
  - Both whole facility AC metering and DC sub-metering will be required
  - For facilities requiring telemetry ( $\geq 5$  MW and/or CSF or ATRR), DC telemetering will also be required
  - Assigned Meter Readers must be the same
- Continuous Storage Facility charging load, even when supplied by the on-site intermittent asset, is subject to applicable Real Time Load Obligation cost allocations
- In addition, if the battery is registered as a Continuous Storage Facility:
  - Reserve designation issue may apply if there is a facility constraint
  - Offer management complexity due to separate asset impacting CSF capability

## Configuration 3A – Single Non-Intermittent Resource - Hybrid Asset

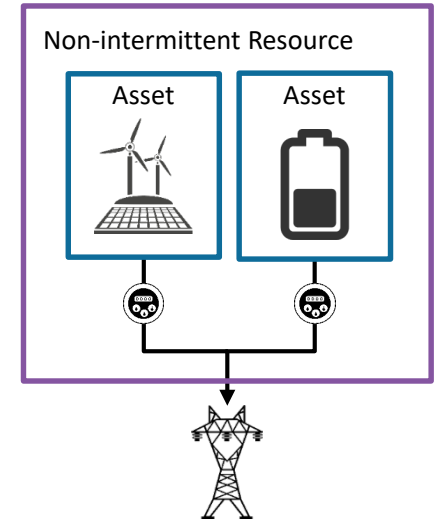
- The facility is managed and optimized as a whole, and any shared constraint is reflected in offer so full available reserves can be designated (for non-Settlement Only assets)
- DC metering is not required for DC-coupled systems; whole facility metering and any required telemetry are at the AC point of interconnection
- Battery charging from onsite intermittent component is done outside the market and is not subject to Real-Time Load Obligation cost allocations
- Must have one Lead Market Participant and Designated Entity
- The charge/discharge schedule of the battery might require modification when the participant's forecast of intermittent output is different from actual output



## Configuration 3B – Single Non-Intermittent Resource - Separate Assets

- Assets may have different Lead Market Participants but must have a single Assigned Meter Reader and Designated Entity
- DC metering and telemetry is required for DC-coupled systems
- If battery is registered as a CSF:
  - Reserve designation issue may exist if there is a facility constraint
  - CSF charging load, even when supplied by the on-site intermittent asset, is subject to applicable Real Time Load Obligation cost allocations
  - Offer management complexity due to separate asset impacting CSF capability

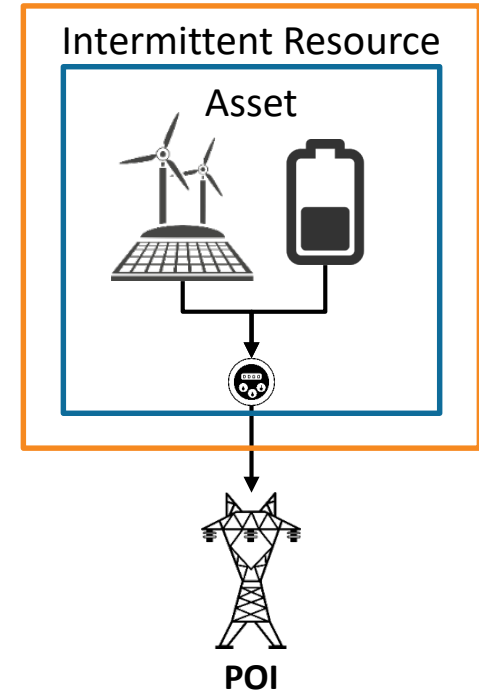
3B





## Configuration 4 – Intermittent Power Resource – Hybrid Asset

- Configuration will not provide reserves or regulation
- DC metering is not required for DC-coupled systems participating as an entire facility; whole facility metering and any required telemetry is at the AC point of interconnection
- Battery charging from onsite intermittent component is done outside the market and is not subject to Real-Time Load Obligation cost allocations
- Any battery charging from the grid must be reported in a separate Load Asset
- Must have one Lead Market Participant



# Summary of Configurations

Configuration	New Capacity Qualification*	Existing Capacity Qualification	Asset(s) Seasonal Claimed Capability (SCC)**
1 and 2: Two Resources, two Assets, with or without facility limitation	Expected Median Output of intermittent during Reliability Hours plus lower of: 50% usable stored energy and maximum discharge rate of battery	Intermittent is average of past 5 SCCs for each season; non-intermittent is median of past 5 SCCs for each season	Median output over reliability hours for intermittent; average output over two hours for non-intermittent
3A: One Resource, One Asset, Non-Intermittent	Expected Median Output of intermittent during Reliability Hours plus lower of: 50% usable stored energy and maximum discharge rate of battery	Median of past 5 SCCs for each season	Average output over two hours
3B: One Resource, Two Assets, Non-Intermittent	Expected Median Output of intermittent during Reliability Hours plus lower of: 50% usable stored energy and maximum discharge rate of battery	Median of the sum of Asset SCCs for past 5 years for each season	Median output over reliability hours for intermittent; average output over two hours for non-intermittent
4: One Resource, One Asset, Intermittent	Expected Median Output of intermittent during Reliability Hours plus lower of: 50% usable stored energy and maximum discharge rate of battery	Average of past 5 SCCs for each season	Median output over reliability hours

\* New Capacity Qualification will not exceed facility limitation

\*\* SCC cannot exceed Establish Claimed Capability, which is constrained by Network Resource Capability, reflecting any facility limits

## Methods for Contacting Customer Support

### Ask ISO

- Recommended method to reach Customer Support
- Use an Ask ISO ticket to send questions about the contents of this webinar



Email [custserv@iso-ne.com](mailto:custserv@iso-ne.com)

### Phone

- (413) 540-4220
- (833) 248-4220

**Inquiries will be responded to during business hours (Monday through Friday; 8:00 a.m. to 5:00 p.m.)**

**Outside of regular business hours, the pager (877) 226-4814 may be used for emergency inquiries**