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.*

February 21, 2019

WebEx Broadcast

*Presentation updated **12/31/2024**, to support Order No. 841.*
Impacted slides are noted.

Continuous Storage Facility Participation

Part of the Enhanced Storage Participation Revisions and Energy Storage Device Project

Tim Peet
Manager, Customer Support

Jacques Asselin
Lead Analyst, Asset Registration & New Generation Coordination

Sarthak Pant
Sr. Settlement Analyst, Hourly Markets, Settlements

Disclaimer for Customer Training

ISO New England (ISO) provides training to enhance participant and stakeholder understanding. Because not all issues and requirements are addressed by the training, participants and other stakeholders should not rely solely on this training for information but should consult the effective *Transmission, Markets and Services Tariff* ("Tariff") and the relevant *Market Manuals*, *Operating Procedures* and *Planning Procedures* ("Procedures").

Training examples are provided for illustrative purposes only. Company names and numerical values used are fictitious.

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 assumes approval of *Enhanced Storage Participation Revisions* (ER19–84–000).

Disclaimer

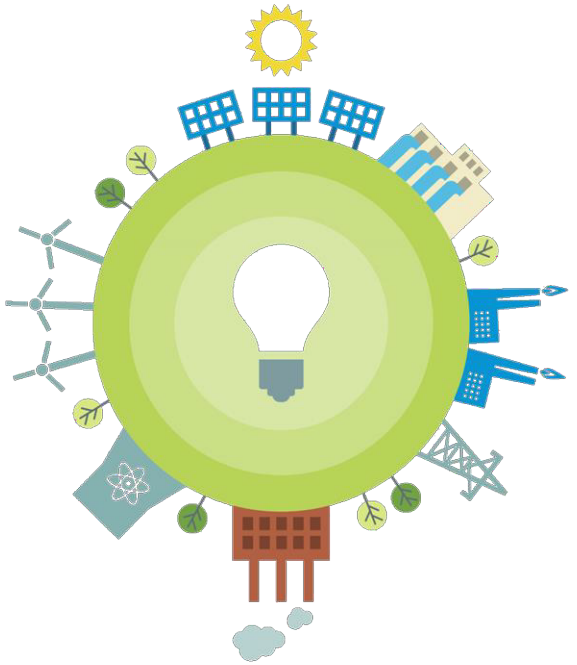
This presentation demonstrates all the components of a Continuous Storage Facility.

A storage facility incapable of receiving and storing electricity from the grid may participate in the New England Markets as a Continuous Storage Facility, so long as that facility satisfies all Continuous Storage Facility registration and participation requirements that are not solely related to consumption capability. As a result, the Asset Related Demand (ARD) portion, except for registration, can be disregarded.

Slide added on 12/31/2024.

Topics

1. Continuous Storage Facility (CSF) Option
2. Market Participation by Continuous Storage Facilities
3. Initial Modeling, Technical Requirements, and Asset Registration
4. eMarket Requirements
5. Examples of How a CSF May Offer or Bid into Markets
6. Settlements and Billing Impacts



Objectives

- Identify continuous storage facility option
- Describe how to register as continuous storage facility
- Recall requirements for managing CSF assets in eMarket software platform
- Discuss examples of how CSF may offer or bid in to markets
- Recognize CSF settlement changes
- Locate helpful information, including alternative options that storage facilities have for market participation

Acronyms

AGC	automatic generation control
ARD	asset-related demand
ATRR	alternative technology regulation resource
CLAIM10	offline 10-minute nonspinning reserves
CLAIM30	offline 30-minute operating reserve
CROW	Control Room Operations Window (interface)
CSF	continuous storage facility
DAM	Day-Ahead Energy Market
DARD	dispatchable asset-related demand
DDP	desired dispatch point
DE	designated entity
Eco Max	economic maximum value
Eco Min	economic minimum value
ESD	energy storage device
FCM	Forward Capacity Market
FCTS	Forward Capacity Tracking System
FERC	Federal Energy Regulatory Commission
ISO-TEN	ISO Training & Events Network
LEG	limited-energy generator
LMP	locational marginal price; lead market participant
MIS	market information server

MR1	Market Rule 1 (Section III of ISO Tariff)
MW	megawatt
MWh	Megawatt-hour
***MyFacility*_ARD**	CSF's DARD
***MyFacility*_ATRR**	CSF's ATRR
***MyFacility*_GEN**	CSF's generator asset
NCPC	net commitment-period compensation
NEPOOL	New England Power Pool
NPCC	Northeast Power Coordinating Council
OP	operating procedure
PTF	pool transmission facility
PURPA	Public Utility Regulatory Policies Act
Reg High	regulation high value
Reg Low	regulation low value
RQM	revenue quality meter
RTM	Real-Time Energy Market
RTU	remote terminal unit
SOG	settlement-only generator
TMNSR	10-minute nonspinning reserves
TMOR	30-minute operating reserves
TMSR	10-minute spinning reserves

Market Rule References

- Rules specific to continuous storage facilities are in Section III of *ISO New England Inc. Transmission, Markets, and Services Tariff*
  - Section III known as Market Rule 1 (MR1)
  - See Section III.1.10.6, *Electric Storage*
    - Available now in FERC filing
    - Available in published Market Rule 1 on April 1, 2019
- For non-CSF market participation, see market-specific rules applying to all technologies
- CSFs also subject to ISO-NE Operating Procedures:
  - No. 14 (OP 14): *Technical Requirements For Generators, Demand Resources, Asset Related Demands, and Alternative Technology Regulation Resources*
  - No. 18 (OP 18): *Metering and Telemetering Criteria*

Look for tariff references at bottom left

MR1, Section III.1.10.6

Continuous Storage Facility Option

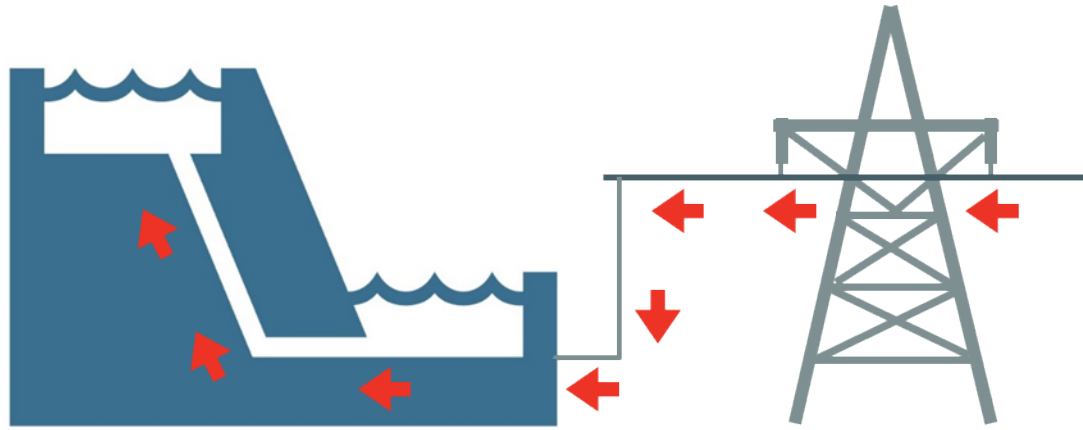
Tim Peet
Manager, Customer Support

A Long and Evolving History

- Since 1970s, 2,000 MW pumped-storage hydro active in New England
  - Have provided energy, reserves, regulation, and capacity since inception of region's wholesale electricity markets
- Early 2016, interest began growing in building new storage technologies
  - Hundreds of MWs of battery storage currently in ISO New England Interconnection Request Queue

Pumped-Storage Hydro Operates in Binary Fashion

- Reversible pump/turbine:
  - Spins in one direction to pump water uphill (aka, charging)
  - Stops and takes time to spin in reverse to generate electricity (aka, discharging)
- Has two corresponding asset types modeled in ISO system and participating in markets:
  - *Charging:* Dispatchable asset-related demand (DARD) submits bids to consume energy
  - *Discharging:* Generator asset offers to supply energy and provide regulation



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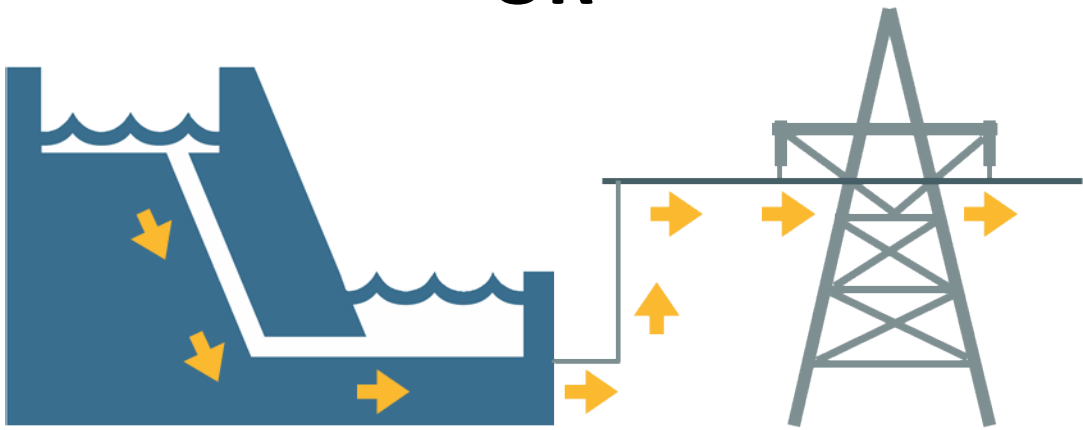
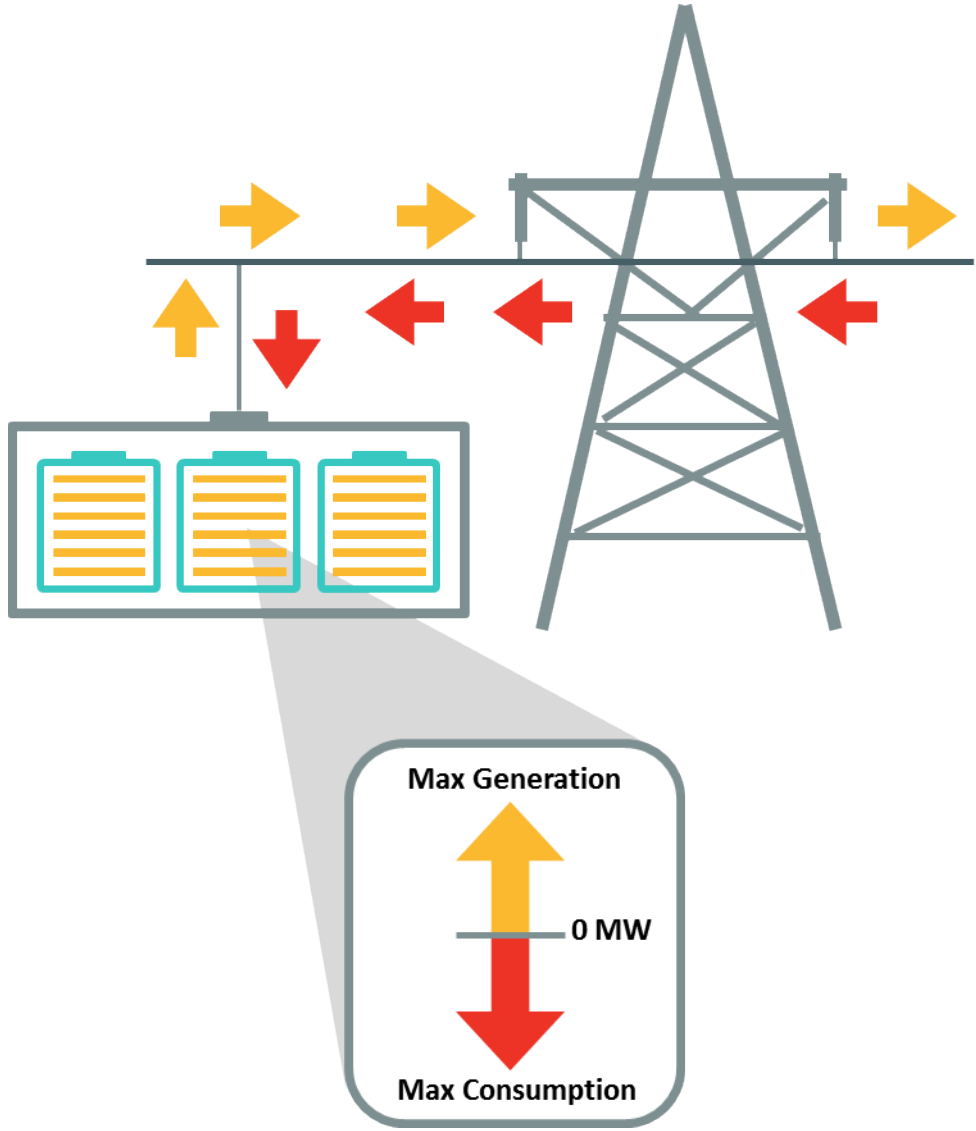


New Storage Technologies Operate in Continuous Fashion

Batteries and similar technologies can:

- Move continuously and nearly instantaneously between charging and discharging in continuous range of generation and consumption
- Set regulation range that crosses zero and can provide regulation while charging or discharging



Expanding Options for Storage in New England

March 2015—**Regulation Market Redesign**	April 1, 2019—**Enhanced Storage Participation Revisions**
New energy-neutral regulation dispatch signal for storage participating as alternative technology regulation resources (ATRRs)	(aka, Energy Storage Device Project) • Introduces electric storage facility rules for: – Binary storage facilities (i.e., pumped-storage hydro) – **Continuous storage facilities (e.g., batteries)** • Storage facilities as small as 1 MW can participate
June 2018—**Price-Responsive Demand Project**	December 2019—**Additional revisions include:**
Enabled demand response to participate in energy market as dispatchable resource and provide reserves	• Any technology can participate under binary storage facility rules • Electric storage facilities as small as 0.1 MW can participate • Electric storage facilities may be exempted from Schedule 9 (regional network service) charges when consuming

What Are Electric Storage Facilities?

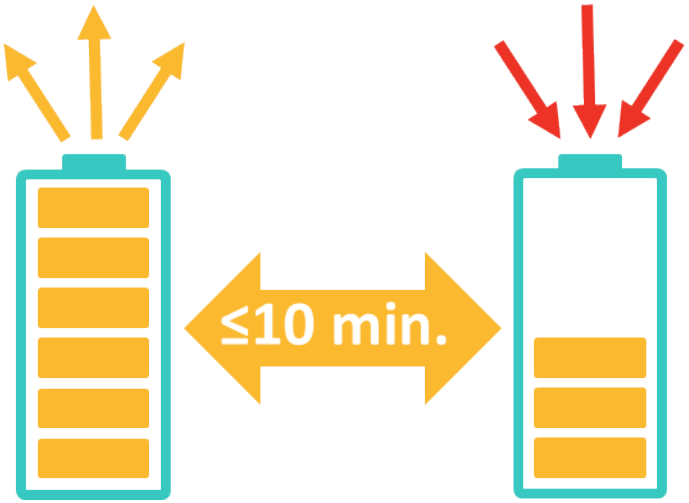
In New England markets, this means storage facilities that:

- Are capable of receiving electricity from the grid and storing the energy for later injection of electricity back to the grid
- Register as and follow rules for both:
  - Dispatchable generator asset
  - Dispatchable asset-related demand (DARD)
- Qualify as one of two subtypes:
  - Binary storage facility (i.e., pumped storage)
  - **Continuous storage facility (e.g., batteries)** NEW
    - **Can simultaneously participate in energy, reserves, and regulation markets**

MR1, Section III.1.10.6

Qualifying as a Continuous Storage Facility (CSF)

In addition to general electric storage facility requirements, CSFs must be capable of max output to max consumption in ≤10 minutes

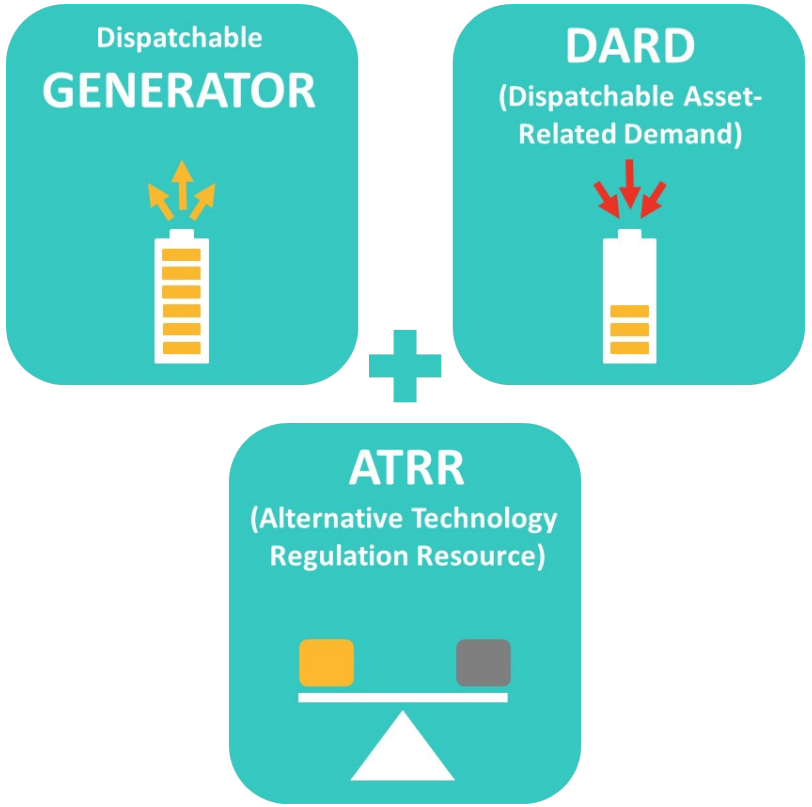


MR1, Section III.1.10.6

Qualifying as a Continuous Storage Facility (CSF), *continued*

CSFs must also register as ATRR:

- Must all be same equipment
- Can't use storage capability shared with another generator asset, DARD, or ATRR
- Not required to actually provide regulation



Participation as a continuous storage facility is **optional, except for:**

- ATRRs ≥5 MW
- Facilities of any size registered with this three-part configuration

MR1, Section III.1.10.6

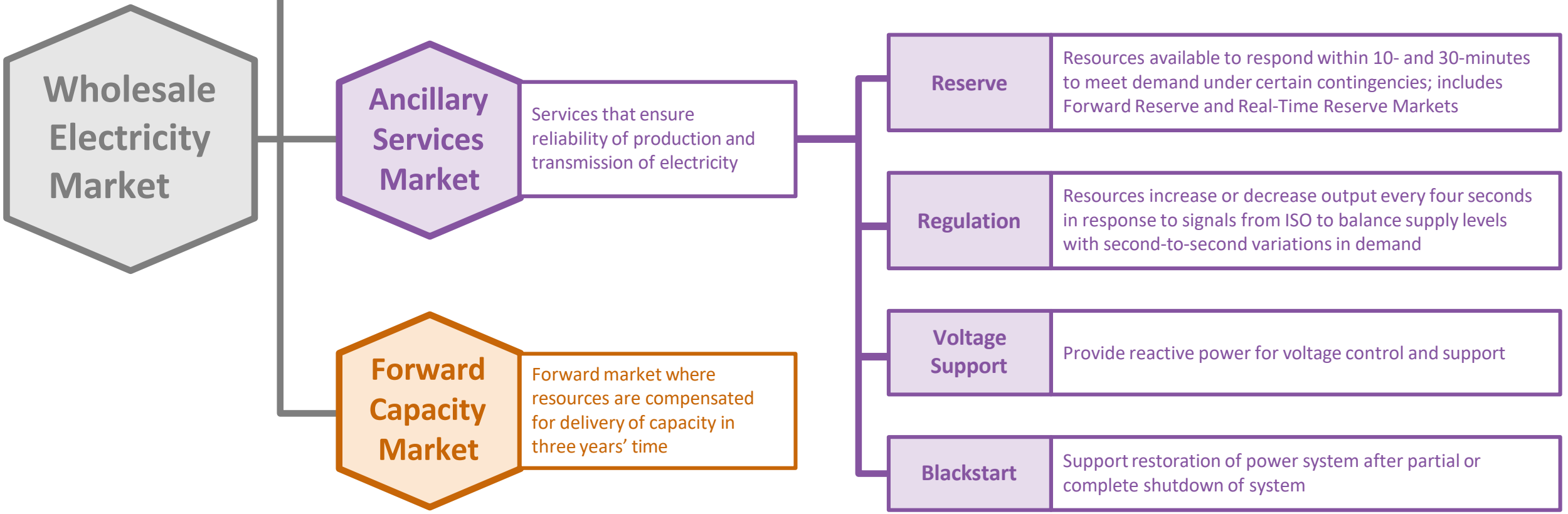
Questions?

Coming Up:

- *Market Participation by Continuous Storage Facilities*
- *Initial Modeling, Technical Requirements, and Asset Registration*
- *eMarket Requirements*
- *Examples*
- *Settlement and Billing Impacts*
- *Additional Resources*

Market Participation by Continuous Storage Facilities

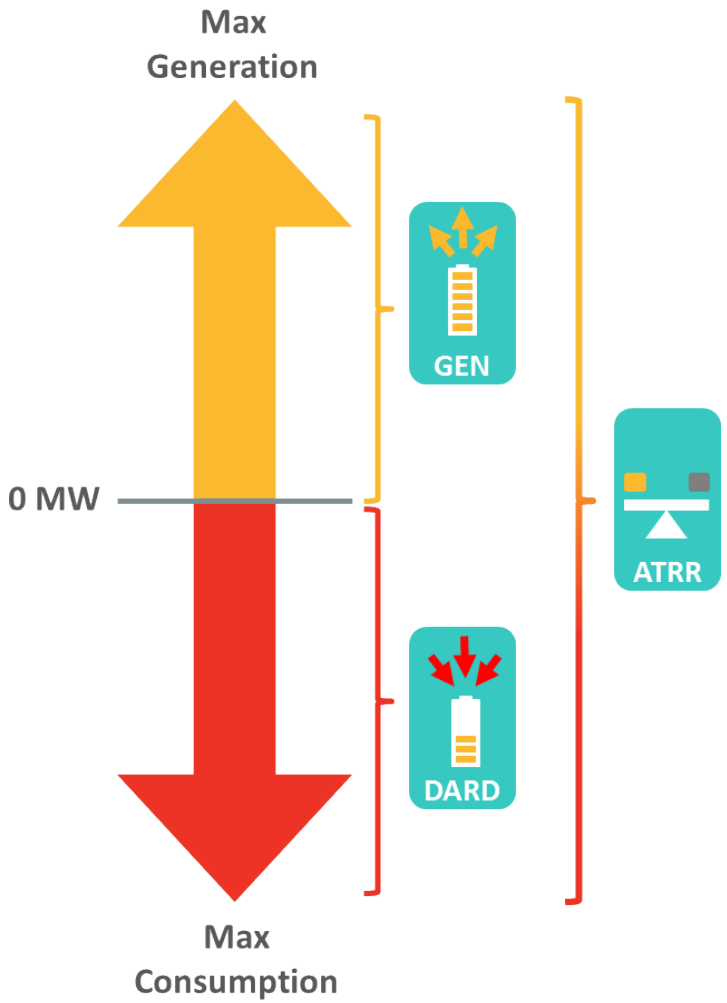
New England's Wholesale Electricity Market



Different Asset Types Correspond to Different Abilities and Markets

- A CSF's three asset types enable simultaneous participation in energy, reserves, and regulation markets
- Each asset responsible for different operating activity

Generator Asset	DARD	ATRR
Used to inject energy into grid and provide reserves	Used to manage energy consumed and reserves	Used to manage regulation (positive or negative)

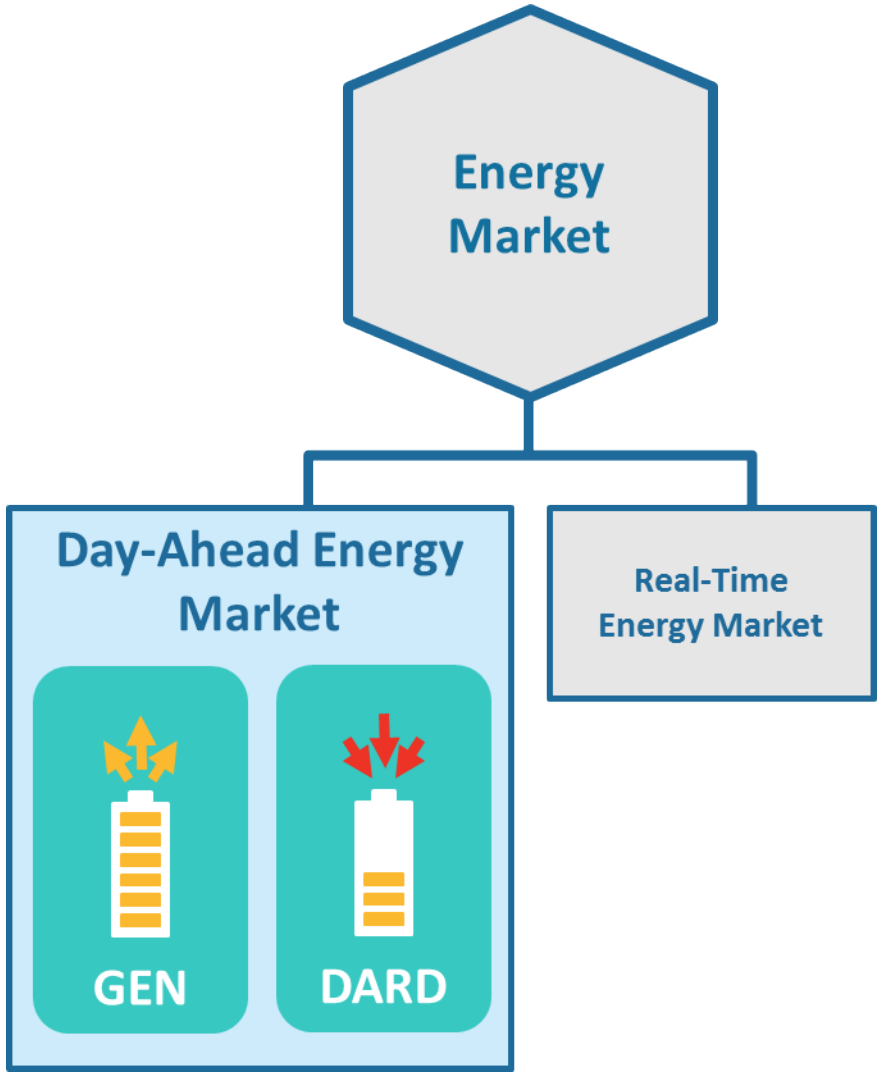


CSFs *cannot* participate as demand response; must be directly metered, with no load behind same meter

MR1, Section III.1.10.6

Day-Ahead Energy Market

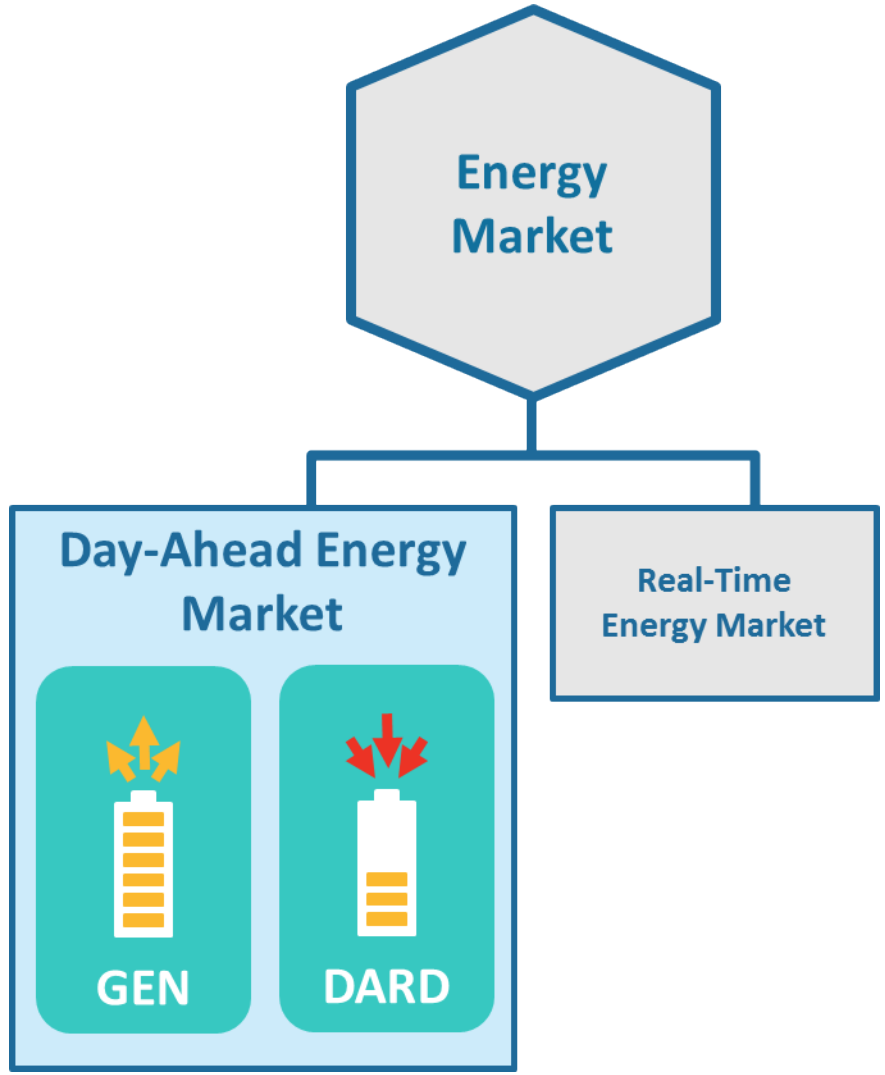
- CSF's generator and DARD assets may participate
  - CSF's generator asset required to offer in if they have capacity supply obligation through Forward Capacity Market
- Both generator asset and DARD always committed online at 0 MW, unless participant declares it unavailable in eMarket
  - Each CSF asset must be online and operational unless declared unavailable



Day-Ahead Energy Market, *continued*

- Dispatch level based on offers and economics, with each asset receiving:
  - Independent dispatch MW level when cleared
  - Zero when not cleared

Participant is responsible for developing day-ahead bids and offers so that CSF does not get day-ahead obligation to charge and discharge at same time. ISO day-ahead software will not check this for you.

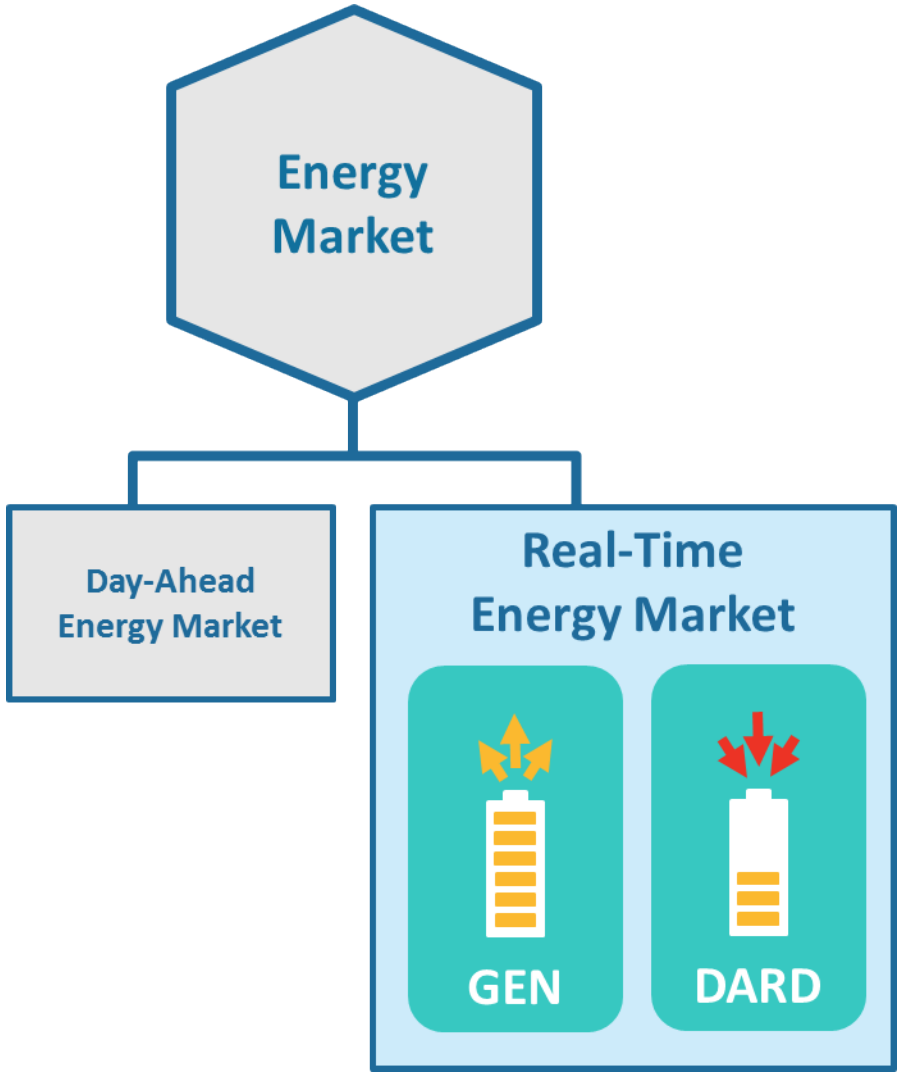


Real-Time Energy Market

- Assets must self-schedule and be operational and online, unless declared unavailable

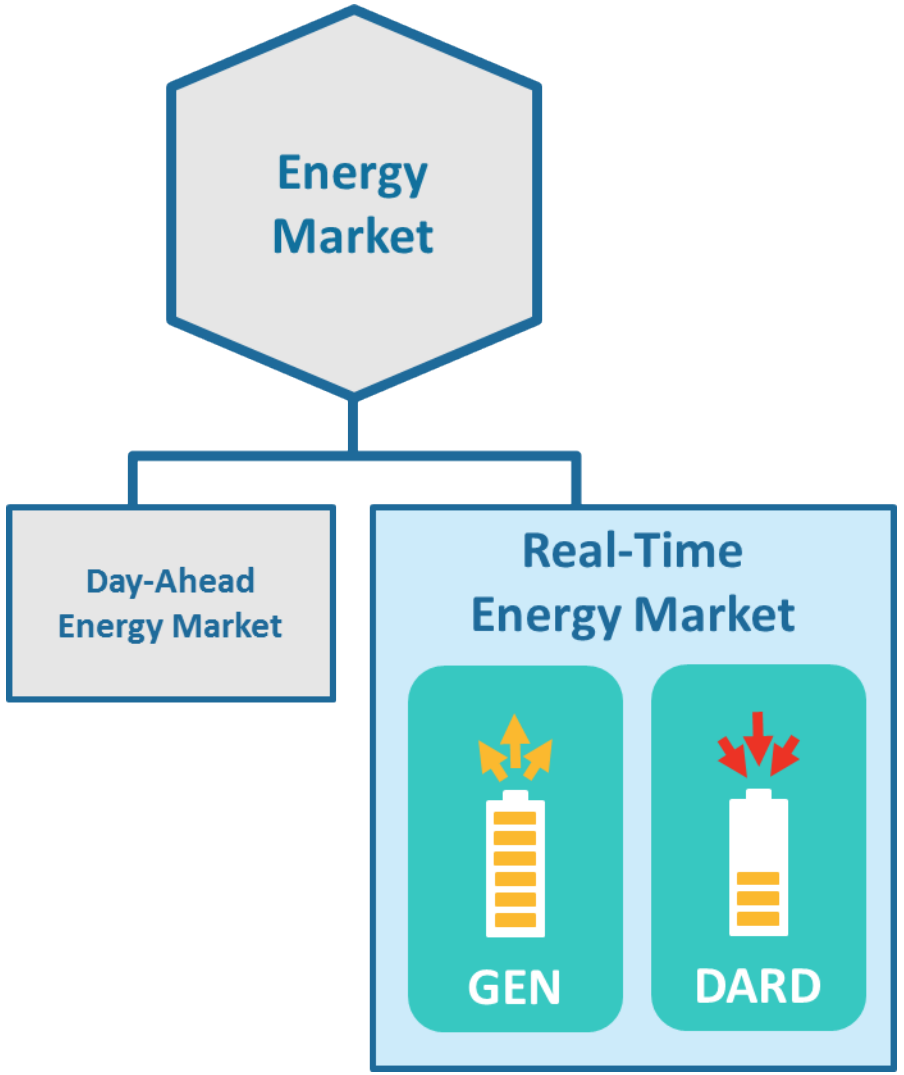
CSFs must telemeter key inputs to ISO via remote terminal unit (RTU), including available MWhs of energy and available MWhs of storage.

See RTU and telemetry requirements in ISO-NE Operating Procedures No. 18 (OP 18): *Metering and Telemetering Criteria.*



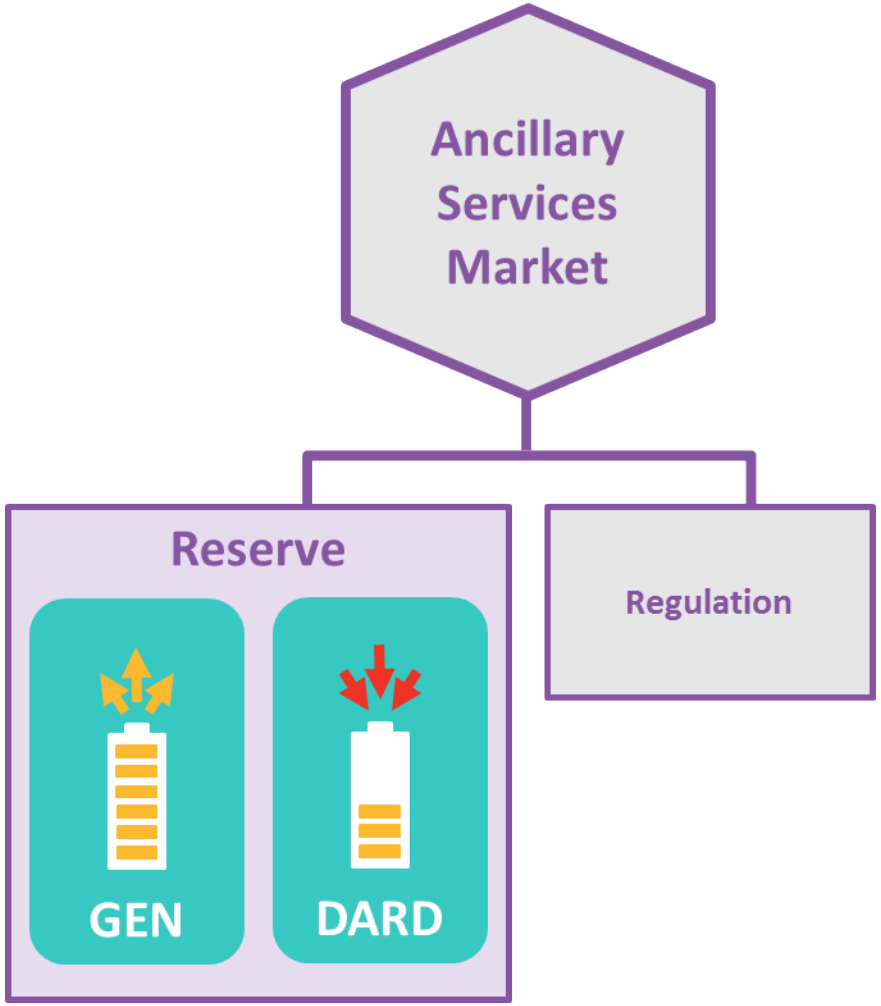
Real-Time Energy Market, *continued*

- CSF assets dispatched based on charge status:
  - **When fully *discharged*** (i.e., available energy = 0 MWh) only DARD is available for dispatch
  - **When fully *charged*** (i.e., available storage = 0 MWh) only generator asset is available for dispatch
  - **When *partially* charged or discharged,** dispatch based on offer parameters, availability status, and dispatch limits economically
    - Dispatch limits updated based on telemetered available energy and storage



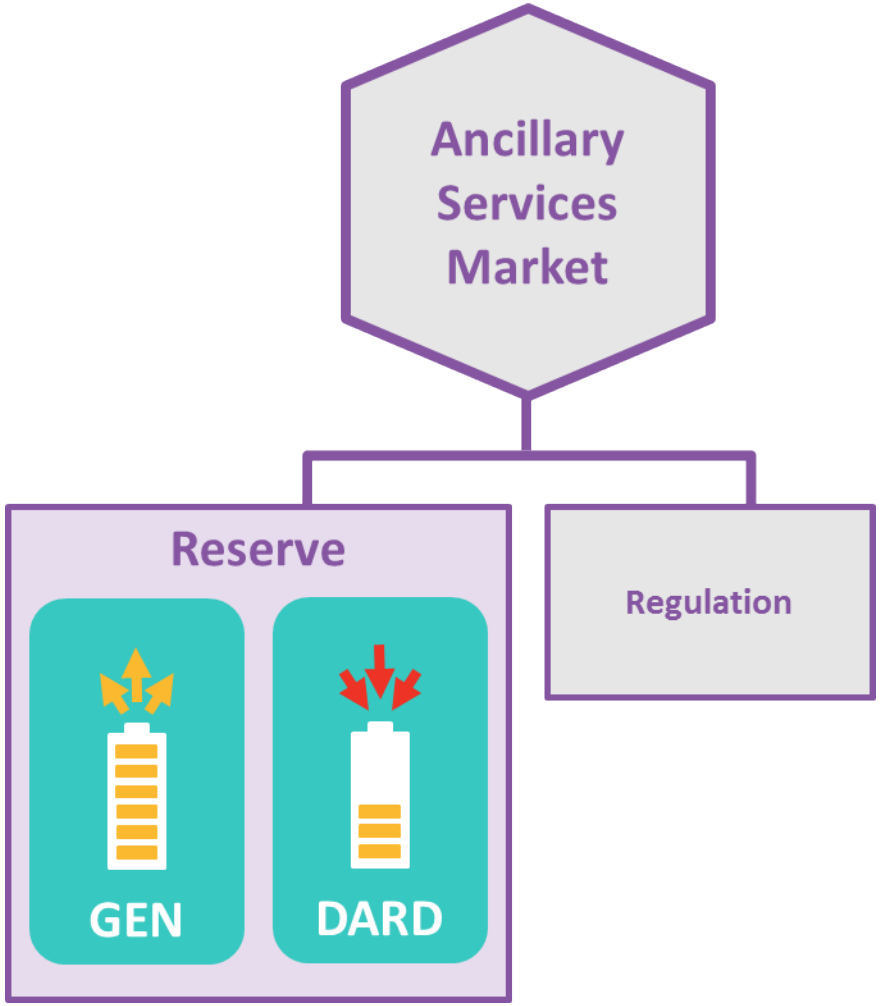
Reserve Markets

- CSF can provide **10-minute spinning reserves** with generator asset and DARD, not ATRR
  - *Generator asset:* reserves counted from current MW to economic max parameter
    - Economic max may be recalculated by system to meet reliability requirements based on telemetered output (details on later slide)
    - Participant required to bid Eco Min at 0 MW
  - *DARD asset:* reserves counted from current MW to Minimum Consumption parameter
    - Based on absolute value of telemetered output
    - Participant required to bid Min Consumption at 0 MW



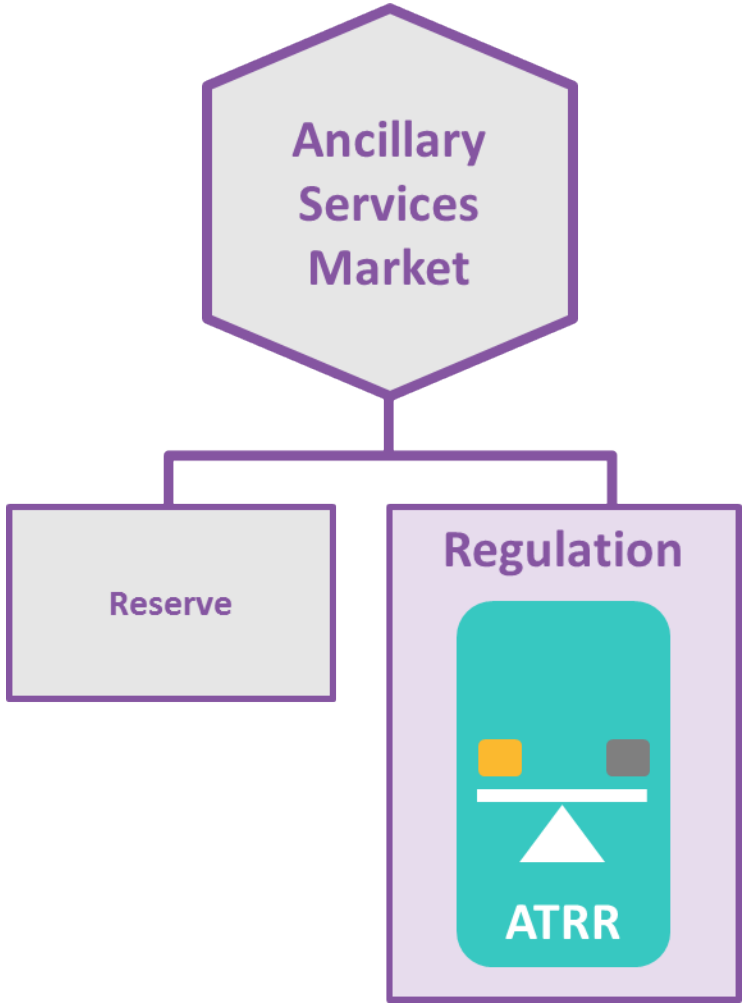
Reserve Markets, *continued*

- CSFs do not provide:
  - Offline 10-minute nonspinning reserves (aka, CLAIM10)
  - Offline 30-minute operating reserve (aka, CLAIM30)
- This is due to requirement to always be operational and on line, unless declared unavailable



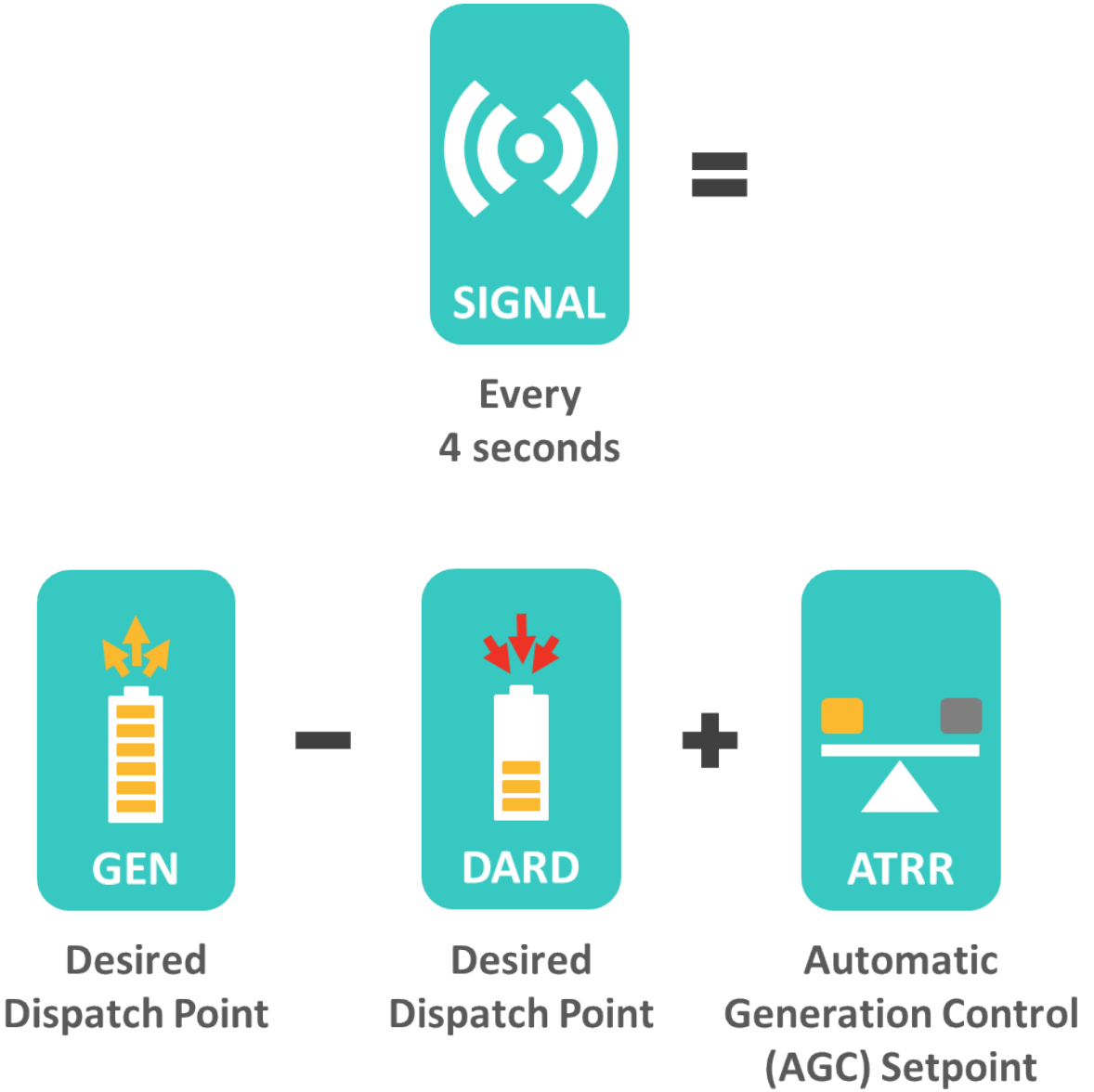
Regulation Market

- CSF's ATRR asset can participate in Regulation Market in real time
- Average net energy consumption for ATRR generally around 0 MWh because:
  - ATRR regulates via an energy neutral signal
  - Regulation limits must be set close to symmetric limits around 0 MW
    - Can include small bias towards charging to account for efficiency loss



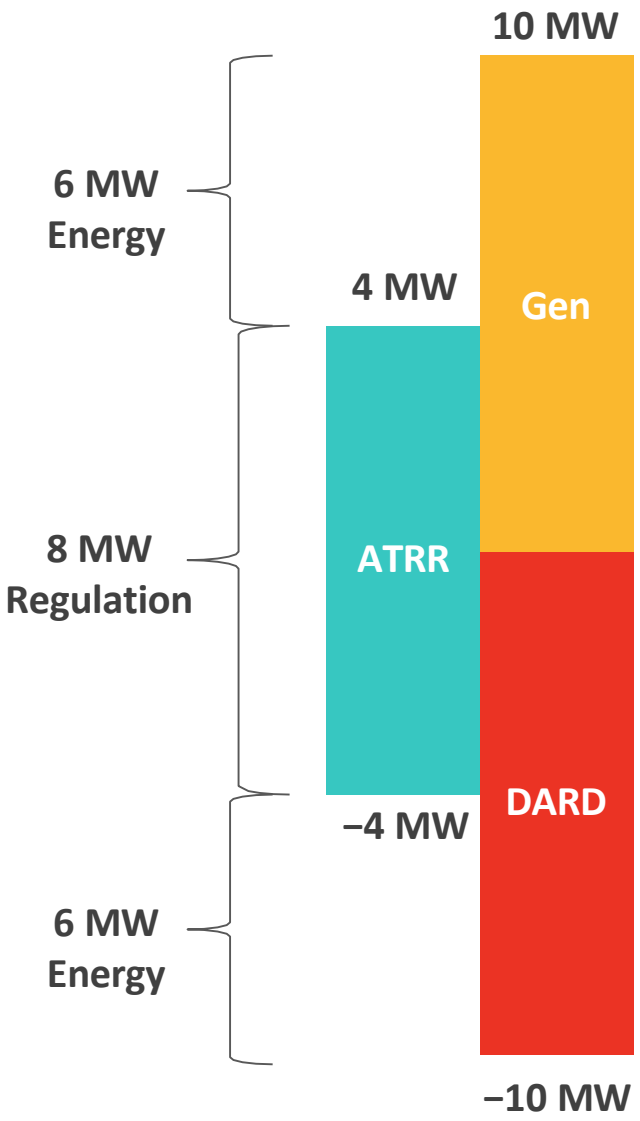
Simultaneous Dispatch of CSF

- Dispatch software treats CSF as three different assets, and calculates separate dispatch signal for each
- CSF gets single dispatch signal equal to:
  - Desired dispatch point of generator asset
    - Generating output level to which they are expected to move
  - Minus desired dispatch point of DARD
    - Amount to reduce consumption from adjusted baseline
  - Plus AGC setpoint of ATRR
- Signal sent at 4 second intervals

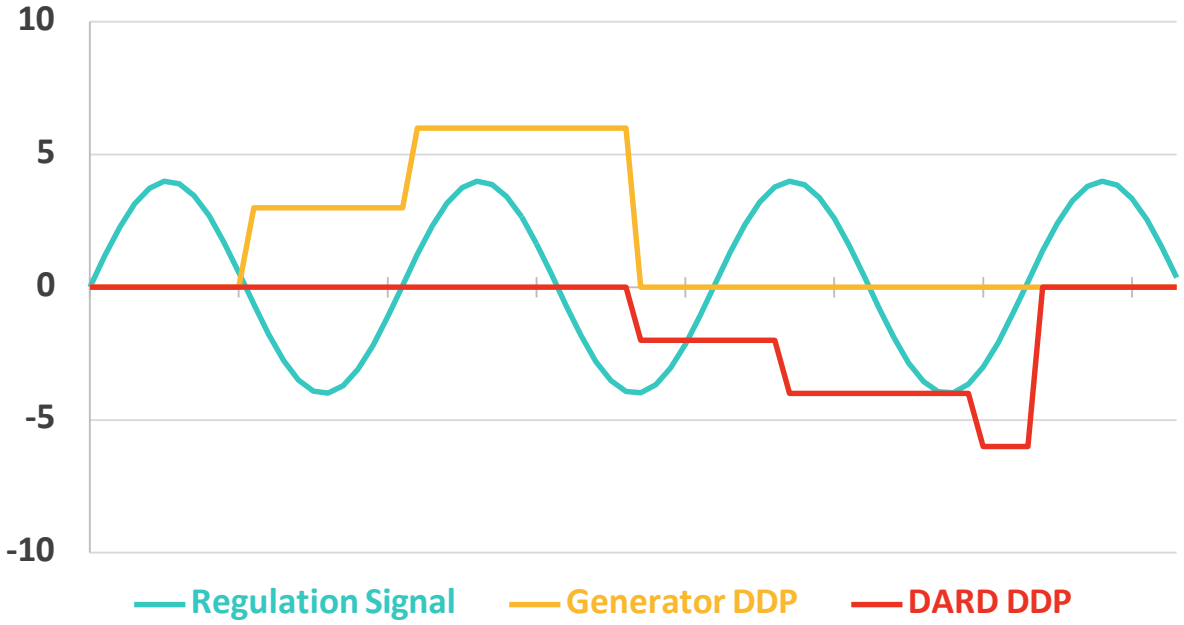


MR1, Section III.1.10.6

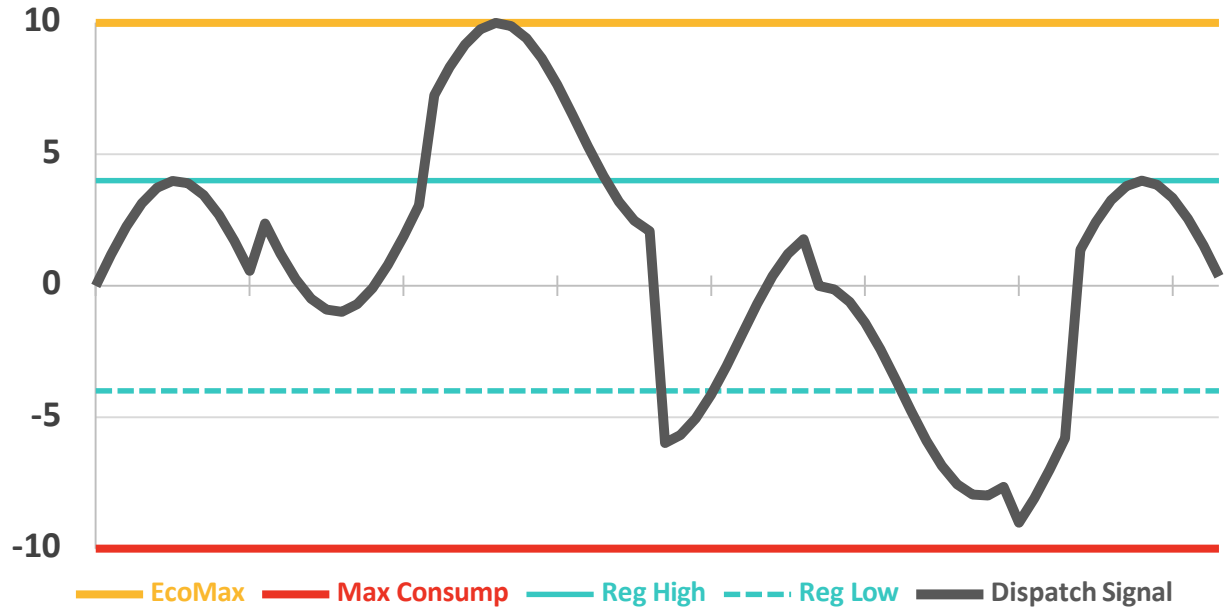
Example of Simultaneous Dispatch



Individual Dispatch



Single Dispatch Signal



Questions?

Coming Up:

- *Initial Modeling, Technical Requirements, and Asset Registration*
- *eMarket Requirements*
- *Examples*
- *Settlement and Billing Impacts*
- *Additional Resources*

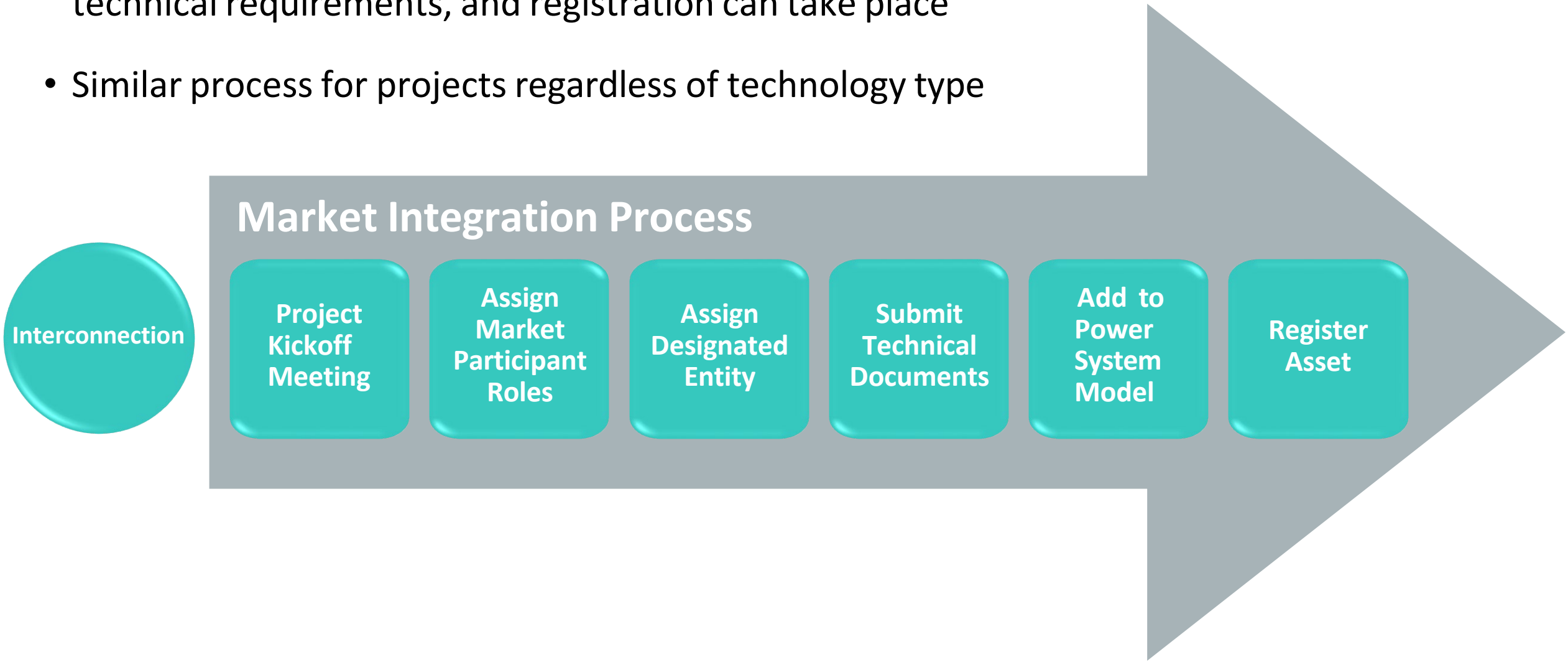
Initial Modeling, Technical Requirements, and Asset Registration

Market Integration Process

Jacques Asselin
Lead Analyst, Asset Registration & New Generation Coordination

Market Integration Process

- Once interconnection is complete, initial modeling, technical requirements, and registration can take place
- Similar process for projects regardless of technology type

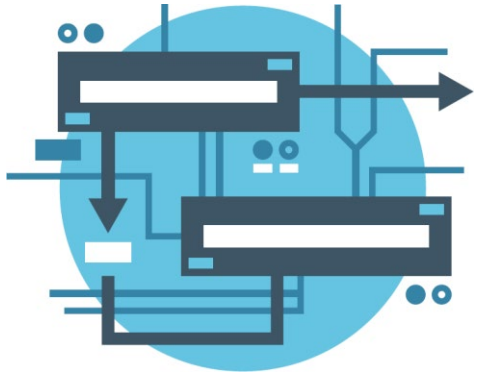


The Interconnection Process

Before pursuing market participation, you must complete or be near completion of the interconnection process

- If required to follow ISO New England interconnection process, you must have at least:
  - Interconnection Study (System Impact Study) completed
  - Proposed Plan Application submitted
- Some facilities must follow state interconnection process, instead

Per FERC Order No. 2003-A, "Facilities subject to the *[open access transmission tariff]* are: transmission facilities used to transmit electric energy in interstate commerce either at wholesale or for unbundled retail sales; and 'distribution' facilities that are used for wholesale sales in interstate commerce."



ISO New England vs. State Interconnection Process Overview

1. Is project interconnecting to ISO-administered transmission system (pool transmission facility [PTF], non-PTF, and FERC-jurisdictional distribution)?
   - If **YES,** see #2
   - If **NO,** use state interconnection process
     - Contact distribution company/owner of state-jurisdictional distribution facility

2. Is project exempt?

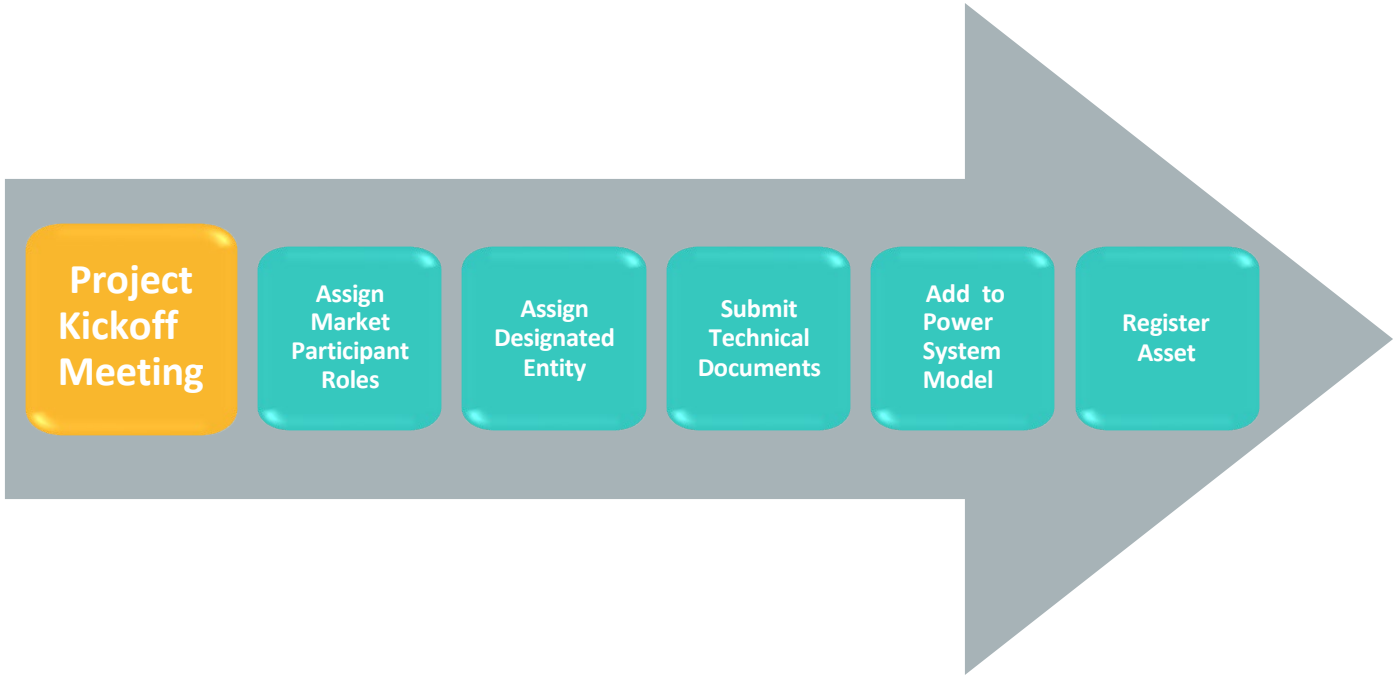
   Exemptions:
   - Retail customer interconnecting new generating facility whose energy will ONLY be consumed at retail customer's site
   - New generating facility connected to distribution facility subject to ISO Tariff, IF generating facility will not be used to make wholesale sales of electricity in interstate commerce
   - Qualifying facility defined by PURPA, where facility's owner intends to sell all output to its interconnected electric utility

   - If **YES,** use state interconnection process
   - If **NO,** use ISO interconnection process
     - See ISO's New or Modified Interconnections webpage

For details, see *Distribution-Connected Generation Guidance* presentation

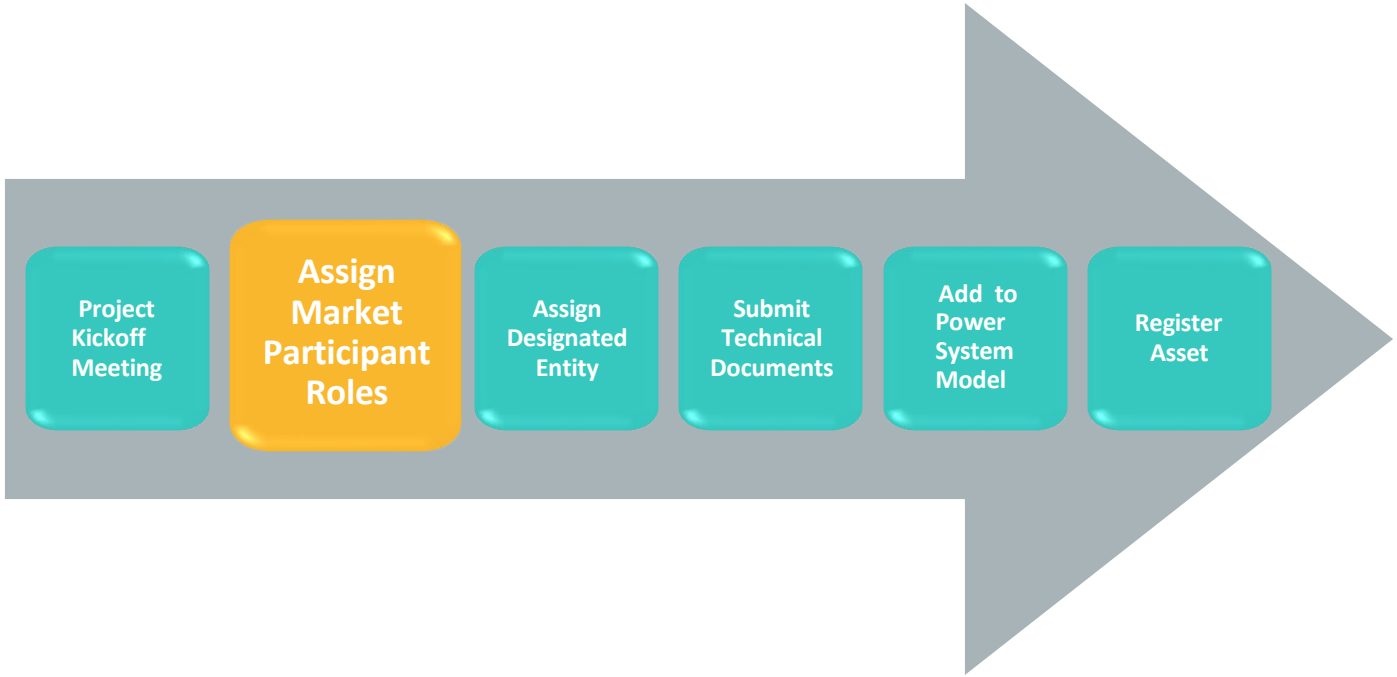
Market Integration: Project Kickoff Meeting

- Should be scheduled 12–15 months in advance of targeted commercial operation date
  - Contact ISO via Ask ISO or NewGenCoord@iso-ne.com
- Meeting will review action items for market integration
  - Process outlined in New Generation Projects: Process Guide

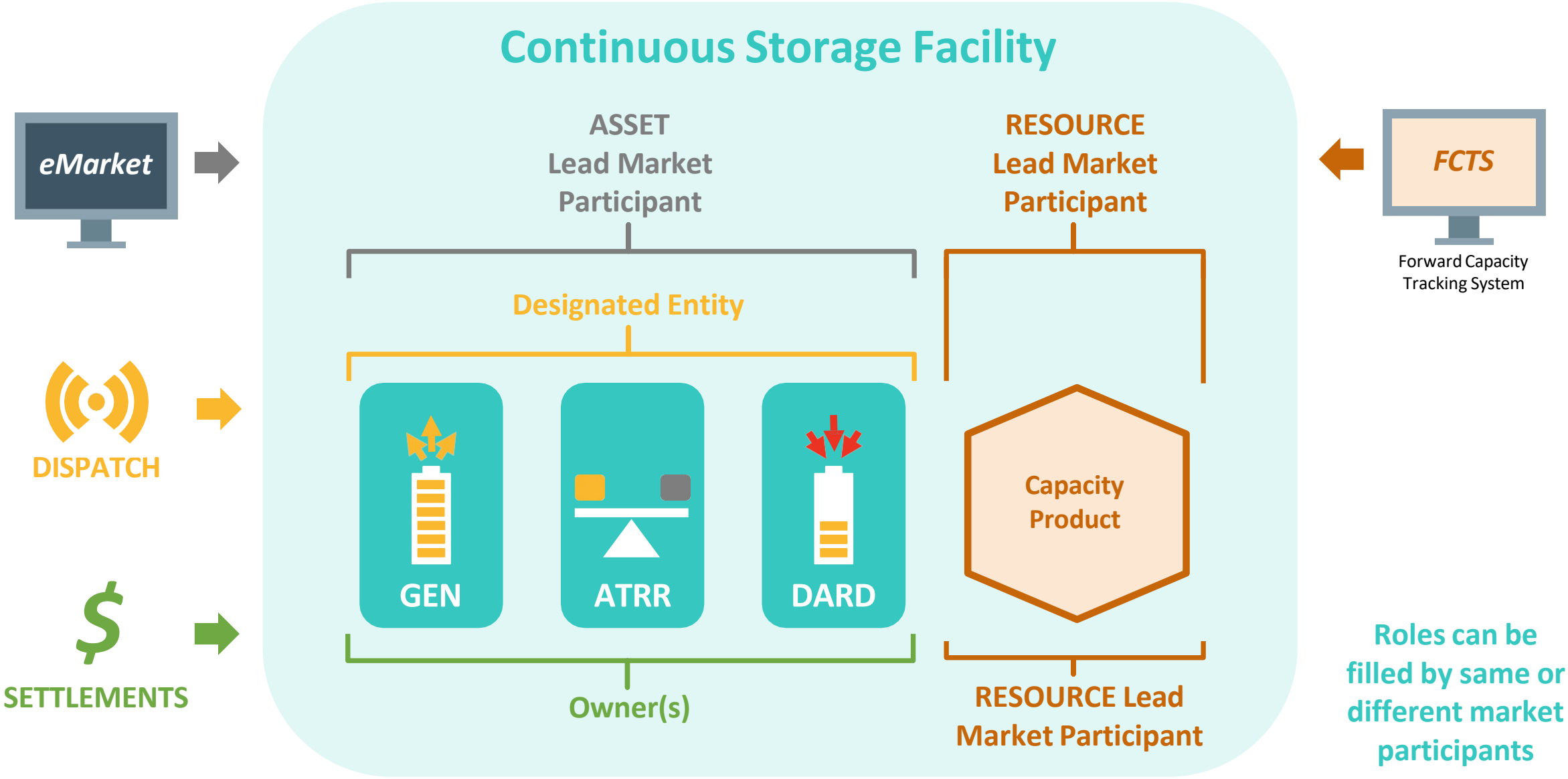


Market Integration: Assign Market Participant Roles

- Specify which market participants will play required roles related to CSFs
  - Can be same or different market participants
- Each role has different responsibilities for:
  - Scheduling and bidding assets to market
  - Wholesale settlement obligation (regulation, energy, reserves)
  - Forward Capacity Market



Market Participant Roles and Responsibilities for CSFs



Market Participant Roles and Responsibilities for CSFs, *continued*

- **Asset lead market participant**
  - Single settleable market participant
  - Acts as "quarterback" for CSF
  - Responsible for:
    - Technical documentation and market compliance
    - Day-to-day offers and bidding of CSF assets in eMarket for energy (injections and withdrawals), reserves, and regulation

$

SETTLEMENTS

- **Asset owner(s)**
  - Incurs settlement obligation for:
    - Generator asset (energy injections)
    - ATRR (regulation)
    - DARD (energy withdrawals)

DISPATCH

- **Designated entity**
  - Handles dispatch communications

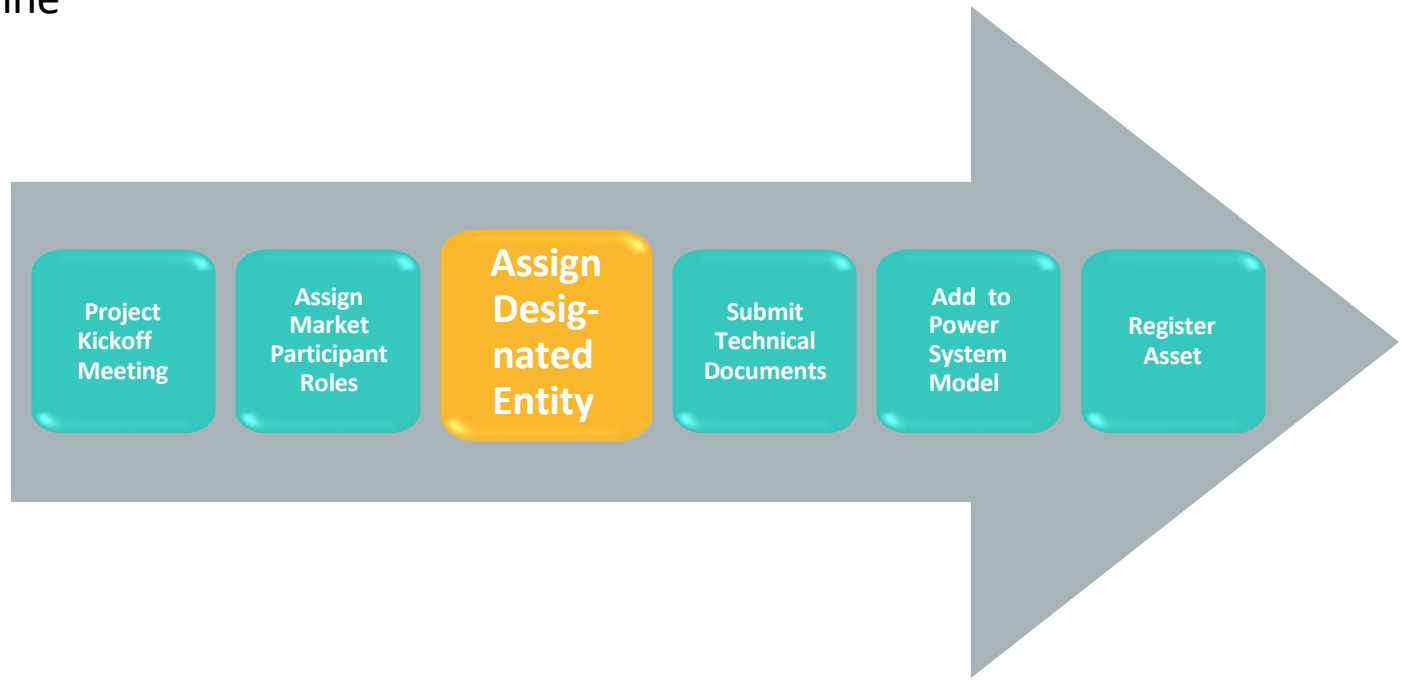
Roles can be filled by same or different market participants

Market Participant Roles and Responsibilities for CSFs, *continued*

- **Resource lead market participant:**
  - Single entity
  - May be one of the market participants associated with asset OR another market participant
  - Responsible for capacity market-related
    - Administrative functions
    - Offers
    - Settlement
- More information on capacity market:
  - *FCM Participation Guide*

Market Integration: Assign Designated Entity (DE)

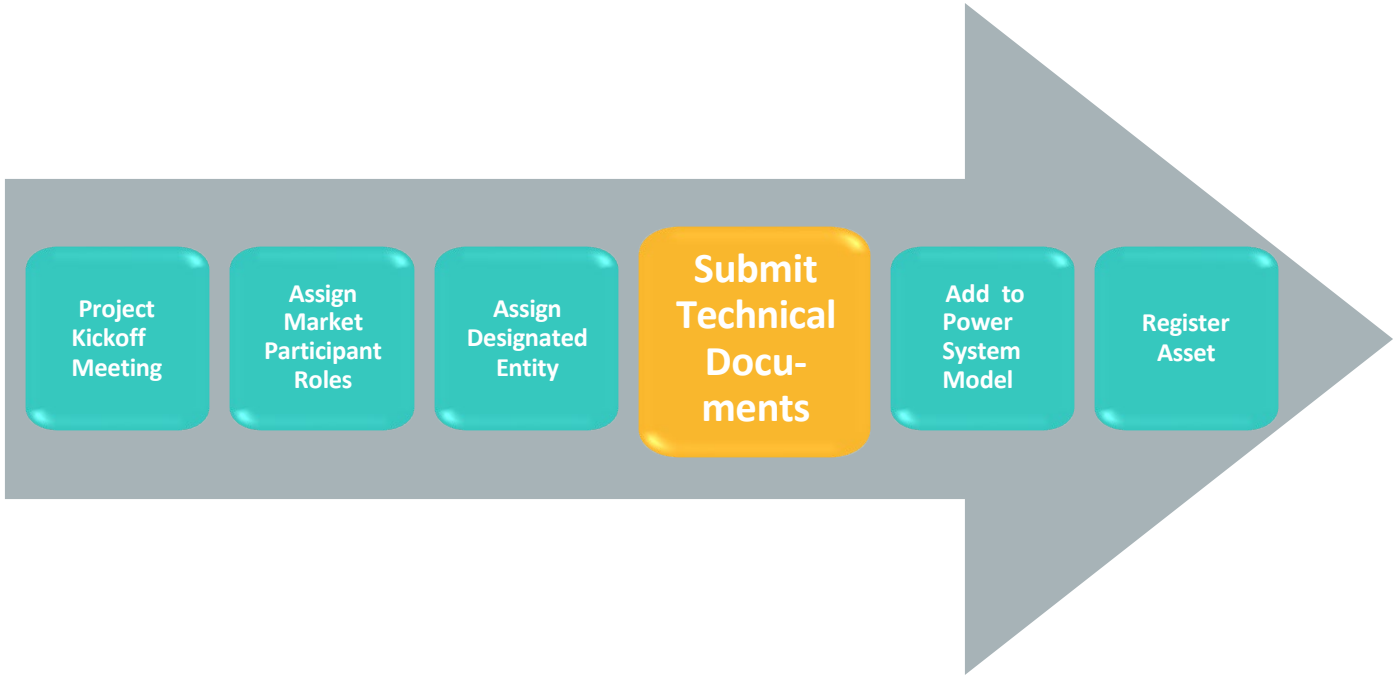
- Designated entity is responsible for 24/7 dispatch communications with ISO control room
  - **Must have equipment dedicated to ISO New England**
  - **If not, allow 90 days to order/deliver/install:**
    - Remote terminal unit (RTU)
    - Electronic dispatch circuits/router
    - Exclusive phone line
- ISO validates assigned dispatch location and coordinates registration, if needed



Market Integration: Submit Technical Documents

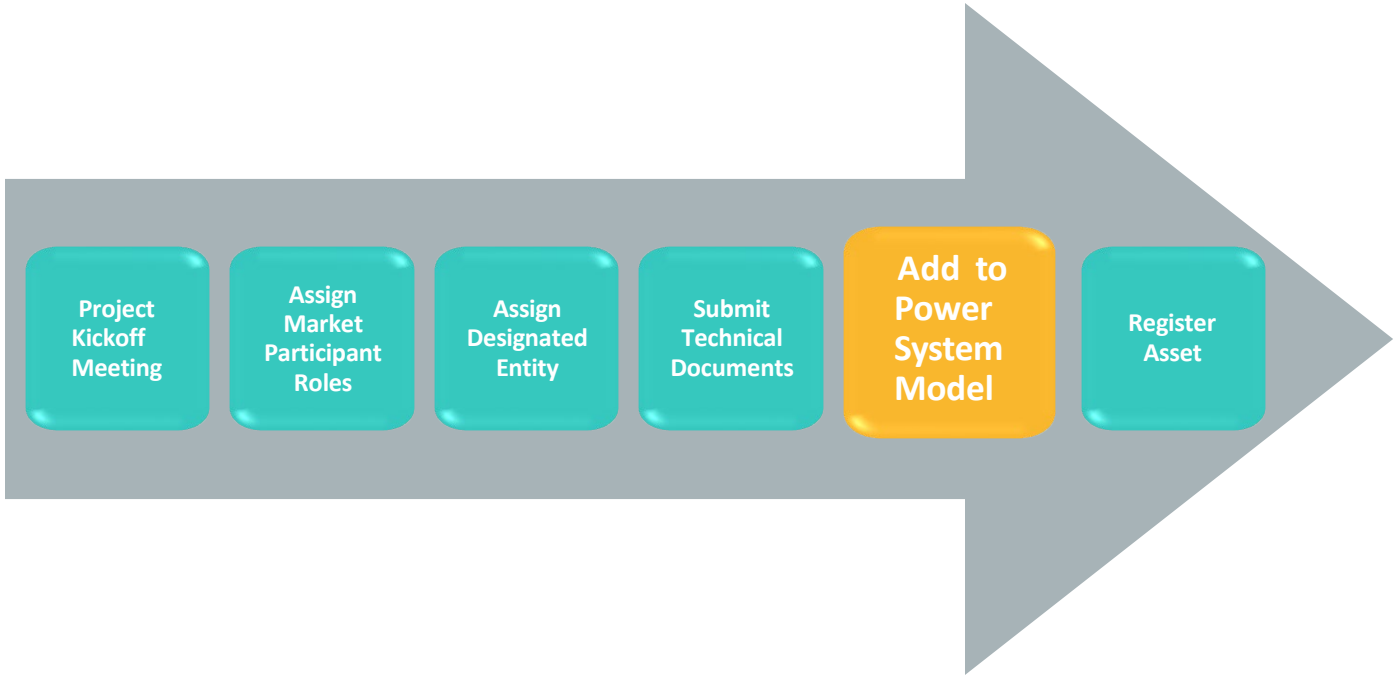
See requirements in ISO-NE operating procedures (OPs):

- **No. 12 (OP 12):** *Voltage and Reactive Control*
- **No. 14 (OP 14):** *Technical Requirements For Generators, Demand Resources, Asset Related Demands, and Alternative Technology Regulation Resources*
  - Required NX technical data forms available on operating procedures webpage
  - **Separate technical data form required for each asset** (generator asset, ATRR, and DARD)
- **No. 16 (OP 16):** *Transmission System Data* (if necessary)
- **No. 18 (OP 18):** *Metering and Telemetering Criteria*



Market Integration: Add to Power System Model

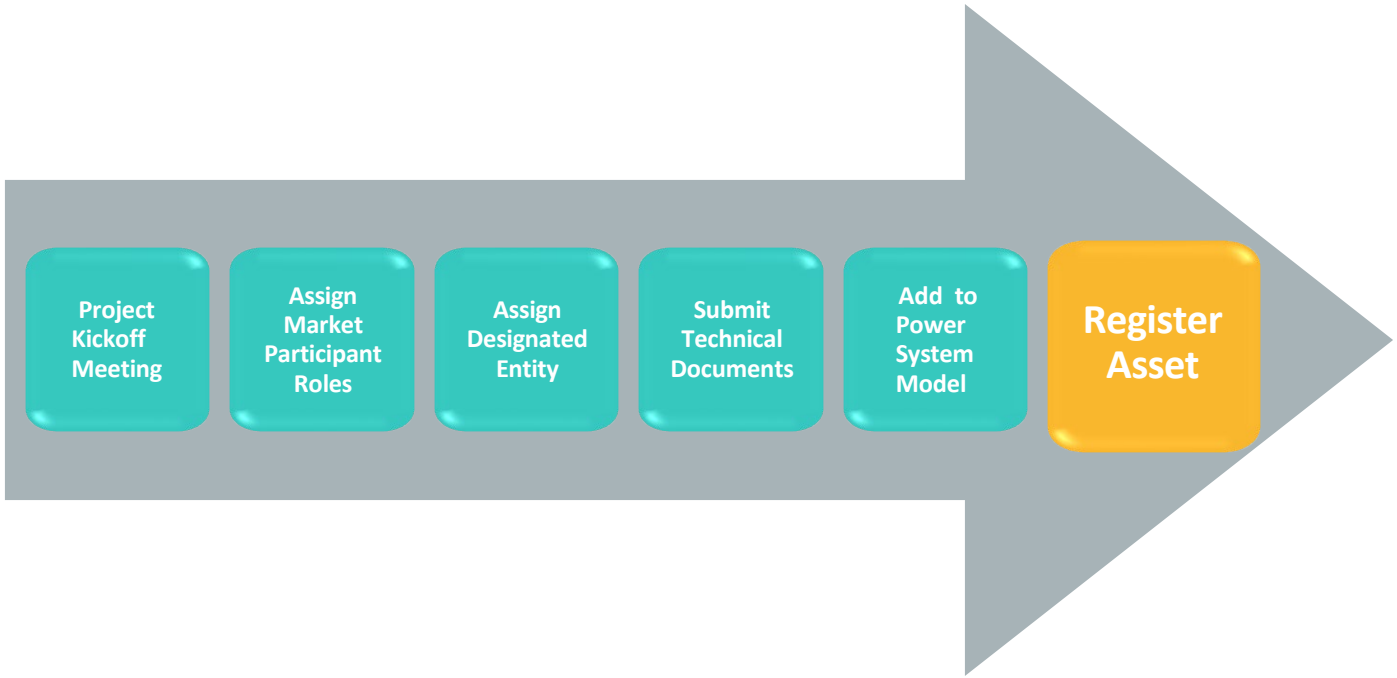
- Before operating, facility must be represented in ISO New England power system model
- Requires submission of one-line diagram of facility in advance of scheduled model update (February, May, September)



Deadlines for One-Line Diagram Submission	
Submit by *previous*:	For inclusion in update of:
November	**February**
March	**May**
July	**September**

Market Integration: Register Asset

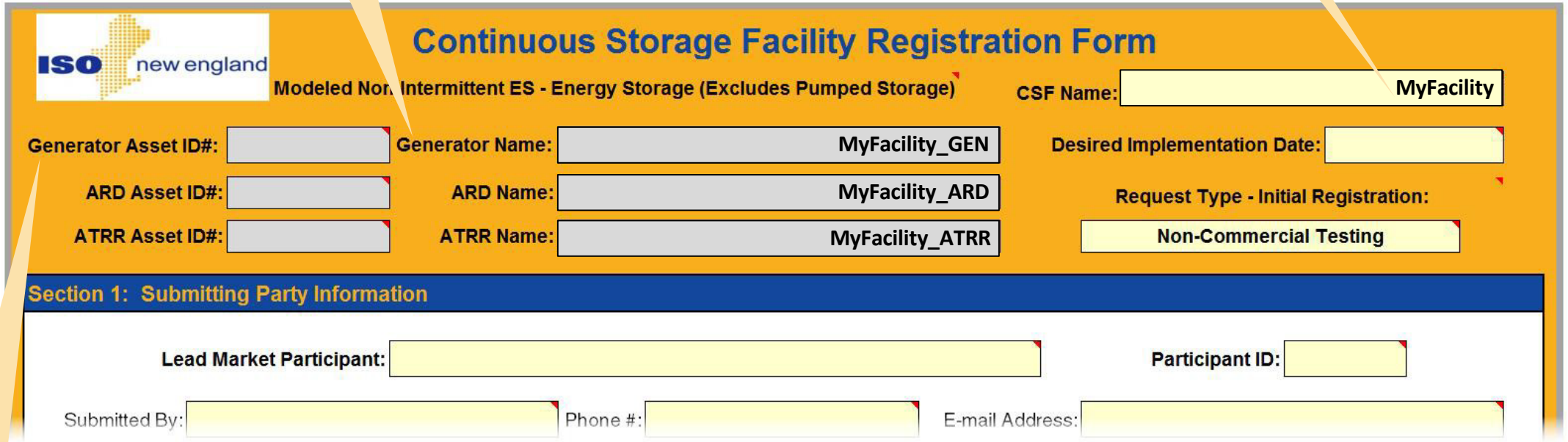
1. Submit request for continuous storage registration to Customer Support via Ask ISO
   - See Ask ISO user guide
2. ISO will contact you and guide you through submitting registration form
   - **Single registration form** for all three assets



Registration Results in Three Separate Assets IDs

1 **Lead market participant provides facility name;** must be unique and ≤26 characters

2 Suffixes automatically added to facility name to represent each CSF asset: "_GEN" for generator asset; "_ARD" for DARD; and "_ATRR" for ATRR



3 Asset IDs are generated by ISO and reflected in eMarket

Questions?

Coming Up:

- *eMarket Requirements*
- *Examples*
- *Settlement and Billing Impacts*
- *Additional Resources*

eMarket Requirements

Rules for Managing Assets, Bids, and Offers

Tim Peet
Manager, Customer Support

CSFs Must Follow Certain Rules in eMarket

- Rules for managing availability, bids, and offers
  - Rules relate to CSF registration and operating characteristics
- Subsequent slides cover only CSF changes, not general eMarket usage
  - To learn more about eMarket, see eMarket User Guide and FAQs: Using eMarket
- Web services and upload/download protocols:
  - For CSF asset types, same validation rules applied in XML uploads/downloads as in eMarket user interface
  - For more information, see Energy Storage Device (ESD) Project customer readiness webpage

There are **no changes for** *non*-CSF resources

Offer and Bid Data Requirements for CSFs

Values to be entered into eMarket application

- To self-schedule and maintain continuous range of potential dispatch points, CSF assets must **specify 0 MW** for:
  - **Economic minimum limit** (generator asset's lowest sustainable output level)
  - **Emergency minimum limit** (generator asset's minimum output deliverable for limited period without exceeding stability limits and operating permits)
  - **Minimum consumption limit** (DARD's lowest available consumption level)
- Since CSF generator asset operates without temporal constraints or costs and isn't part of commitment process, it must specify:
  - **0 value for:**
    - **Notification time**
    - **Start-up time**
    - **Minimum run time**
    - **Minimum down time**
  - **$0 for:**
    - **Start-up fee**
    - **No-load fee**

MR1, Section III.1.10.6

Declaring Unavailability or Scheduling Outages

Continuous Storage Facility Must Operate in On-line State Unless Declared Unavailable

Setting Availability Status

- *Day ahead:* participant sets status in eMarket to Must Run or unavailable
- *Real time:*
  - *For generator asset and DARD,* participant calls ISO control room to change availability
  - *For ATRR,* participant can change offer status in eMarket each hour *before* Regulation Selector is run
    - Once ATRR is selected, must call ISO control room to change status

Outages

- CSF generating asset must submit outages into CROW outage scheduler
  - DARDs and ATRRs cannot schedule outages

How Day-Ahead Asset Status Affects Real-Time Status

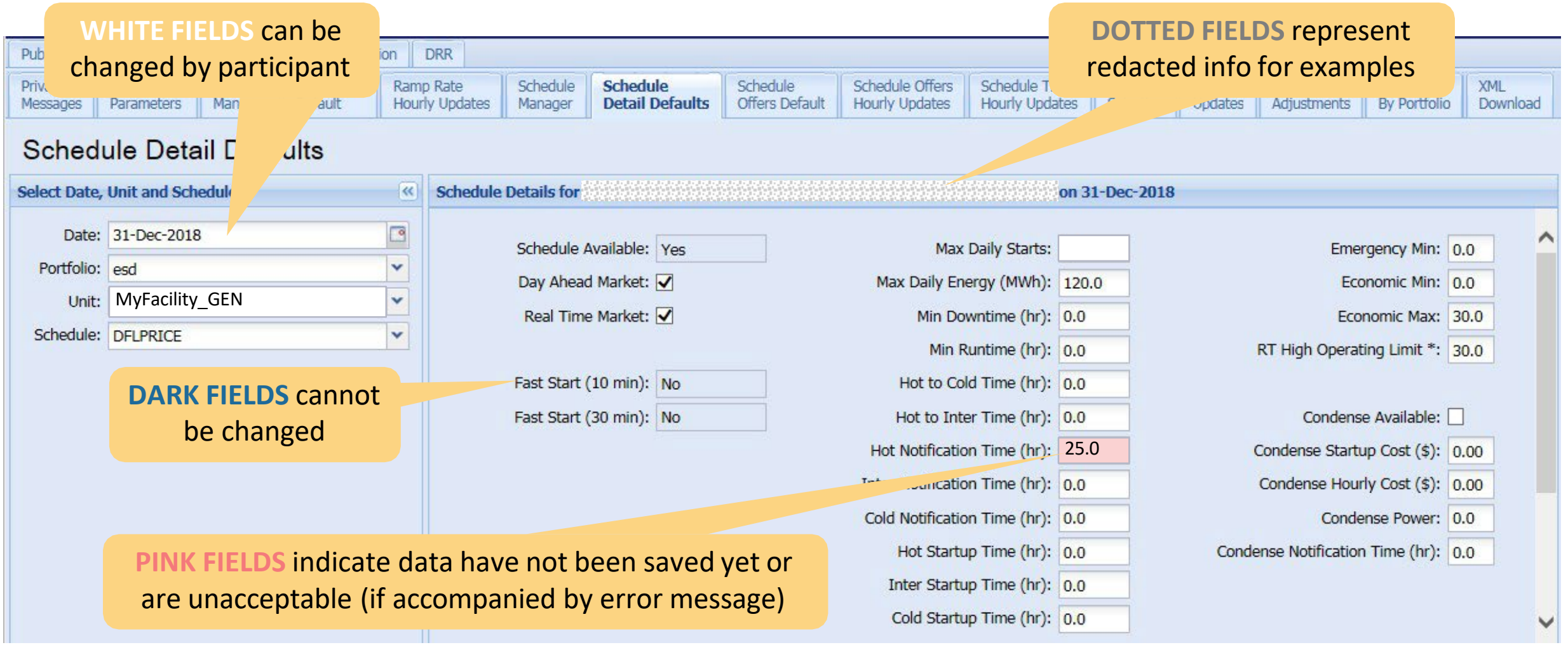
- Day-ahead market:
  - Participant can set Must Run or Unavailable status independently for generator asset and DARD
    - ATRR doesn't participate in Day-Ahead Energy Market
- Real-time operations:
  - **For generator asset and DARD,** if *either* is offered as Must Run, *both* are treated as available
    - Generator asset and DARD status always kept in synch
      - ATRR's status doesn't impact them
  - **For ATRR,** if generator and DARD are:
    - Unavailable, ATRR also unavailable
    - Must Run, ATRR can be *either* Must Run or Unavailable
  - Participant must call ISO control room to change status in real time (see preceding slide)

Status Interplay

DAY AHEAD			REAL-TIME OPERATIONS		
GEN	DARD		GEN	DARD	ATRR
✓	✓	→	✓	✓	✓ or ✗
✓	✗	→	✓	✓	✓ or ✗
✗	✓	→	✓	✓	✓ or ✗
✗	✗	→	✗	✗	✗

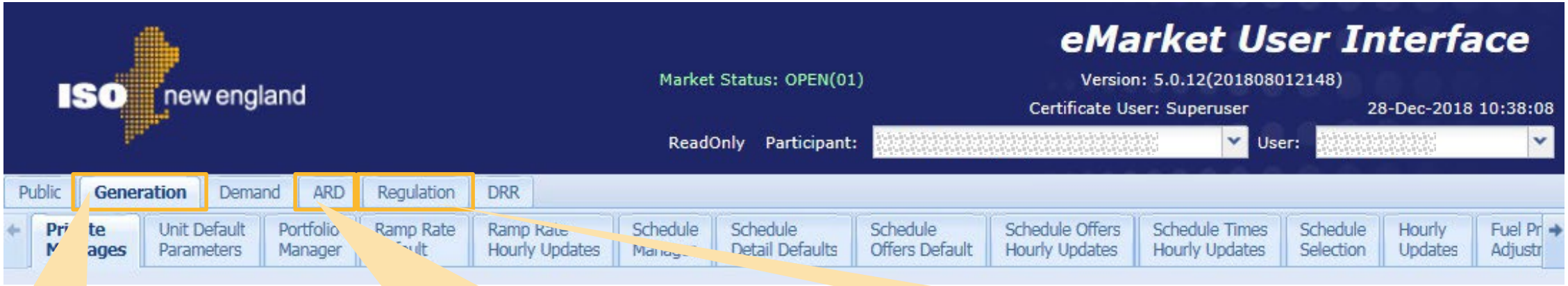
✓ = Must Run ✗ = Unavailable

Key to eMarket Fields



Manage Availability and Offers or Bids Separately for Each CSF Asset Type

Look for Appropriate Tab



1 Use to manage **generator** asset

2 Use to manage **dispatchable asset-related demand (DARD)** asset

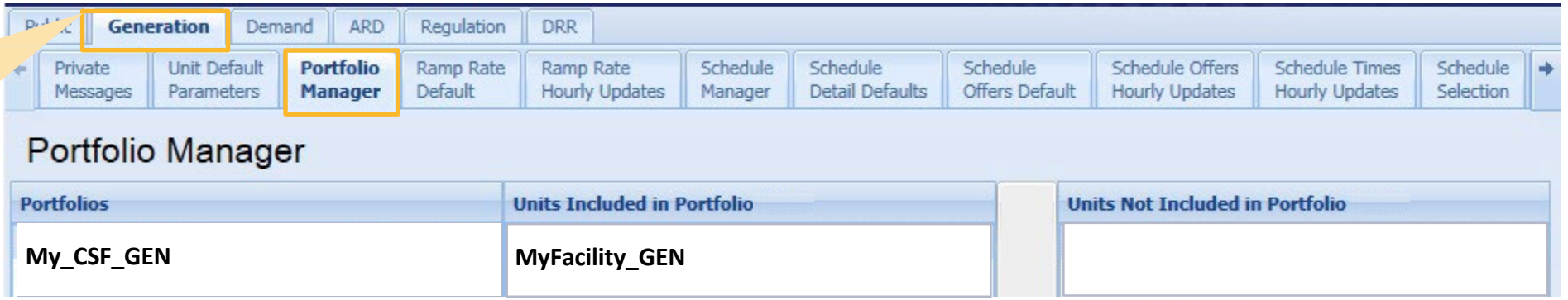
3 Use to manage **alternative technology regulation resource (ATRR)** asset

Remember, participant is responsible for developing day-ahead bids and offers so that CSF does not get day-ahead obligation to charge and discharge at same time. ISO day-ahead software will not check for this.

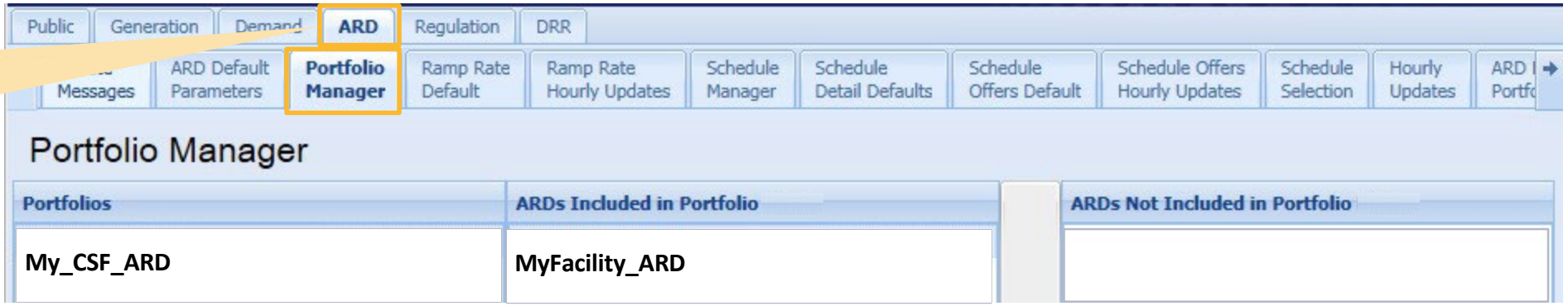
Portfolio Manager Tabs

Start by Adding Each CSF Asset into Corresponding Portfolios

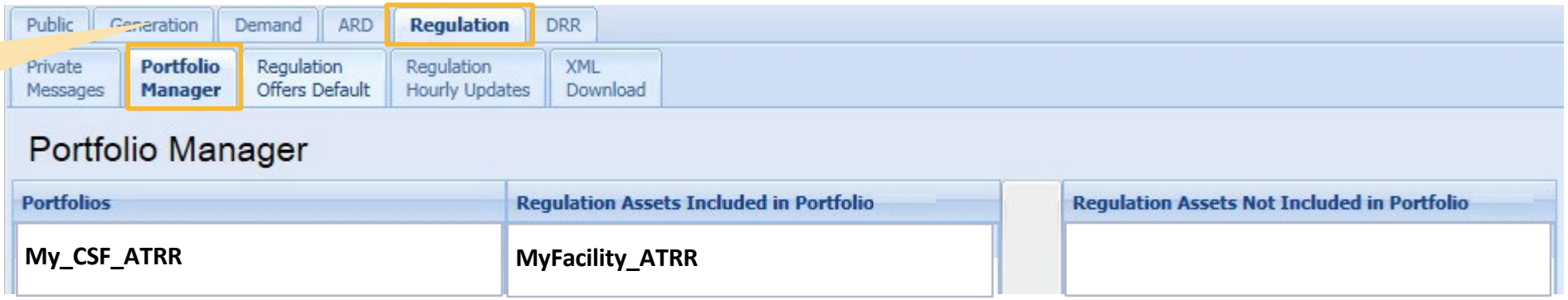
1 Add *MyFacility_**GEN*** to **generation** portfolio



2 Add *MyFacility_**ARD*** to **asset-related demand** portfolio



3 Add *MyFacility_**ATRR*** to **regulation** portfolio



Questions?

Coming Up:

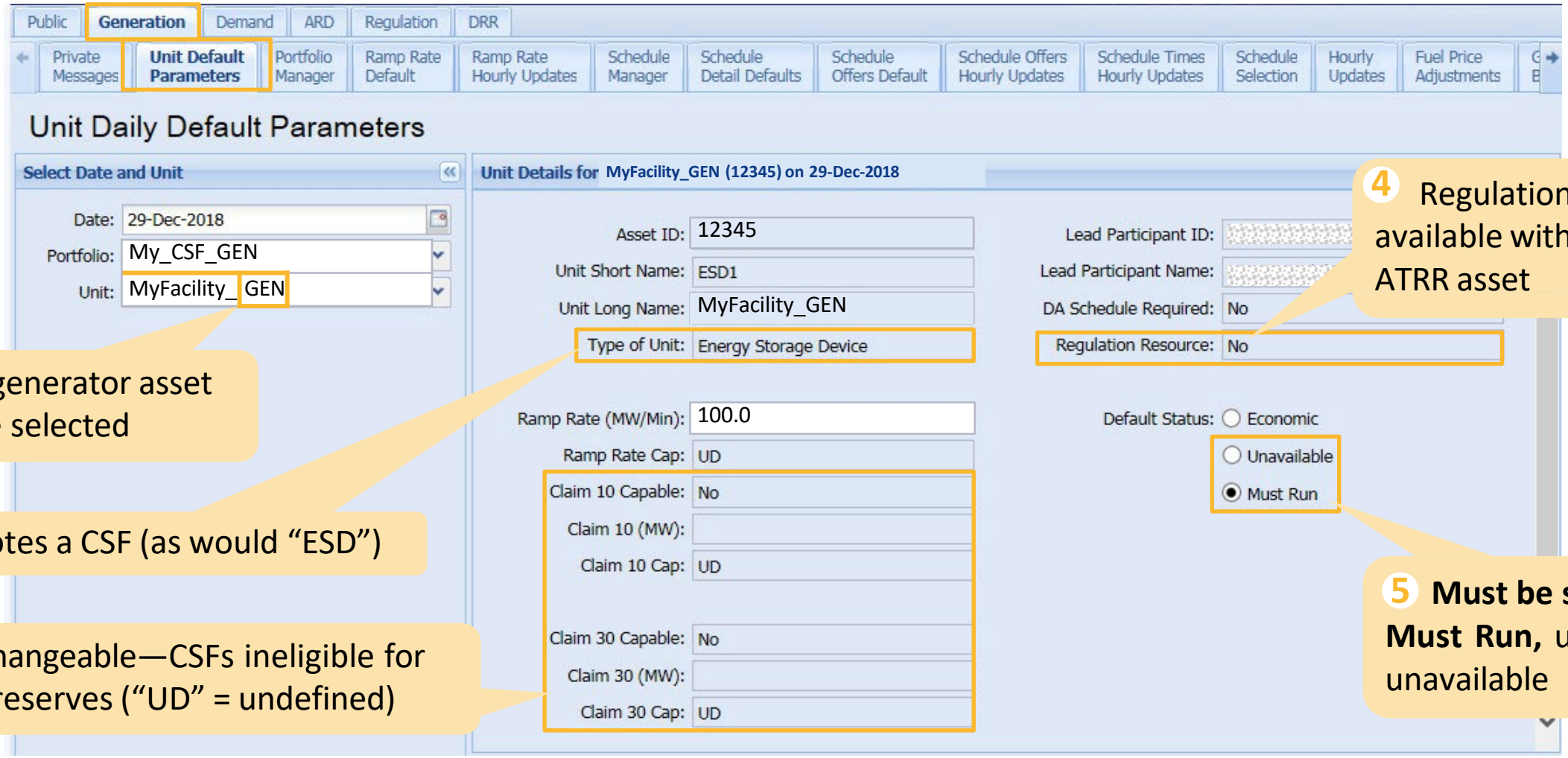
- *eMarket Requirements for CSF Generator Assets*
- *Examples*
- *Settlement and Billing Impacts*
- *Additional Resources*

CSF Generator Asset

eMarket Rules for Continuous Storage Facilities

Generation Tab: Unit Default Parameters

Inputs Here Establish Default Values



1 CSF generator asset must be selected

2 Denotes a CSF (as would "ESD")

3 Unchangeable—CSFs ineligible for offline reserves ("UD" = undefined)

4 Regulation only available with ATRR asset

5 **Must be set to Must Run,** unless unavailable

Generation Tab: Schedule Detail Defaults

Inputs Here Establish Default Values

[1]A Max Daily Energy value is the maximum amount of energy a unit can produce in one operating day, whereas a blank field means the value is unlimited. Specifying a value allows you to choose to operate as a limited-energy generator (LEG) in real time.

Limited Energy Generator (LEG) Option

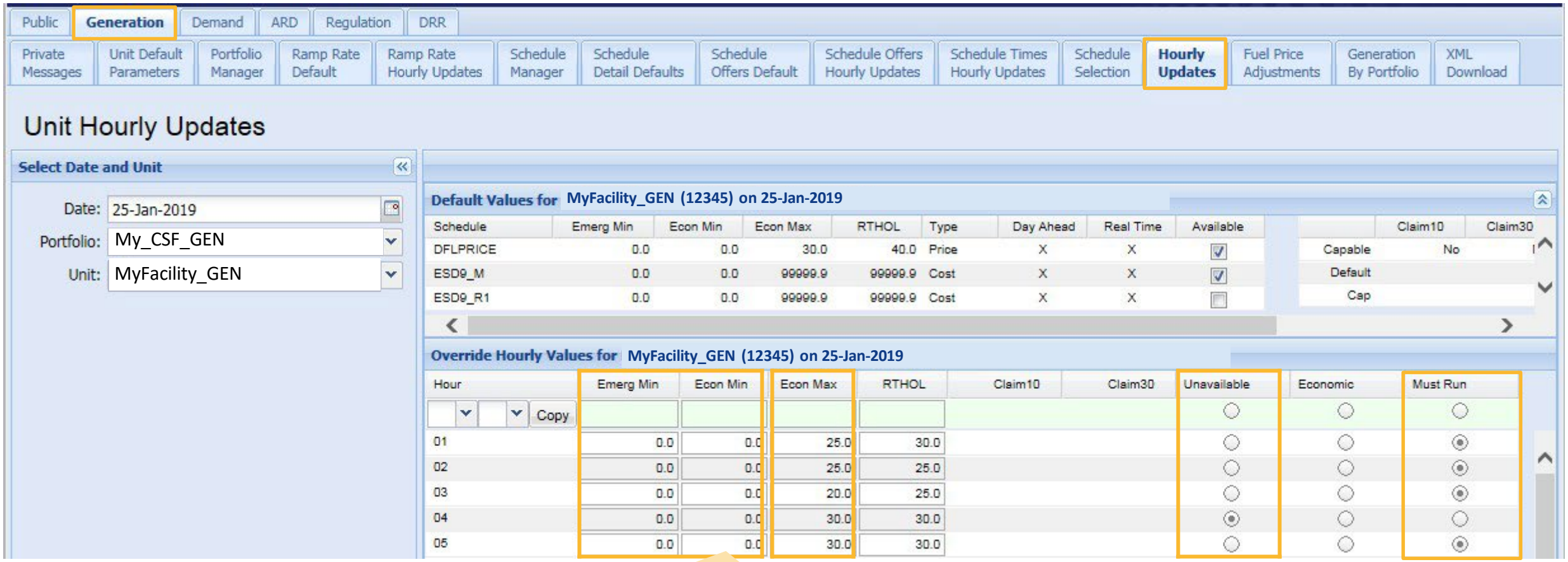
- Enter Maximum Daily Energy value (MWh) in Schedule Detail Defaults tab
- **Day ahead,** software schedules limited energy in hours with greatest positive difference between locational marginal price and generator offer
- **In real time,** two options:
  1. Do nothing and operate as economic resource
     - Unit dispatched without consideration of Max Daily Energy value (e.g., energy may be depleted before day's end)
     - ISO may posture resource to preserve capacity through peak hour, if necessary
  2. Call ISO control room to activate LEG dispatch
     - Unit dispatched economically between CSF's Eco Min of 0 MW and *hourly* LEG limit
       - Participant can call in hourly LEG limit in advance (including 0 MW)

Effective Economic Max

- Participant can offer economic max in eMarket using daily default with hourly overrides
  - Illustrated on Schedule Detail Defaults screenshot
- But *effective* economic max may be different from *offered* economic max to comply with reliability requirement
  - Reserves must be sustainable for at least one hour
- *Effective* economic max is calculated in real time using telemetered available energy

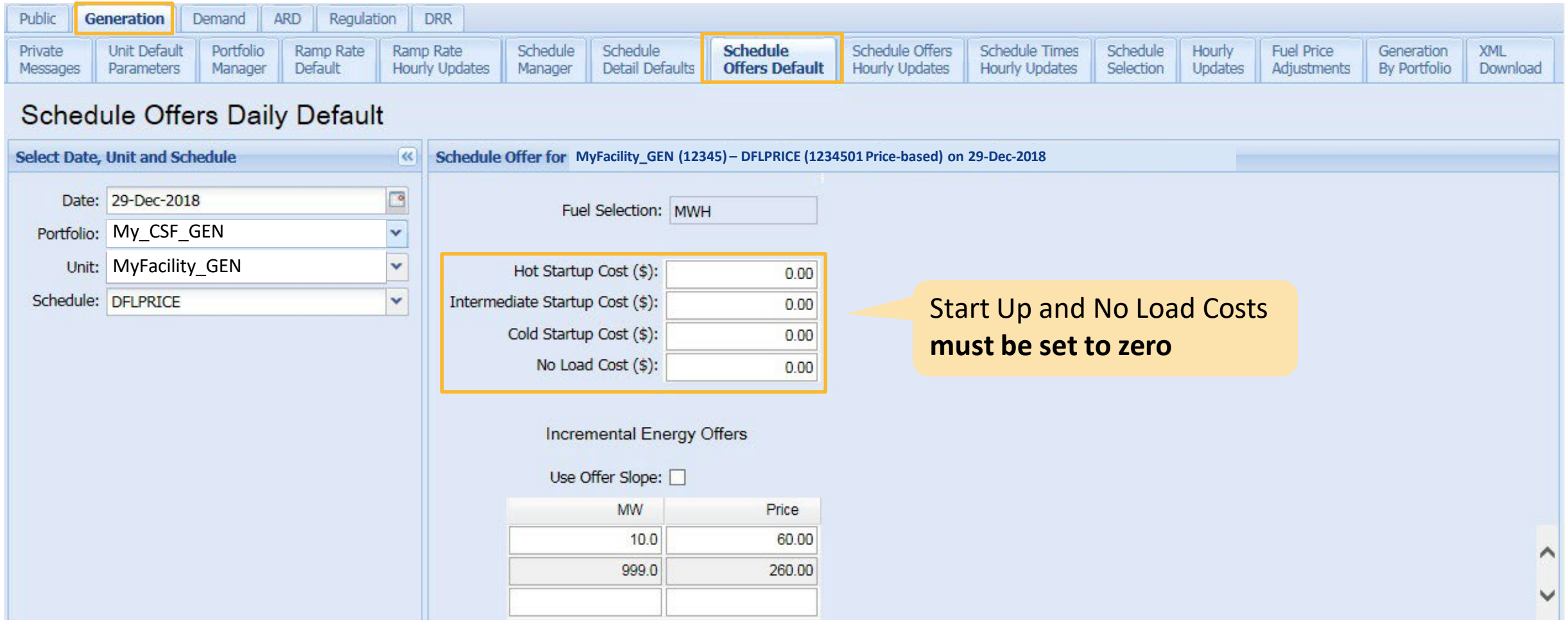
Generation Tab: Hourly Updates

Economic Max and Availability for CSF Generator Asset Can Be Set On an Hourly Basis to Override Default Values



Remember that Economic Min and Emergency Min **must be set to zero**

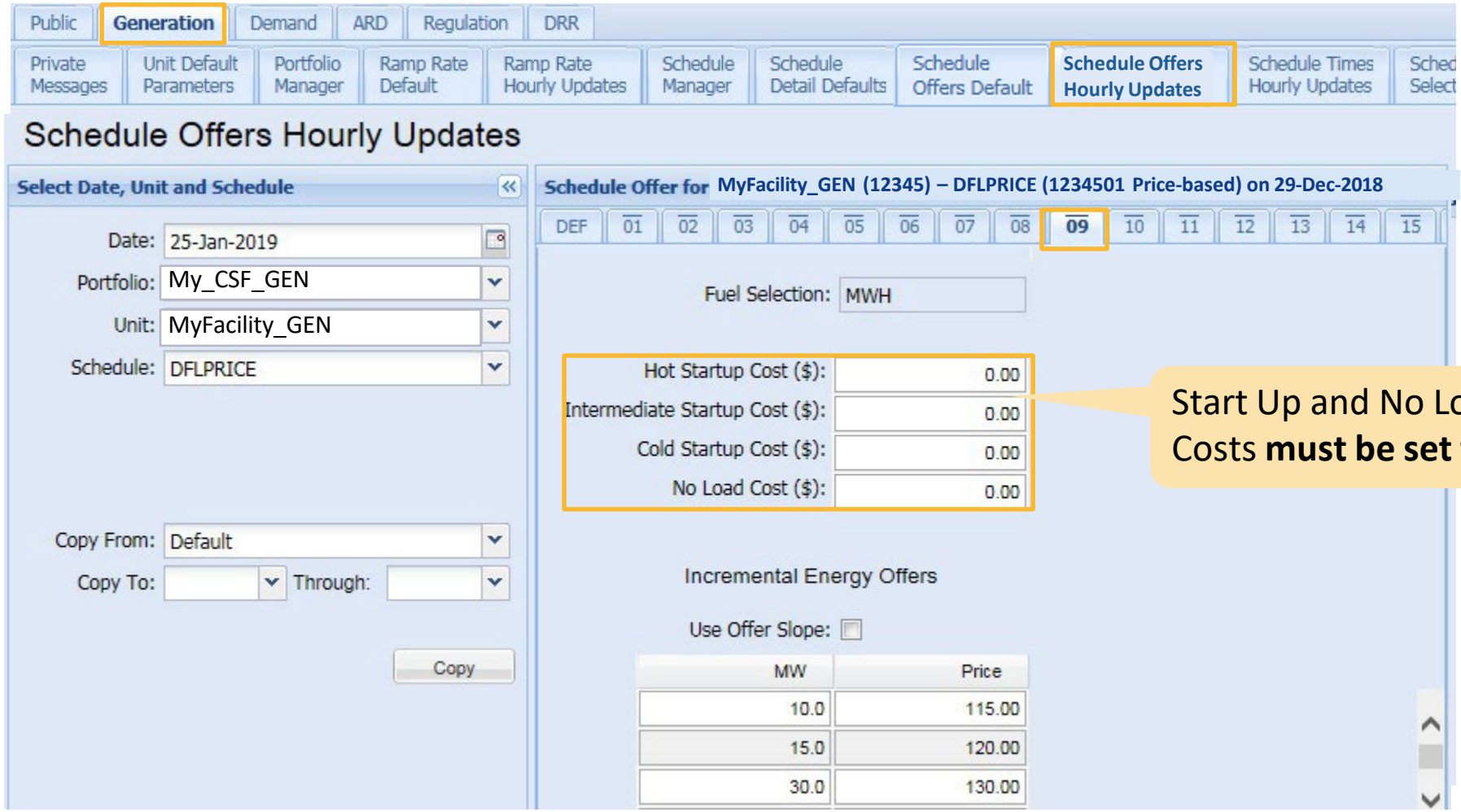
Generation Tab: Schedule Offers Default



Start Up and No Load Costs **must be set to zero**

Generation Tab: Schedule Offer Hourly Updates

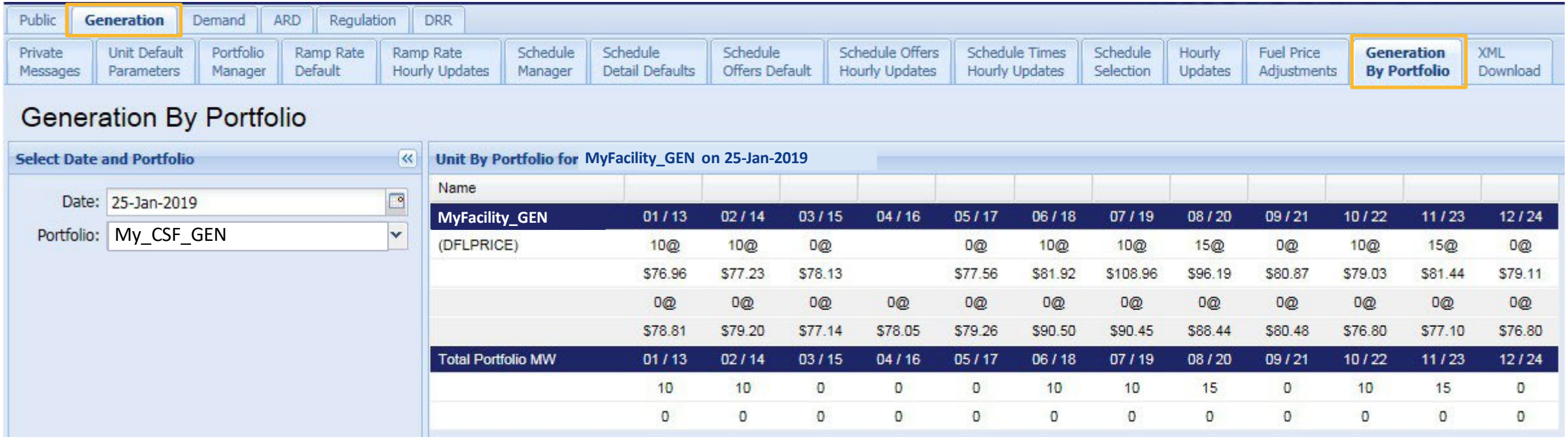
Offers Can Be Set on an Hourly Basis to Override Default Values



Start Up and No Load Costs **must be set to zero**

Generation Tab: Generation by Portfolio

Portfolio Clearing Results in Day-ahead Energy Market Based on Economics and CSF Generator Asset Availability



Public | Generation | Demand | ARD | Regulation | DRR

Private Messages | Unit Default Parameters | Portfolio Manager | Ramp Rate Default | Ramp Rate Hourly Updates | Schedule Manager | Schedule Detail Defaults | Schedule Offers Default | Schedule Offers Hourly Updates | Schedule Times Hourly Updates | Schedule Selection | Hourly Updates | Fuel Price Adjustments | **Generation By Portfolio** | XML Download

Generation By Portfolio

Select Date and Portfolio

Date: 25-Jan-2019

Portfolio: My_CSF_GEN

Unit By Portfolio for MyFacility_GEN on 25-Jan-2019

Name												
MyFacility_GEN	01 / 13	02 / 14	03 / 15	04 / 16	05 / 17	06 / 18	07 / 19	08 / 20	09 / 21	10 / 22	11 / 23	12 / 24
(DFLPRICE)	10@	10@	0@		0@	10@	10@	15@	0@	10@	15@	0@
	$76.96	$77.23	$78.13		$77.56	$81.92	$108.96	$96.19	$80.87	$79.03	$81.44	$79.11
	0@	0@	0@	0@	0@	0@	0@	0@	0@	0@	0@	0@
	$78.81	$79.20	$77.14	$78.05	$79.26	$90.50	$90.45	$88.44	$80.48	$76.80	$77.10	$76.80
Total Portfolio MW	01 / 13	02 / 14	03 / 15	04 / 16	05 / 17	06 / 18	07 / 19	08 / 20	09 / 21	10 / 22	11 / 23	12 / 24
	10	10	0	0	0	10	10	15	0	10	15	0
	0	0	0	0	0	0	0	0	0	0	0	0

Questions?

Coming Up:

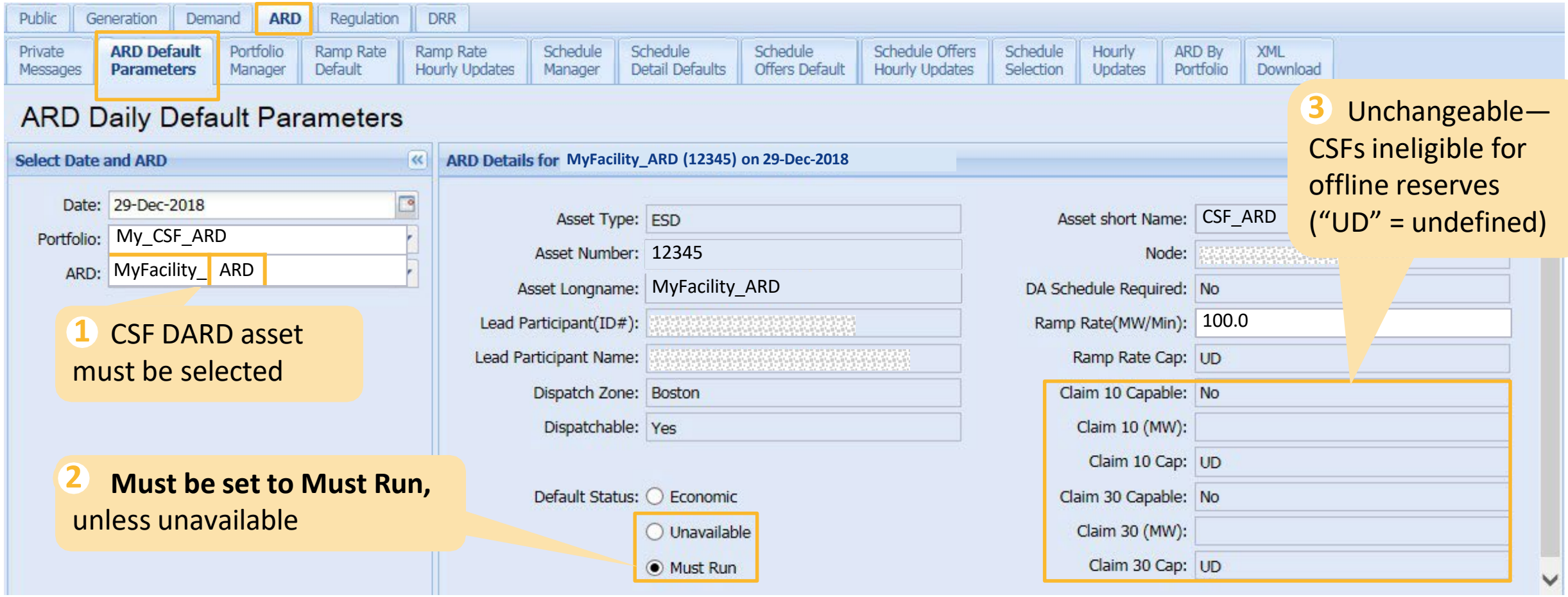
- *eMarket Requirements for CSF DARDs and CSF ATRRs*
- *Examples*
- *Settlement and Billing Impacts*
- *Additional Resources*

CSF DARD Asset

eMarket Rules for Continuous Storage Facilities

ARD Tab: ARD Default Parameters

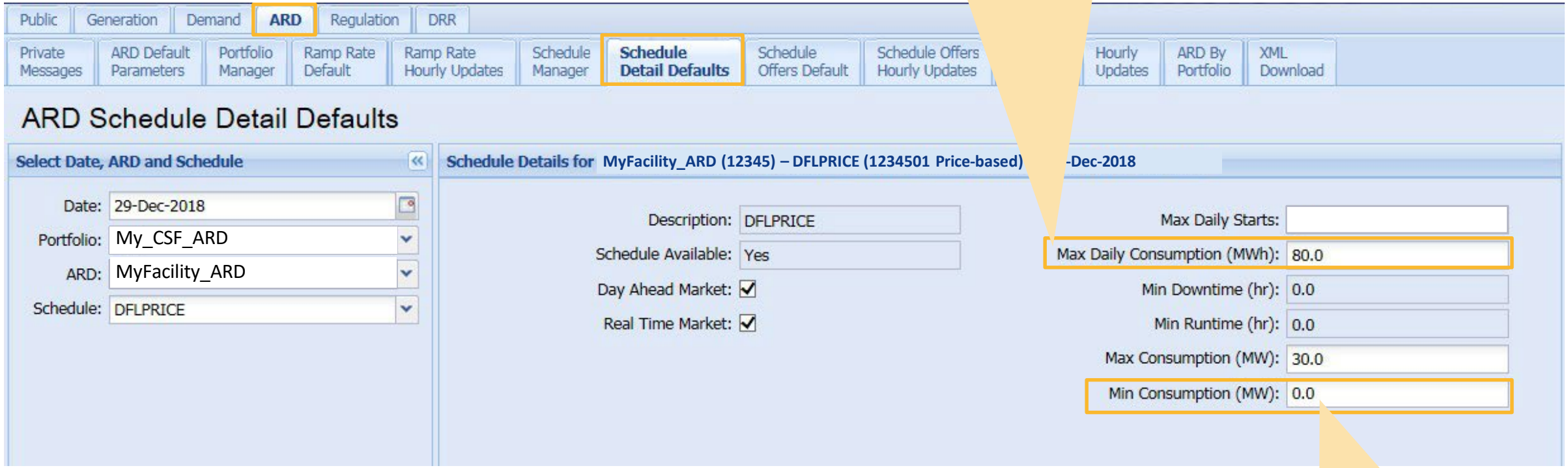
Inputs Here Establish Default Values



ARD Tab: Schedule Detail Defaults

Inputs Here Establish Default Values

1 Specify maximum energy to be consumed in day-ahead market



2 **Must be set to zero**

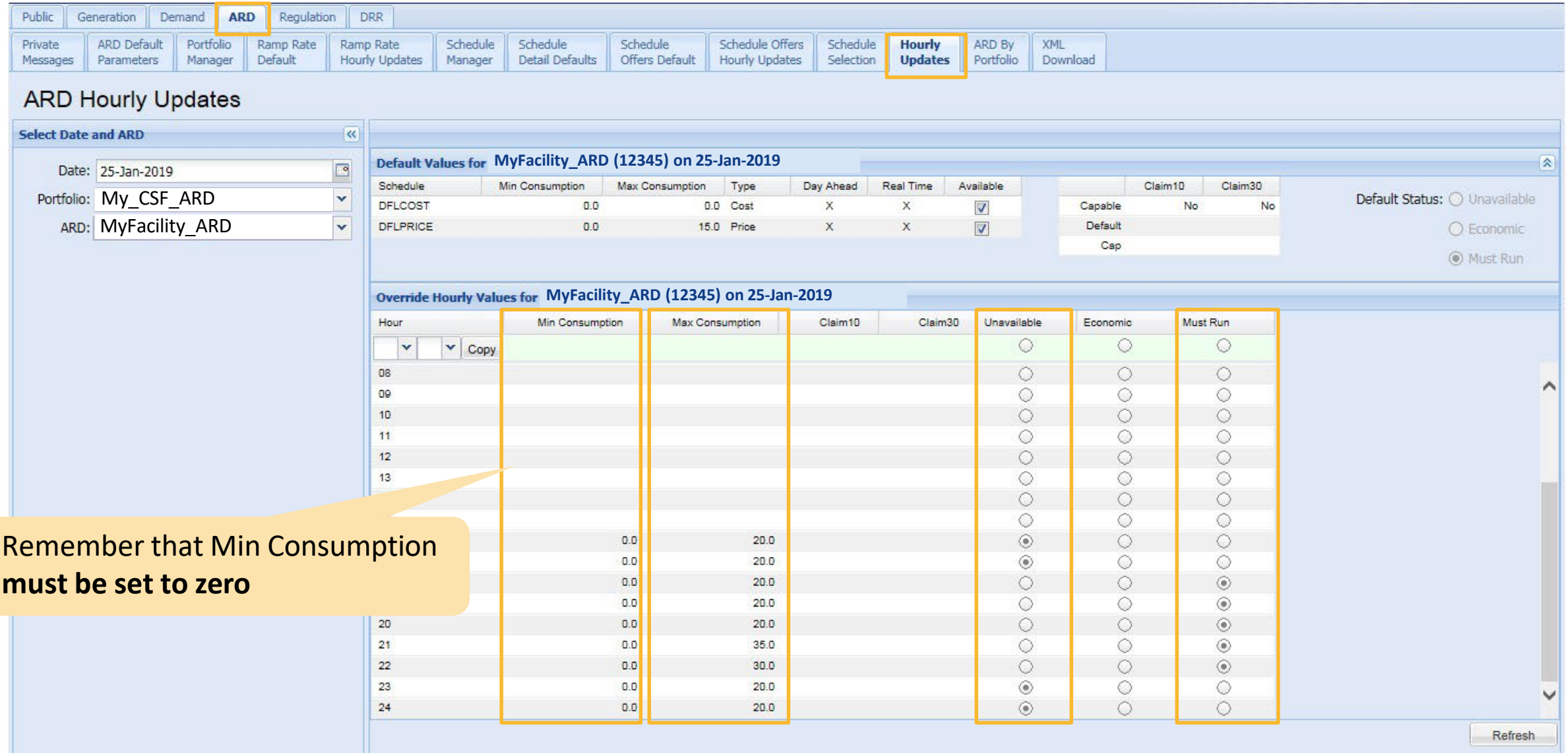
Effective Consumption Max

Similar to Effective Economic Max Discussed Previously for CSF Generator Asset

- Participant can offer max consumption in eMarket using daily default with hourly overrides
  - Illustrated on Schedule Detail Defaults screenshot
- But *effective* max consumption may differ from *offered* max consumption to ensure sustainability for ≥15 minutes
  - Necessary to comply with economic dispatch period
- *Effective* max consumption is calculated in real time using participant's telemetered available storage

ARD Tab: Hourly Updates

Max Consumption and Availability for CSF DARD Can Be Set on an Hourly Basis to Override Default Values



Remember that Min Consumption **must be set to zero**

ARD Tab: ARD by Portfolio

Clearing Results in Day-Ahead Energy Market Based on Economics and DARD Availability

Ard/Schedule												
MyFacility_ARD	01 / 13	02 / 14	03 / 15	04 / 16	05 / 17	06 / 18	07 / 19	08 / 20	09 / 21	10 / 22	11 / 23	12 / 24
(DFLPRICE)	0@	0@	0@	0@	0@	0@	0@	0@	0@	0@	0@	0@
	$76.96	$77.23	$78.13	$76.84	$77.56	$81.92	$108.96	$96.19	$80.87	$79.03	$81.44	$79.11
	0@	0@	0@	0@	0@	0@	0@	8.5@	9.9@	0@	0@	0@
	$78.81	$79.20	$77.14	$78.05	$79.26	$90.50	$90.45	$88.44	$80.48	$76.80	$77.10	$76.80
Total Portfolio MW	01 / 13	02 / 14	03 / 15	04 / 16	05 / 17	06 / 18	07 / 19	08 / 20	09 / 21	10 / 22	11 / 23	12 / 24
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	8.5	9.9	0	0	0

Questions?

Coming Up:

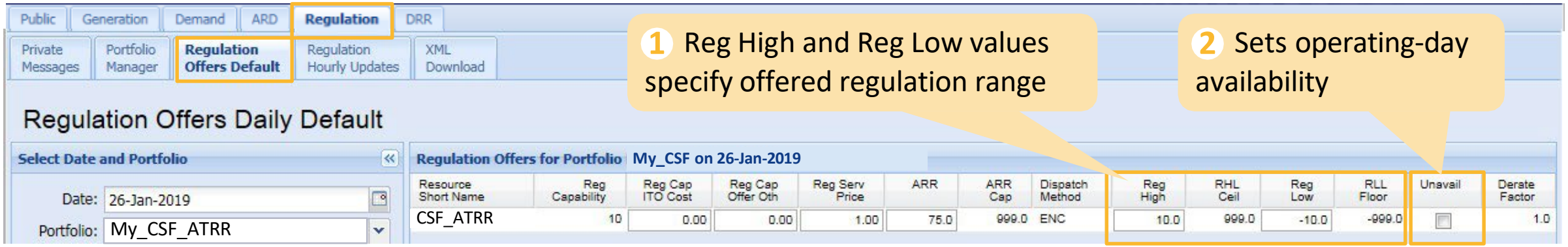
- *eMarket Requirements for CSF ATRRs*
- *Examples*
- *Settlement and Billing Impacts*
- *Additional Resources*

CSF ATRR Asset

eMarket Rules for Continuous Storage Facilities

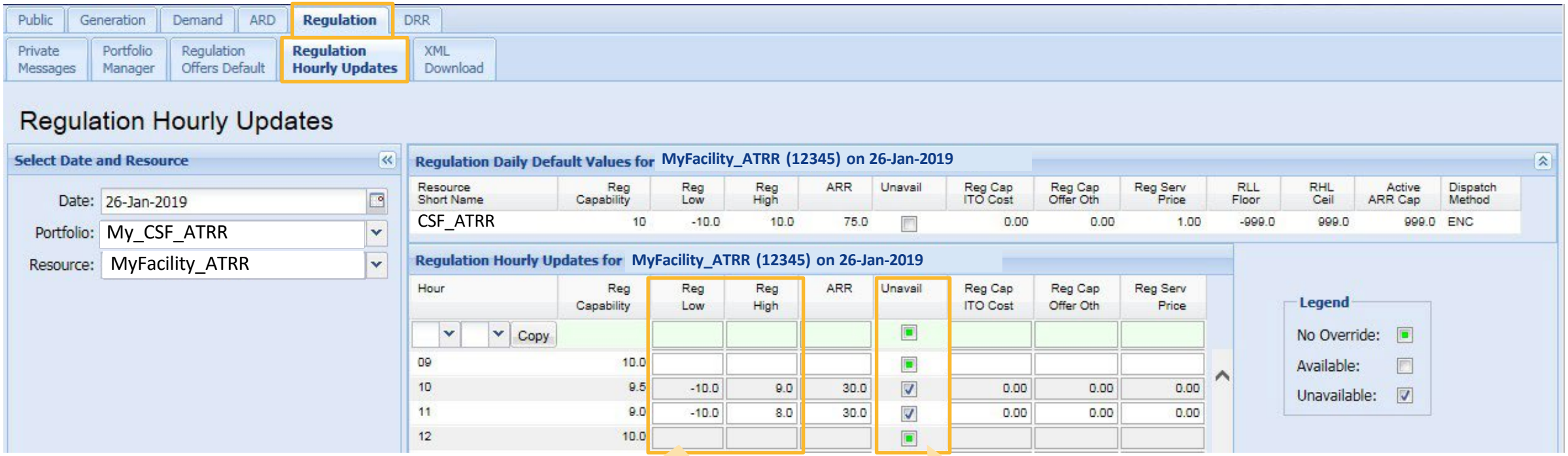
Regulation Tab: Regulation Offers

*Use to Set CSF ATRR's **Daily** Availability and Regulation Limits*



Regulation Tab: Regulation Hourly Updates

*Use to Set CSF ATRR's **Hourly Overrides** for Availability and Regulation Limits*



1 Reg High and Reg Low values specify offered regulation range

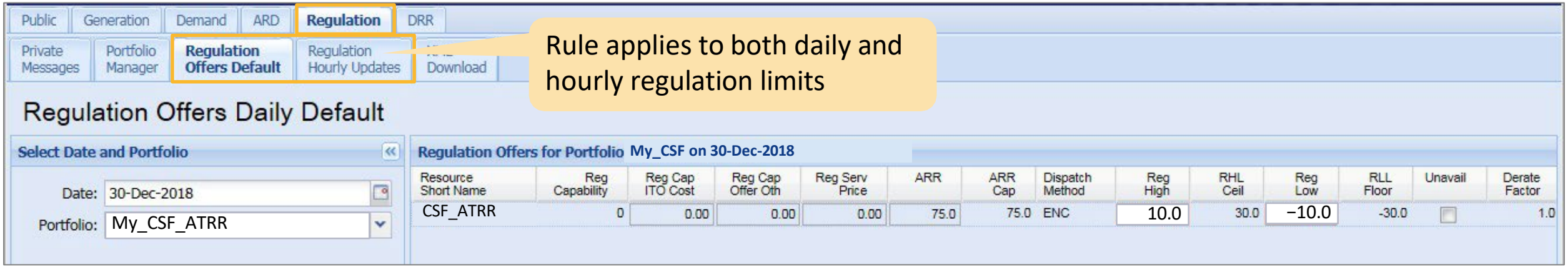
2 Sets hourly availability

New Mid-Point Limit Validation Rule

Only Applies to CSF ATRR

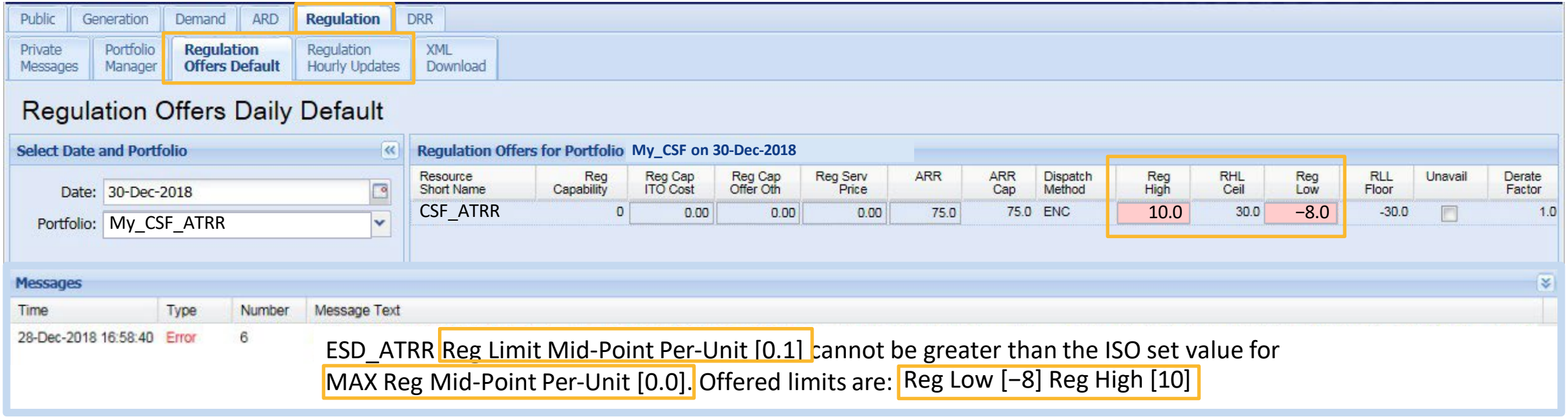
- ATRR's average net consumption of 0 MW allows ISO to dispatch CSF generator or DARD asset for energy while ATRR simultaneously provides regulation

- To accomplish this:
  - Regulation range (i.e., Reg High and Reg Low) must be symmetrical or biased slightly to charging
  - System validation ensures range doesn't exceed maximum or minimum mid-point limit
    - Limit will be made available



Error Example: Exceeding MAX Midpoint Limit

Error Must Be Cleared to Submit Offer

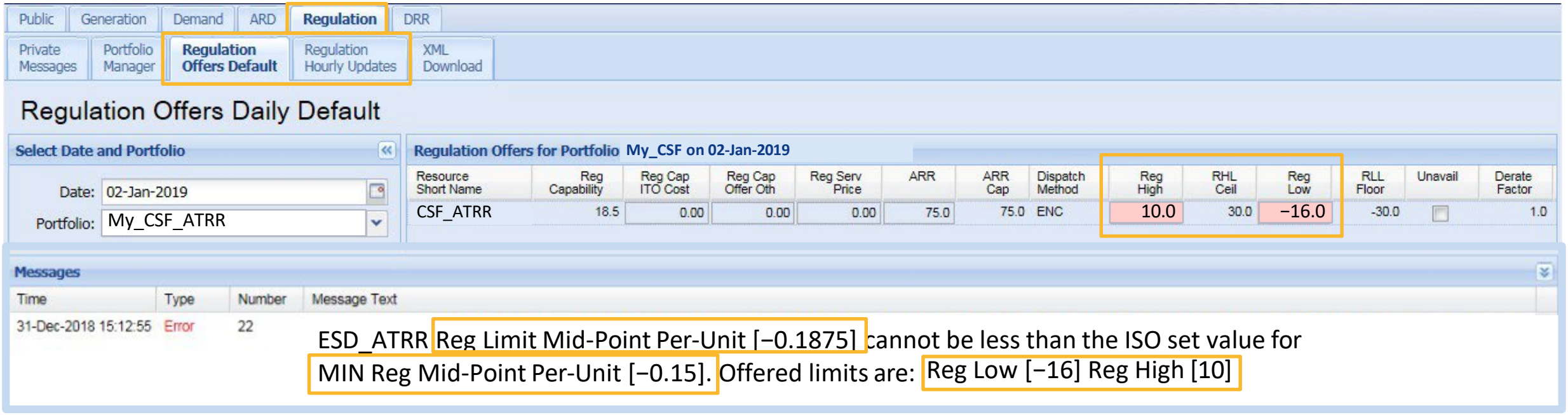


If Reg Limit Mid-Point > Max Reg Mid-Point = ERROR

1. **Mid-point of regulation range** = (Reg High + Reg Low) ÷ 2 = (10 + −8) ÷ 2 = 1.0
2. **Reg Limit Mid-Point** = mid-point of regulation range ÷ the greater of the *absolute* value of Reg High and the *absolute* value of Reg Low = 1 ÷ 10 = 0.1
3. **Max Reg Limit Mid-Point** for this unit (set by ISO) = 0.0
4. 0.1 > 0.0 = **ERROR**

Error Example: Falling Below MIN Midpoint Limit

Error Must Be Cleared to Submit Offer



If Reg Limit Mid-Point < Min Reg Mid-Point = ERROR

1. **Mid-point of regulation range** = (Reg High + Reg Low) ÷ 2 = [10 + −16] ÷ 2 = −3
2. **Reg Limit Mid-Point** = mid-point of regulation range ÷ greater of the *absolute* value of Reg High and the *absolute* value of Reg Low = −3 ÷ 16 = −0.1875
3. **Min Reg Mid-Point** for this unit (set by ISO) = −0.15
4. −0.1875 < −0.15 = **ERROR**

Examples

How Continuous Storage Facilities Could Offer or Bid into Markets

Example 1

Default Offers Are Used for Day-Ahead Commitment of Generator Asset and DARD

MyFacility_GEN

Economic Max (MW):	12	
Max Daily Energy (MWh):	10	
	MW	Price
Incremental Energy Offer:	12	$30

1 Participant specifies daily max values; do not have to match

MyFacility_ARD

Max Consumption (MW):	12	
Max Daily Consumption (MWh):	12	
	MW	Price
Incremental Energy Offer:	12	$15

2 10 MWh from generator asset and 12 MWh from DARD are committed based on market clearing

Clearing in Day-Ahead Energy Market

Asset	Hourly Interval																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
LMP ($/MWh)	$15	$15	$15	$15	$15	$20	$25	$30	$30	$30	$30	$25	$25	$25	$30	$35	$35	$30	$25	$25	$20	$20	$15	$15
MyFacility_GEN	0	0	0	0	0	0	0	1	1	1	1	0	0	0	2	4	0	0	0	0	0	0	0	0
MyFacility_ARD	2	3	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1

Example 2

Participant Strategically Offers and Bids Day Ahead with Goal of Alternating Discharging and Consumption

MyFacility_GEN

Economic Max (MW):	12
Max Daily Energy (MWh):	60

1 Participant sets daily max values so to limit each asset to 12 hours of operation (12 MW x 5 hrs = 60 MWh)

MyFacility_ARD

Max Consumption (MW):	12
Max Daily Consumption (MWh):	60

2 Participant staggers low and high offers and bids. (Low generator asset offers signal desire to generate, while low DARD bids signal desire *not* to consume. Conversely, *high* generator asset offer signals desire *not* to generate, while high DARD bid signals desire to consume.)

Hourly Updates

Asset		Hourly Interval																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
MyFacility_GEN	MW	0	0	0	0	0	0	0	0	0	0	0	0	12	12	12	12	12	0	0	0	0	0	0	0
	Price	100	100	100	100	100	100	100	100	100	100	100	100	−150	−150	-150	-150	-150	100	100	100	100	100	100	100
MyFacility_ARD	MW	12	12	12	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Price	50	50	50	50	50	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150

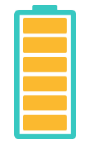
Clearing in Day-Ahead Energy Market

3 Market clears with 60 MWh spread across each asset's 5 economic hours

Asset		Hourly Interval																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	LMP ($/MWh)	$20	$20	$10	$10	$20	$22	$25	$27	$30	$30	$30	$25	$30	$35	$29	$25	$35	$35	$20	$20	$20	$20	$20	$20
MyFacility_GEN	MW	0	0	0	0	0	0	0	0	0	0	0	0	12	12	12	12	12	0	0	0	0	0	0	0
MyFacility_ARD	MW	12	12	12	12	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Example 3

CSF Hopes to Regulate at ±10 MW and Generate at 2 MW



Offers and Bids

Asset		Hourly Interval	
		1	2
MyFacility_GEN	MW	12	12
	Price	−150	−150
MyFacility_ARD	MW	12	12
	Price	−150	−150
MyFacility_ATRR	Reg High	10	10
	Reg Low	−10	−10
	Price	0	20

1 Low generator asset offer signals desire to generate

2 Low DARD bid signals desire ***not*** to consume

3 Low ATRR offer signals strong desire to regulate

Clearing in Real-Time Energy Market

Asset		Hourly Interval	
		1	2
	LMP ($/MWh)	$20	$20
MyFacility_GEN	MW	2	12
MyFacility_ARD	MW	0	0
MyFacility_ATRR	MW	±10	0

4 Generator asset and ATRR selected. CSF receives single dispatch signal between 12 MW and −8 MW in hour 1

5 Only generator asset selected. Single dispatch signal = 12 MW for entire hour 2

Questions?

Coming Up:

- *Settlement and Billing Impacts*
- *Additional Resources*

Settlement and Billing Impacts

Sarthak Pant
Sr. Settlement Analyst, Hourly Markets, Settlements

CSF Impacts to Settlements

- No changes to ISO's *overarching* settlement design
  - CSF assets largely compensated same as any generator, DARD, or ATRR
  - Same day-ahead and real-time net commitment-period compensation (NCPC) cost allocation (i.e., same as pumped-storage hydro)
- A few adjustments to reflect CSFs:
  - Enhanced metered quantity for settlement (i.e., energy quantity)
  - In NCPC rules:
    - Existing NCPC logic extended to all electric storage facilities, unless specified
    - "DARD pump" term replaced by "storage DARD"
      - "Binary storage DARD" specified where applicable
  - In settlement reports, CSF DARD type identified as "energy storage"
- For details, see Enhanced Storage Participation Revisions filing

High-Level Overview of Continuous Storage Facility Settlement Impacts

Includes All Changes Effective April 2019 with Enhanced Storage Participation Revisions

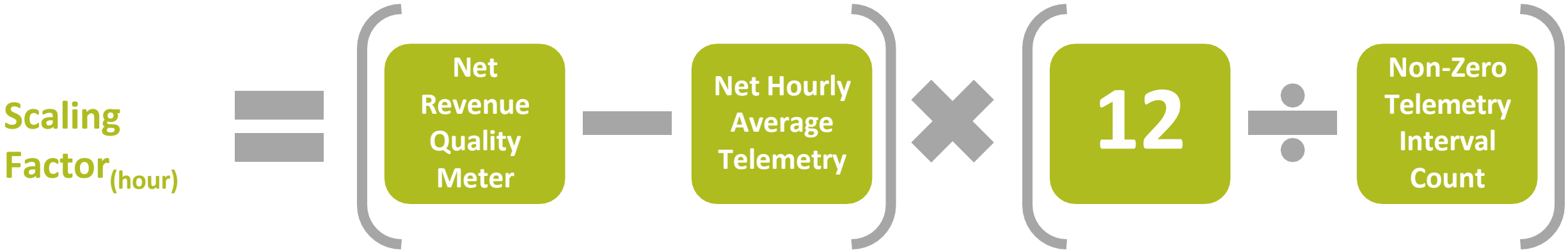
Settlement Type	Calculation Impact	Settlement Report Changes (No New Reports)
Day-Ahead Energy	None	None
Day-Ahead NCPC	Always-committed CSF generator asset treated like fast-start unit	New CSF DARD type identified as "Energy Storage"
Energy Quantity	New calculation method for CSFs	New calculation method identified as "Net Adjustment"
Real-Time Energy	None	New CSF load asset subtype identified as "Energy Storage"
Real-Time NCPC	• CSF generator asset uses DDP instead of actual output, if CSF ATRR is regulating • CSF generator asset not eligible for real-time NCPC commitment credit or hourly shortfall NCPC credit • CSF DARD not eligible for hourly shortfall NCPC credit	• New column in SR_RTNCPCGEN5MIN and SR_RTNCPCDARD5MIN reports: Continuous Storage Regulating Flag • New CSF credit class identified as "ESD" • New reason codes for CSF used in real-time NCPC settlements
Reserve Market	None	None
Regulation Market	DARD real-time load obligation related to regulation dispatch of ATRR is excluded from cost allocation	New columns in SR_REGSUMMARY report: RT Load Obligation for DARDs, Pool RT Load Obligation for DARDs, Subaccount RT Load Obligation for DARDs
Financial Transmission Rights	None	None
Forward Capacity Market	• Follows current treatment for pumped storage DARD • Excluded from annual peak and peak contribution	None

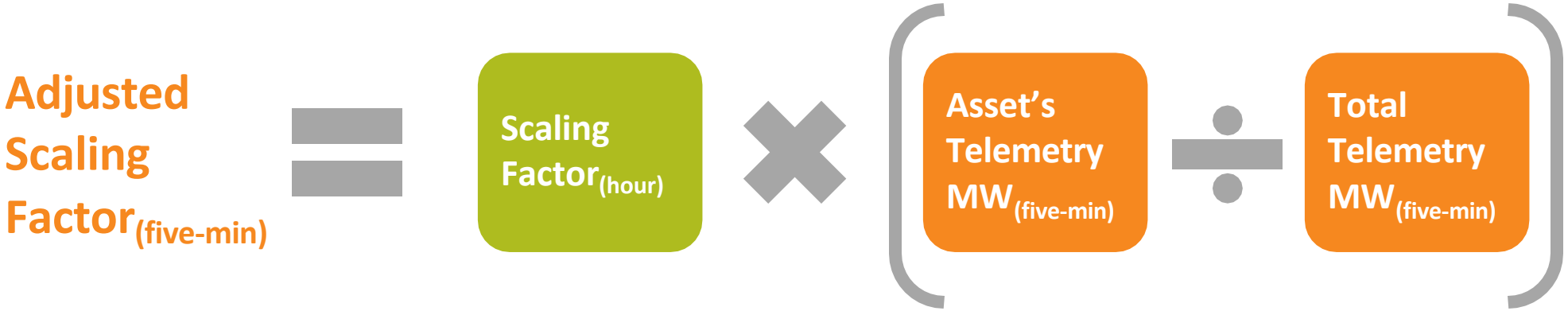
Inputs to Energy Quantity Calculation for CSF

- New profiling method due to potential use of net metering telemetry
  - **Positive** telemetry reported under generator asset
  - **Negative** telemetry reported under DARD

- Net metering for revenue quality meter (RQM)
  - If **positive:**
    - Generator asset reports positive value
    - DARD reports 0 value
  - If **negative:**
    - DARD reports negative value
    - Generator asset reports 0 value

Energy Quantity: New CSF Scaling Factor Calculations (in MW)





Example

CSF Energy Quantity Determination in Hourly Settlements

1. Calculation of Hourly Scaling Factor

(Net RQM – Net Hourly Average Telemetry)

x (**12** ÷ Non-Zero Telemetry Interval Count)

Five-Minute Interval	Telemetry MW		
	Gen	DARD	Net
1	4	0	
2	4	0	
3	4	0	
4	4	0	
5	4	1	
6	4	1	
7	8	2	
8	8	2	
9	8	2	
10	8	2	
11	0	2	
12	0	2	
Net Hourly Average Telemetry			

1. Calculation of Hourly Scaling Factor, *continued*

(**Net RQM** – Net Hourly Average Telemetry)

x (12 ÷ Non-Zero Telemetry Interval Count)

Assumption:

Net Revenue Quality Meter (RQM)	4

= (**4** –) x (12 ÷)

Five-Minute Interval	Telemetry MW		
	Gen	DARD	Net
1	4	0	
2	4	0	
3	4	0	
4	4	0	
5	4	1	
6	4	1	
7	8	2	
8	8	2	
9	8	2	
10	8	2	
11	0	2	
12	0	2	
Net Hourly Average Telemetry			

1. Calculation of Hourly Scaling Factor, *continued*

(Net RQM – **Net Hourly Average Telemetry**)

x (12 ÷ Non-Zero Telemetry Interval Count)

Assumption:

Net Revenue Quality Meter (RQM)	4

= (4 – **3.5**) x (12 ÷)

Five-Minute Interval	Telemetry MW		
	Gen	DARD	Net
1	4	0	**4**
2	4	0	**4**
3	4	0	**4**
4	4	0	**4**
5	4	1	**3**
6	4	1	**3**
7	8	2	**6**
8	8	2	**6**
9	8	2	**6**
10	8	2	**6**
11	0	2	**–2**
12	0	2	**–2**
Net Hourly Average Telemetry			**3.5**

Calculate Net = Gen – DARD

1. Calculation of Hourly Scaling Factor, *continued*

(Net RQM – Net Hourly Average Telemetry)
x (12 ÷ **Non-Zero Telemetry Interval Count**)

Assumption:

Net Revenue Quality Meter (RQM)	4

= (4 – 3.5) x (12 ÷ **12**)

Five-Minute Interval	Telemetry MW		
	Gen	DARD	Net
1	4	0	4
2	4	0	4
3	4	0	4
4	4	0	4
5	4	1	3
6	4	1	3
7	8	2	6
8	8	2	6
9	8	2	6
10	8	2	6
11	0	2	–2
12	0	2	–2
Net Hourly Average Telemetry			3.5

Calculate Net = Gen – DARD

Calculate non-zero telemetry intervals = **12**

1. Calculation of Hourly Scaling Factor, *continued*

(Net RQM – Net Hourly Average Telemetry)
x (12 ÷ Non-Zero Telemetry Interval Count)

Assumption:

Net Revenue Quality Meter (RQM)	4

= (4 – 3.5) x (12 ÷ 12)
= **0.5 MW hourly scaling factor**

Carries forward into step #2

Five-Minute Interval	Telemetry MW		
	Gen	DARD	Net
1	4	0	4
2	4	0	4
3	4	0	4
4	4	0	4
5	4	1	3
6	4	1	3
7	8	2	6
8	8	2	6
9	8	2	6
10	8	2	6
11	0	2	–2
12	0	2	–2
Net Hourly Average Telemetry			3.5

Calculate Net = Gen – DARD

Calculate non-zero telemetry intervals = **12**

2. Calculation of Net Adjusted Energy Quantity

Scaling factor (0.5 MW) added to each five-minute interval

Five-Minute Interval	Telemetry MW		
	Gen	DARD	Net
1	4	0	**4**
2	4	0	4
3	4	0	4
4	4	0	4
5	4	1	3
6	4	1	3
7	8	2	6
8	8	2	6
9	8	2	6
10	8	2	6
11	0	2	−2
12	0	2	−2
Net Hourly Average Telemetry			3.5

Scaling factor (+0.5 MW) applied to first interval:
4 + 0.5 = 4.5 MW

Energy Quantity MW		
Net Adj	Gen	DARD
4.5		

2. Calculation of Net Adjusted Energy Quantity, *continued*

Scaling factor (0.5 MW) added to each five-minute interval

Five-Minute Interval	Telemetry MW		
	Gen	DARD	Net
1	4	0	**4**
2	4	0	**4**
3	4	0	**4**
4	4	0	**4**
5	4	1	**3**
6	4	1	**3**
7	8	2	**6**
8	8	2	**6**
9	8	2	**6**
10	8	2	**6**
11	0	2	**–2**
12	0	2	**–2**
Net Hourly Average Telemetry			3.5

Scaling factor (+0.5 MW) applied to all intervals

Energy Quantity MW		
Net Adj	Gen	DARD
4.5		
4.5		
4.5		
4.5		
3.5		
3.5		
6.5		
6.5		
6.5		
6.5		
–1.5		
–1.5		
4		

Average net adjusted energy quantity will equal net RQM

3. Calculation Of Prorated Five-Minute Energy Quantity in Intervals Where One Asset Reports Zero Value

Net adjusted energy quantity value carries over

Five-Minute Interval	Telemetry MW		
	Gen	DARD	Net
1	4	**0**	4
2	4	**0**	4
3	4	**0**	4
4	4	**0**	4
5	4	1	3
6	4	1	3
7	8	2	6
8	8	2	6
9	8	2	6
10	8	2	6
11	**0**	2	−2
12	**0**	2	−2
Net Hourly Average Telemetry			3.5

Energy Quantity MW		
Net Adj	Gen	DARD
4.5	**4.5**	**0**
4.5	**4.5**	**0**
4.5	**4.5**	**0**
4.5	**4.5**	**0**
3.5		
3.5		
6.5		
6.5		
6.5		
6.5		
−1.5		
−1.5		
4		

A Generator asset reflects **positive** value and DARD is **0**

3. Calculation Of Prorated Five-Minute Energy Quantity in Intervals Where One Asset Reports Zero Value, *continued*

Net adjusted energy quantity value carries over

Five-Minute Interval	Telemetry MW		
	Gen	DARD	Net
1	4	0	4
2	4	0	4
3	4	0	4
4	4	0	4
5	4	1	3
6	4	1	3
7	8	2	6
8	8	2	6
9	8	2	6
10	8	2	6
11	**0**	2	–2
12	**0**	2	–2
Net Hourly Average Telemetry			3.5

Energy Quantity MW		
Net Adj	Gen	DARD
4.5	4.5	0
4.5	4.5	0
4.5	4.5	0
4.5	4.5	0
3.5		
3.5		
6.5		
6.5		
6.5		
6.5		
–1.5	**0**	**–1.5**
–1.5	**0**	**–1.5**
4		

A Generator asset reflects **positive** value and DARD is **0**

B DARD reflects **negative** value and generator asset is **0**

4. Calculation of Prorated Five-Minute Energy Quantity in Intervals Where *Both* Assets Report *Non*-Zero Value

Adjusted scaling factor applied to telemetry values

Five-Minute Interval	Telemetry MW			Energy Quantity MW		
	Gen	DARD	Net	Net Adj	Gen	DARD
1	4	0	4	4.5	4.5	0
2	4	0	4	4.5	4.5	0
3	4	0	4	4.5	4.5	0
4	4	0	4	4.5	4.5	0
5	**4**	**1**	3	3.5		
6	4	1	3	3.5		
7	8	2	6	6.5		
8	8	2	6	6.5		
9	8	2	6	6.5		
10	8	2	6	6.5		
11	0	2	−2	−1.5	0	−1.5
12	0	2	−2	−1.5	0	−1.5
Net Hourly Average Telemetry			3.5	4		

A Calculate Gen adjusted scaling factor

= Scaling Factor$_{(hour)}$ x (Asset's Telemetry MW$_{(five\text{-}min)}$ ÷ Total Telemetry MW$_{(five\text{-}min)}$)

= 0.5 x (4 ÷ [4 + 1]) = 0.5 x (4 ÷ 5) = 0.4

4. Calculation of Prorated Five-Minute Energy Quantity in Intervals Where *Both* Assets Report *Non*-Zero Value, *continued*

Adjusted scaling factor applied to telemetry values

Five-Minute Interval	Telemetry MW		
	Gen	DARD	Net
1	4	0	4
2	4	0	4
3	4	0	4
4	4	0	[illegible]
5	4	1	3
6	4	1	3
7	8	2	6
8	8	2	6
9	8	2	6
10	8	2	6
11	0	2	−2
12	0	2	−2
Net Hourly Average Telemetry			3.5

Energy Quantity MW		
Net Adj	Gen	DARD
4.5	4.5	0
4.5	4.5	0
4.5	4.5	0
4.5	4.5	0
3.5	**4.4**	
3.5		
6.5		
6.5		
6.5		
6.5		
−1.5	0	−1.5
−1.5	0	−1.5
4		

A Calculate Gen adjusted scaling factor
= Scaling Factor$_{(hour)}$ x (Asset's Telemetry MW$_{(five\text{-}min)}$ ÷ Total Telemetry MW$_{(five\text{-}min)}$)
= 0.5 x (4 ÷ [4 + 1]) = 0.5 x (4 ÷ 5) = 0.4

B Calculate Gen energy quantity MW
= Adjusted Scaling Factor$_{(five\text{-}min)}$ + Gen Telemetry MW
= 0.4 + 4 = **4.4**

4. Calculation of Prorated Five-Minute Energy Quantity in Intervals Where *Both* Assets Report *Non*-Zero Value, *continued*

Adjusted scaling factor applied to telemetry values

Five-Minute Interval	Telemetry MW			Energy Quantity MW		
	Gen	DARD	Net	Net Adj	Gen	DARD
1	4	0	4	4.5	4.5	0
2	4	0	4	4.5	4.5	0
3	4	0	4	4.5	4.5	0
4	4	0	4	4.5	4.5	0
5	**4**	**1**	3	3.5	4.4	
6	4	1	3	3.5		
7	8	2	6	6.5		
8	8	2	6	6.5		
9	8	2	6	6.5		
10	8	2	6	6.5		
11	0	2	−2	−1.5	0	−1.5
12	0	2	−2	−1.5	0	−1.5
Net Hourly Average Telemetry			3.5	4		

A Calculate Gen adjusted scaling factor

= Scaling Factor$_{(hour)}$ x (Asset's Telemetry MW$_{(five\text{-}min)}$ ÷ Total Telemetry MW$_{(five\text{-}min)}$)

= 0.5 x (4 ÷ [4 + 1]) = 0.5 x (4 ÷ 5) = 0.4

B Calculate Gen energy quantity MW

= Adjusted Scaling Factor$_{(five\text{-}min)}$ + Gen Telemetry MW

= 0.4 + 4 = **4.4**

C Calculate DARD adjusted scaling factor

= Scaling Factor$_{(hour)}$ x (Asset's Telemetry MW$_{(five\text{-}min)}$ ÷ Total Telemetry MW$_{(five\text{-}min)}$)

= 0.5 x (1 ÷ [4 + 1]) = 0.5 x (1 ÷ 5) = 0.1

4. Calculation of Prorated Five-Minute Energy Quantity in Intervals Where *Both* Assets Report *Non*-Zero Value, *continued*

Adjusted scaling factor applied to telemetry values

Five-Minute Interval	Telemetry MW			Energy Quantity MW		
	Gen	DARD	Net	Net Adj	Gen	DARD
1	4	0	4	4.5	4.5	0
2	4	0	4	4.5	4.5	0
3	4	0	4	4.5	4.5	0
4	4	0	4	4.5	4.5	0
5	**4**	**1**	3	3.5	4.4	**–0.9**
6	4	1	3	3.5		
7	8	2	6	6.5		
8	8	2	6	6.5		
9	8	2	6	6.5		
10	8	2	6	6.5		
11	0	2	–2	–1.5	0	–1.5
12	0	2	–2	–1.5	0	–1.5
Net Hourly Average Telemetry			3.5	4		

A Calculate Gen adjusted scaling factor
= Scaling Factor$_{(hour)}$ x (Asset's Telemetry MW$_{(five\text{-}min)}$ ÷ Total Telemetry MW$_{(five\text{-}min)}$)
= 0.5 x (4 ÷ [4 + 1]) = 0.5 x (4 ÷ 5) = 0.4

B Calculate Gen energy quantity MW
= Adjusted Scaling Factor$_{(five\text{-}min)}$ + Gen Telemetry MW
= 0.4 + 4 = **4.4**

C Calculate DARD adjusted scaling factor
= Scaling Factor$_{(hour)}$ x (Asset's Telemetry MW$_{(five\text{-}min)}$ ÷ Total Telemetry MW$_{(five\text{-}min)}$)
= 0.5 x (1 ÷ [4 + 1]) = 0.5 x 1 ÷ 5 = 0.1

D Calculate DARD energy quantity MW
= Adjusted Scaling Factor$_{(five\text{-}min)}$ – DARD Telemetry MW
= 0.1 – 1 = **–0.9**

4. Calculation of Prorated Five-Minute Energy Quantity in Intervals Where *Both* Assets Report *Non*-Zero Value, *continued*

Adjusted scaling factor applied to telemetry values

Five-Minute Interval	Telemetry MW			Energy Quantity MW		
	Gen	DARD	Net	Net Adj	Gen	DARD
1	4	0	4	4.5	4.5	0
2	4	0	4	4.5	4.5	0
3	4	0	4	4.5	4.5	0
4	4	0		4.5	4.5	0
5	4	1		3.5	4.4	−0.9
6	**4**	**1**	3	3.5	**4.4**	**−0.9**
7	**8**	**2**	6	6.5	**8.4**	**−1.9**
8	**8**	**2**	6	6.5	**8.4**	**−1.9**
9	**8**	**2**	6	6.5	**8.4**	**−1.9**
10	**8**	**2**	6	6.5	**8.4**	**−1.9**
11	0	2	−2	−1.5	0	−1.5
12	0	2	−2	−1.5	0	−1.5
Net Hourly Average Telemetry			3.5	4	5.03	−1.03

A Calculate Gen adjusted scaling factor
= Scaling Factor$_{(hour)}$ x (Asset's Telemetry MW$_{(five\text{-}min)}$ ÷ Total Telemetry MW$_{(five\text{-}min)}$)
= 0.5 x (4 ÷ [4 + 1]) = 0.5 x (4 ÷ 5) = 0.4

B Calculate Gen energy quantity MW
= Adjusted Scaling Factor$_{(five\text{-}min)}$ + Gen Telemetry MW
= 0.4 + 4 = **4.4**

C Calculate DARD adjusted scaling factor
= Scaling Factor$_{(hour)}$ x (Asset's Telemetry MW$_{(five\text{-}min)}$ ÷ Total Telemetry MW$_{(five\text{-}min)}$)
= 0.5 x (1 ÷ [4 + 1]) = 0.5 x 1 ÷ 5 = 0.1

D Calculate DARD energy quantity MW
= Adjusted Scaling Factor$_{(five\text{-}min)}$ − DARD Telemetry MW
= 0.1 − 1 = −0.9

E Repeat A–D for remaining intervals

Calculated CSF Energy Quantity Values Can Be Found in Settlements Report

Look for them under "Energy Quantity"

Real-Time Asset 5 Minute Energy Quantity*

Trading Interval	Hour End	Asset Name	Asset Type	Calculation Method	Telemetry Value	Energy Quantity
Interval Begin	Hour End				MW	MW
00:00	1	MyFacility_GEN	GENERATOR	NET ADJUSTMENT	4	4.5
00:05	1	MyFacility_GEN	GENERATOR	NET ADJUSTMENT	4	4.5
00:10	1	MyFacility_GEN	GENERATOR	NET ADJUSTMENT	4	4.5
00:15	1	MyFacility_GEN	GENERATOR	NET ADJUSTMENT	4	4.5
00:20	1	MyFacility_GEN	GENERATOR	NET ADJUSTMENT	4	4.4
00:25	1	MyFacility_GEN	GENERATOR	NET ADJUSTMENT	4	4.4
00:30	1	MyFacility_GEN	GENERATOR	NET ADJUSTMENT	8	8.4
00:35	1	MyFacility_GEN	GENERATOR	NET ADJUSTMENT	8	8.4
00:40	1	MyFacility_GEN	GENERATOR	NET ADJUSTMENT	8	8.4
00:45	1	MyFacility_GEN	GENERATOR	NET ADJUSTMENT	8	8.4
00:50	1	MyFacility_GEN	GENERATOR	NET ADJUSTMENT	0	0
00:55	1	MyFacility_GEN	GENERATOR	NET ADJUSTMENT	0	0
00:00	1	MyFacility_ARD	ASSET RELATED DEMAND	NET ADJUSTMENT	0	0
00:05	1	MyFacility_ARD	ASSET RELATED DEMAND	NET ADJUSTMENT	0	0
00:10	1	MyFacility_ARD	ASSET RELATED DEMAND	NET ADJUSTMENT	0	0
00:15	1	MyFacility_ARD	ASSET RELATED DEMAND	NET ADJUSTMENT	0	0
00:20	1	MyFacility_ARD	ASSET RELATED DEMAND	NET ADJUSTMENT	1	−0.9
00:25	1	MyFacility_ARD	ASSET RELATED DEMAND	NET ADJUSTMENT	1	−0.9
00:30	1	MyFacility_ARD	ASSET RELATED DEMAND	NET ADJUSTMENT	2	−1.9
00:35	1	MyFacility_ARD	ASSET RELATED DEMAND	NET ADJUSTMENT	2	−1.9
00:40	1	MyFacility_ARD	ASSET RELATED DEMAND	NET ADJUSTMENT	2	−1.9
00:45	1	MyFacility_ARD	ASSET RELATED DEMAND	NET ADJUSTMENT	2	−1.9
00:50	1	MyFacility_ARD	ASSET RELATED DEMAND	NET ADJUSTMENT	2	−1.5
00:55	1	MyFacility_ARD	ASSET RELATED DEMAND	NET ADJUSTMENT	2	−1.5

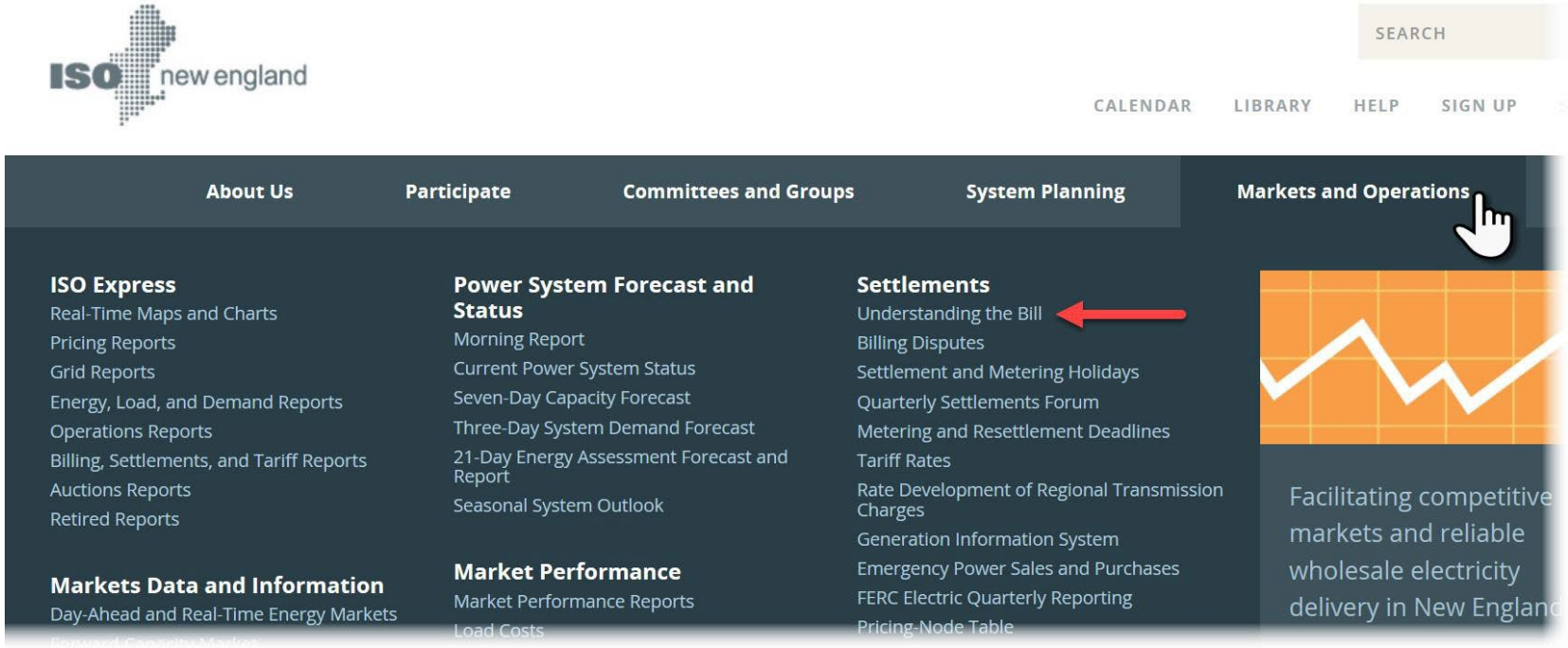
Values used as inputs for other settlement calculations

*For illustration only; actual report includes other data not shown here

CSF Registration Does Not Impact Billing

- No changes to billing process or billable line-item descriptions

- If new to ISO New England, see billing resources:
  - Understanding the Bill webpage
  - Billing Process Summary—brief introduction to billing process for new customers and guide to available settlement-related resources



Questions?

Coming Up:

- *Additional Resources*

Additional Resources

Learn More at iso-ne.com

- Continuous storage facility information
  - Energy Storage Device (ESD) Project Customer Readiness Webpage
  - March 7, 2019, Quarterly Settlements Forum
- General market participation
  - *Flowchart of Energy Storage Registration Options* (see appendix)
  - *Energy Storage Market Participation Overview Webinar* (recording; slides)
  - *New Capacity Qualification for Energy Storage Resources Webinar* (recording; slides)
  - *WEM 101: Introduction to Wholesale Electricity Markets* (see Upcoming Courses webpage)
  - *Regulation Market*
    - *Regulation Market Settlements: Calculations and Examples*
  - *Understanding the Bill*: Information to help reconcile billing statements, including detailed guidance on billable line items and report samples
- Staying informed
  - ISO Training mailing list: announcements of upcoming learning opportunities
  - Upcoming Courses: list of scheduled webinars and classroom trainings
  - ISO Training Materials: recordings and slides of past trainings
  - ISO Quarterly Settlements Forum (March, June, September, December)

Summary

Today's training covered:

- The continuous storage facility option for participation in New England's wholesale electricity markets
- How to register as a continuous storage facility
- Requirements for managing CSF assets in eMarket software platform
- Examples of how CSF may offer or bid in to markets
- Related settlement changes
- Where to find information on alternative options that storage facilities have for market participation
- Where to find other helpful resources

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Slide added on 12/31/2024.

Appendix

Flowchart of Energy Storage Registration Options