



Enabling Foundational Hybrid Facility Models in the IESO-Administered Markets

June 2022

Table of Contents

| | |
|---|-----------|
| List of Abbreviations | 4 |
| 1. Executive Summary | 6 |
| 2. Background | 10 |
| 3. Description of Foundational Models | 11 |
| 3.1 Co-located Hybrid Facility Model | 11 |
| 3.2 Integrated Hybrid Facility Model | 12 |
| 4. Description of Design Modules and Design Elements | 12 |
| 4.1 Capacity Module | 12 |
| 4.1.1 Capacity Qualification | 13 |
| 4.1.2 Performance Obligation & Assessment (POA) | 14 |
| 4.2 Authorization and Registration Module | 15 |
| 4.2.1 Market Registration and Class of Market Participant | 15 |
| 4.2.2 Prudential Security | 16 |
| 4.2.3 Connection Assessment & Approval (CAA) / System Impact Assessment (SIA) | 17 |
| 4.2.4 Resource Size | 18 |
| 4.2.5 Ratio of Storage-to-Generation Capacity | 18 |
| 4.2.6 Facility Registration | 18 |
| 4.2.7 Revenue Meter Registration (RMR) | 19 |
| 4.3 Grid and Market Operations Module | 19 |
| 4.3.1 Dispatch Data and Other Data Inputs | 19 |
| 4.3.2 Market Power Mitigation (MPM) | 21 |
| 4.4 Settlement Module | 22 |
| 4.4.1 Market Settlement | 22 |
| 4.4.2 Uplift Charges | 23 |
| 4.4.3 Global Adjustment (GA) | 23 |
| 5. Decisions and Implementation Considerations | 24 |

| | | |
|-----------|---|-----------|
| 5.1 | Capacity Module | 24 |
| 5.1.1 | Capacity Qualification | 24 |
| 5.1.2 | Performance Obligation & Assessment (POA) | 25 |
| 5.2 | Authorization and Registration Module | 26 |
| 5.2.1 | Market Registration and Class of Market Participant | 26 |
| 5.2.2 | Prudential Security | 28 |
| 5.2.3 | Connection Assessment & Approval (CAA) / System Impact Assessment (SIA) | 28 |
| 5.2.4 | Resource Size | 29 |
| 5.2.5 | Ratio of Storage-to-Generation Capacity | 30 |
| 5.2.6 | Facility Registration | 31 |
| 5.2.7 | Revenue Meter Registration (RMR) | 31 |
| 5.3 | Grid and Market Operations Module | 32 |
| 5.3.1 | Dispatch Data and Other Data Inputs | 32 |
| 5.3.2 | Market Power Mitigation (MPM) | 34 |
| 5.4 | Settlement Module | 35 |
| 5.4.1 | Market Settlement | 35 |
| 5.4.2 | Uplift Charges | 35 |
| 5.4.3 | Global Adjustment (GA) | 36 |
| 6. | Energy and Operating Reserve (OR) Market Participation | 37 |
| 6.1 | Description of Market Timeframes | 37 |
| 6.1.1 | Day-Ahead (DA) | 37 |
| 6.1.2 | Pre-Dispatch (PD) | 37 |
| 6.1.3 | Real-Time (RT) | 38 |
| 6.1.4 | Settlement | 38 |
| 6.2 | Co-located Hybrid Facility Participation | 39 |
| 6.2.1 | Day-Ahead (DA) | 39 |
| 6.2.2 | Pre-Dispatch (PD) | 40 |
| 6.2.3 | Real-Time (RT) | 40 |
| 6.2.4 | Settlement | 41 |
| 6.3 | Integrated Hybrid Facility Participation | 41 |
| 6.3.1 | Day-Ahead (DA) | 42 |

| | |
|-------------------------|----|
| 6.3.2 Pre-Dispatch (PD) | 43 |
| 6.3.3 Real-Time (RT) | 43 |
| 6.3.4 Settlement | 44 |

List of Abbreviations

| Abbreviation | Description |
|-------------------|---|
| AC/DC | Alternating current/direct current |
| ADE | Availability declaration envelope |
| ADRF | Availability de-rating factor |
| CA | Capacity auction |
| CAA | Connection assessment & approval |
| CMSC | Congestion management settlement credit |
| DACP | Day-ahead commitment process |
| DA | Day-ahead |
| DAM | Day-ahead market |
| DEL | Daily energy limit |
| DSC | Distribution system code |
| DxCIA | Distribution connection impact assessment |
| EFOR _d | Equivalent forced outage rate demand |
| ESIA | Expedited system impact assessment |
| EST | Eastern standard time |
| EPT | Eastern prevailing time |
| ERP | Enabling Resources Program |
| GA | Global adjustment |
| HIP | Hybrid integration project |
| HOEP | Hourly Ontario energy price |
| IAM | IESO-administered markets |
| ICAP | Installed capacity |
| ICI | Industrial Conservation Initiative |
| ICG | IESO-controlled grid |
| IESO | Independent Electricity System Operator |
| LMP | Locational marginal price |
| LT | Long-term |
| MCP | Market clearing price |
| MMP | Metered market participant |
| MPM | Market power mitigation |

| | |
|-------|---|
| MW | Megawatts |
| OEB | Ontario Energy Board |
| OR | Operating reserve |
| PD | Pre-dispatch |
| PDF | Peak demand factor |
| POA | Performance obligation & assessment |
| RFP | Request for proposal |
| RFQ | Request for quote |
| RMP | Registered market participant |
| RMR | Revenue meter registration |
| RT | Real-time |
| RTM | Real-time market |
| SEAL | Safety of any person, equipment damage, violation of any applicable law |
| SIA | System impact assessment |
| SoC | State-of-charge |
| SSM | Single scheduled market |
| TSC | Transmission system code |
| TxCIA | Transmission customer impact assessment |
| UCAP | Unforced capacity |
| VG | Variable generation |

1. Executive Summary

The purpose of this document is to summarize the design enabling the two (2) foundational hybrid facility participation models to be implemented in the IESO-administered markets (IAM) post-market renewal¹, to allow hybrid facilities to play a role in helping meet Ontario's future electricity needs.

A hybrid facility consists of generation and storage technologies behind a single connection point to the IESO-controlled grid (ICG). Enabling hybrid facilities will allow the introduction of new resources to help the IESO meet reliability and operability needs, as well as increasing market competition. Various types of generation technologies (including variable generation (VG), other quick start generation types or non-quick start generation) can be included in a hybrid facility alongside the storage technology.

The foundational hybrid participation models will enable hybrid facilities to participate in the IAMs without requiring changes to the calculation engines that optimize schedules and dispatch instructions. The foundational models will utilize existing resource models for generation and storage².

The foundational hybrid facility models are described as follows:

1. The **co-located** model includes three (3) dispatchable resources: (i) a generation resource, (ii) a storage injecting resource for discharging storage, and (iii) a storage withdrawing resource for charging storage from the grid. The resources will be located behind a single connection point to the grid, but will participate separately in capacity³, energy and operating reserve (OR) markets, as allowed for the technology/resource type. Since these resources will be operating separately and participating under existing resource models with limited interdependencies, the design is relatively straightforward.
2. The **integrated** model includes two (2) dispatchable resources: a generation resource combining the generation and storage injecting technologies, and a storage withdrawing resource for charging storage from the grid. The resources will be located behind a single connection point to the grid, but will participate separately in capacity³, energy and OR markets, as allowed for the technology/resource type. Combining storage and generation technologies into a single generation resource results in more complexity for the design.

Critical design elements and decisions are described below.

¹ Detailed information on the Market Renewal Program can be found at: [IESO Market Renewal](#).

² Future enhancements to the current IESO storage model may impact the foundational hybrid models; these enhancements include changes to calculation engines to implement state-of-charge (SoC) management, a single storage resource that can be dispatched to inject and dispatched to withdraw, and changes to uplift allocation for storage.

³ Capacity is qualified for the storage injecting resource/technology, not for the storage withdrawing resource.

- **Capacity Qualification:** For procurement or capacity auctions that use unforced capacity (UCAP) methodologies for qualifying capacity for the resources/technologies under the hybrid facility, capacity will be qualified as follows:
 - For the co-located model, the sum of the UCAPs from the generation resource and the storage injecting resource is the total capacity contribution, subject to the limit at the connection point.
 - For the integrated model, the sum of the UCAPs from the underlying injecting technologies of the combined generation resource is the total capacity contribution, subject to the limit at the connection point.
- **Connection Assessment & Approval (CAA):** No changes are contemplated to the IESO's connection process, which is the same for both models. New resources added behind a connection point to the grid require a system impact assessment (SIA), as current.
- **Energy and OR Market Participation:** No changes are required to the type of dispatch data or other inputs for either model for participation in energy and OR markets. The participant submits bids and offers into the day-ahead market (DAM), and receives a financially binding schedule. Bids and offers are adjusted during the pre-dispatch (PD) timeframe to reflect changing resource capabilities and market conditions. In real-time (RT), the participant delivers upon their five (5) minute dispatch schedules.
 - Participation highlights for the co-located model:
 - The net bid/offer quantity for the generation and storage resources must be less than or equal to the connection point limit, and the participant needs to ensure that the resulting net schedule is also less than or equal to the connection point limit.
 - The dispatch data parameters and participation rules for energy and OR markets that apply to stand-alone generation and storage resources will apply to the generation and storage resources under a co-located facility. As per the existing resource models:
 - All storage charging must be dispatched through the market (not allowed behind-the-meter directly from the generation resource). Storage is allowed to reduce the bid quantity or offer quantity within two (2) hours of the dispatch hour for state-of-charge (SoC) reasons.
 - The "no-overlap" rule will continue to apply to the bid and offer from the storage resources: all bid prices submitted by a storage withdrawing resource must be less than all offer prices submitted by a storage injecting resource for the same hour; however, for clarity, the bid price for the storage injecting resource may overlap with the offer price for the generation resource, which are completely separate technologies and resources, to allow storage charging from the grid at the same time as the generation is injecting to the grid.
 - A co-located facility with VG may use their own forecast quantity in the DAM, otherwise the centralized forecast quantity will apply. VG will

generally operate based on ambient conditions in RT, with the requirement to follow all mandatory dispatch instructions.

- VG is not eligible to provide OR.
- Participation highlights for the integrated model⁴:
 - The dispatch data parameters and participation rules for energy and OR that apply to non-VG quick start generation resources and to a storage withdrawing resource will apply to the combined generation resource and storage withdrawing resource under an integrated facility.
 - Storage charging is allowed behind-the-meter directly from the generation resource, and storage may also be charged by dispatch of the storage withdrawing resource through the market. Storage is allowed to reduce the bid or offer quantity within two (2) hours of the dispatch hour for SoC reasons.
 - The “no-overlap” rule will apply to the bid from the storage withdrawing resource and the offer price of the combined generation resource: bid prices submitted by a storage withdrawing resource must be less than all offer prices submitted by the combined generation resource for the corresponding hour, in order to avoid conflicting dispatches.
 - VG will no longer operate based on ambient conditions in RT but rather as part of the combined generation resource under the quick-start generation model, which must comply with dispatch instructions. The IESO will continue to utilize the centralized forecast for VG under a combined generation resource for visibility reasons, and this information can be provided to the market participant for informational purposes.
 - OR participation rules for the resources under the integrated hybrid facility reflect the participation rules for stand-alone storage resources, since storage is an underlying resource for both the combined generation resource and storage withdrawing resources. The OR quantity offered by the combined generation resource must not be greater than the non-VG capacity, due to VG fuel uncertainty.
 - **Market Power Mitigation (MPM):** Resources under hybrid facilities will be subject to market power mitigation, consistent with all dispatchable resources. Resource-specific reference levels based on the technology type will be developed in consultation with the market participant.

⁴ The net bid/offer quantity and schedule at the connection point is not a concern for the integrated model. The combined generation resource cannot inject at the same time that storage withdraws because the storage injecting technology is part of the combined generation resource, and storage cannot inject and withdraw at the same time.

- For the co-located model, the methodologies to determine reference levels for the storage resource and generation resource have been established through the Market Renewal Program (MRP) based on the technology type.
- For the integrated model, the combined generation resource requires a new methodology to establish reference levels that reflect the multiple underlying technologies, which results in a new technology type for MPM purposes.
- **Settlement:** No changes are required for settlement of hybrid facilities. Each resource will be subject to separate settlement. Uplifts and global adjustment (GA) are applicable to energy withdrawn from the ICG. GA is determined as per Ontario Regulation 429/04.
 - For the co-located model, generation and storage are charged GA at the Class B rate. Class B storage may be reimbursed for injections to the ICG, and may become eligible for Class A treatment after an initial base period under the regulation.
 - For the integrated model, generation and storage are charged GA at the Class B rate. Since the storage technology shares a meter with the generation technology under this model, it does not meet the definition for a storage facility under the regulation, and will not be reimbursed at the Class B rate for injections. However, storage may become eligible for Class A treatment after an initial base period under the regulation.

2. Background

The IESO established the Enabling Resources Program (ERP) with the objective of implementing a work plan that provides sector participants greater certainty for the design and timing of resource enablement. The ERP provides the information market participants require to facilitate their investment planning and to support their understanding of participation in the IESO's markets and resource acquisition mechanisms.

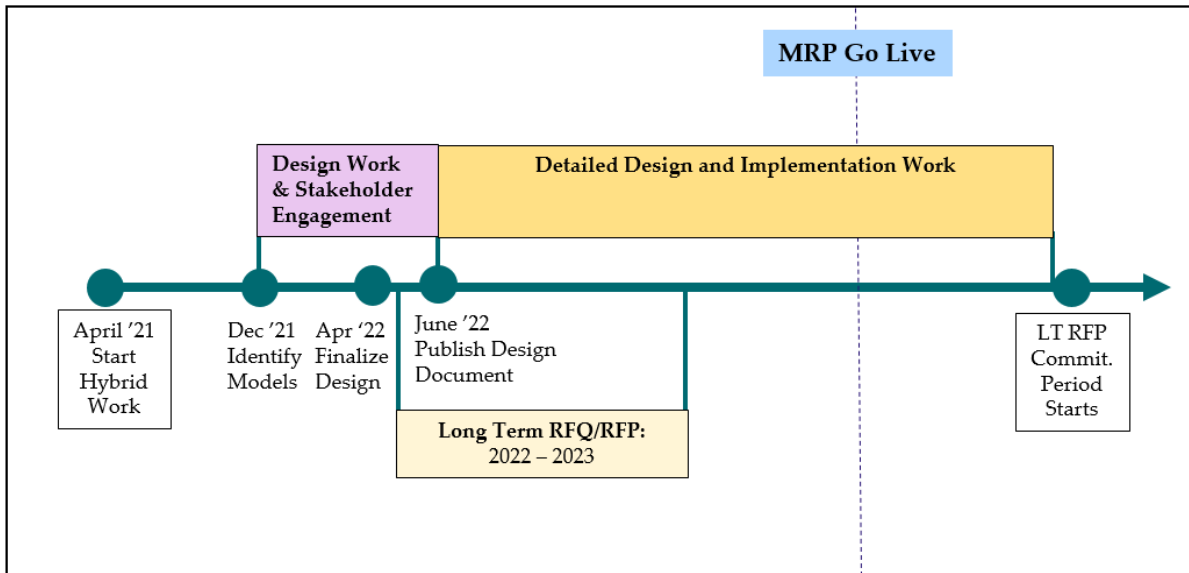
One of the projects under the ERP is the implementation of hybrid facilities, which allow participants to couple generation and storage behind a single connection point to the ICG.

The integration of hybrid facilities has been identified as a high priority initiative by the IESO due to the significant potential for helping to meet system adequacy needs and increasing market competition. Expiring wind and solar contracts along with declining technology costs for battery storage is expected to drive hybrid facility development over the next decade. There are also other generation types where hybridization can potentially benefit the participant and the IESO, but in particular the IESO sees adding storage to existing VG resources under a hybrid participation model as having the potential to improve the reliability of the generation component. The IESO also expects new hybrid facilities to be added to the grid to meet system needs. Hybrid resources will help to address emerging resource adequacy and flexibility needs in a manner that also responds to climate change, similar to other North American jurisdictions responding to carbon policy.

In April, 2021, the IESO launched the hybrid integration project (HIP), through which the IESO with input from sector participants identified two (2) foundational hybrid facility models for participation in the IAMs – the co-located hybrid facility model and the integrated hybrid facility model. Following identification of the foundational models, the HIP clarified the design for the hybrid facility models.

This document summarizes the design to enable the two (2) foundational hybrid participation models to be implemented in the IAMs, including descriptions of the design elements and design decisions. Further, this document outlines hybrid facility participation in the IAMs by describing a "day-in-the-life" to assist sector participants in identifying potential market outcomes. The IESO consulted with sector participants during the design phase to ensure that all necessary design elements were considered and addressed.

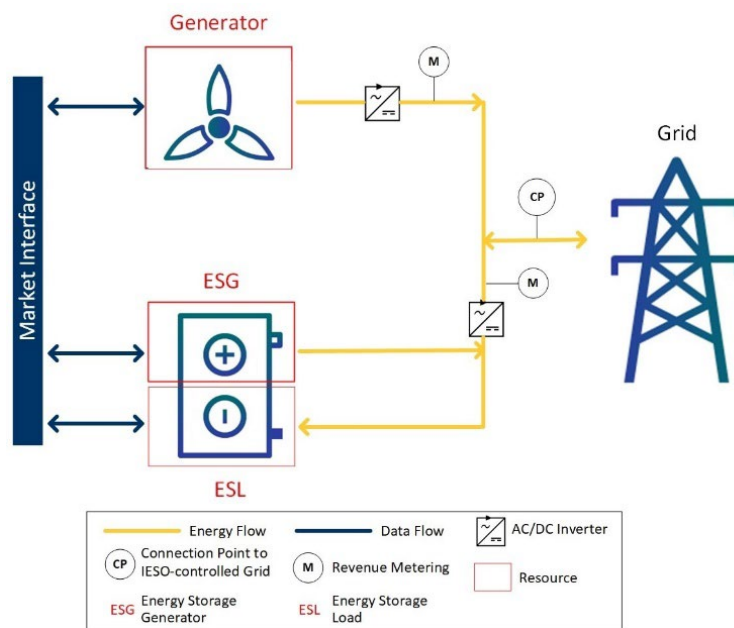
The IESO will continue to work with sector participants as required to collect their feedback throughout the implementation phase in order to fully integrate hybrid facilities into the market. The diagram below provides the timeline for hybrid design and implementation along with timelines for the long-term (LT) request for quote (RFQ)/request for proposal (RFP) that may incorporate procurement of hybrid facilities.



3. Description of Foundational Models

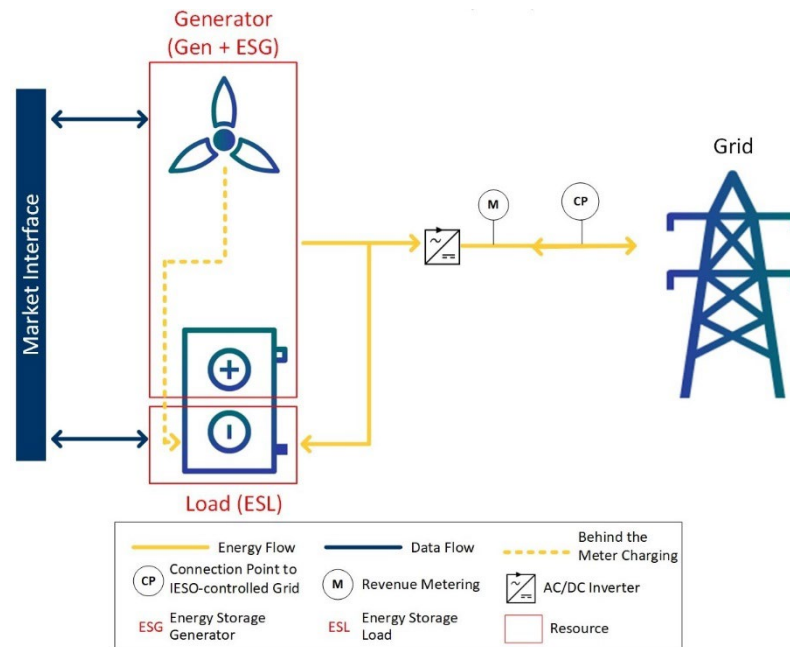
3.1 Co-located Hybrid Facility Model

The foundational co-located hybrid facility model will be registered in the IESO markets as three (3) dispatchable resources: a generation resource, a storage injecting resource for discharging storage, and a storage withdrawing resource for charging storage, all participating behind a single connection point to the grid. The three (3) resources will bid/offer into the market separately, will receive separate dispatch instructions, and will be settled separately. These resources will be eligible to participate in capacity, energy and OR markets as technologies/resource types allow.



3.2 Integrated Hybrid Facility Model

The foundational integrated hybrid facility model will be registered in the IESO markets as two (2) dispatchable resources: a generation resource and a load resource, participating behind a single connection point to the grid. The generation resource will combine the generation and storage injecting technologies into a combined quick start generation resource that provides a combined offer into the market. The load resource will be used to charge the storage technology from the grid. The two (2) resources will provide separate dispatch data, will receive separate dispatch instructions, and will be settled separately. These resources will be eligible to participate in capacity, energy and OR markets as technologies/resource types allow.



4. Description of Design Modules and Design Elements

Section 4 describes the design modules and the design elements that form those modules for the existing resource types that would participate under a hybrid facility (generation and storage).

A design module is a collection of related design elements. A design element is a specific feature related to integration of the hybrid facility in the IAMS.

For clarity, there are no decisions for the co-located or integrated hybrid facility models in Section 4. Decisions and implementation considerations are outlined in Section 5.

4.1 Capacity Module

The design elements under this module clarify how capacity adequacy value of resources may be determined (capacity qualification), the performance obligations related to qualified capacity, and

how performance may be assessed. A capacity value could enable resources at a facility to offer capacity into the capacity auction (CA) or other acquisition mechanisms. This module addresses the proposed capacity qualification methodology, and the performance obligation & assessment (POA).

Detailed information on existing IESO processes and rules can be found in [IESO market rules and market manuals](#).

4.1.1 Capacity Qualification

The capacity qualification design element describes the methodologies the IESO may utilize to determine the quantity of megawatts (MW) for which a hybrid facility will be eligible to offer into a CA or other mechanisms where a similar capacity qualification methodology is employed. This design element does not pertain to facilities under contract with the IESO until those contracts expire (or are terminated in accordance with their terms). In this case, capacity qualification would be required only for the new capacity under the hybrid facility.

Capacity qualification typically estimates the contribution of a technology/resource to meeting peak electricity demand, in order to compensate the market participant appropriately and ensure resource adequacy on the system.

The capacity qualification methodology is applied to every resource participating in a CA or other relevant acquisition methodology. Capacity may be qualified through a capacity qualification methodology that quantifies the resource's expected contribution to resource adequacy in units of UCAP MW. The IESO introduced the UCAP methodology as part of the 2022 CA enhancements (Enhancement #1)⁵. The period over which the capacity is qualified depends on the acquisition mechanism, and could be seasonal or annual. For procurement or capacity auctions that use UCAP methodologies for qualifying capacity, UCAP is equal to installed capacity (ICAP) reduced by the availability de-rating factor (ADRF) for the technology/resource type. The ADRF takes into account the unique operating and participating methods of the technology type, which may reduce its availability to provide energy.

A generation resource may have a nameplate capacity greater than the limit at the connection point, e.g. limit due to transformer size. Even so, ICAP cannot be greater than the limit at the connection point to the grid since the participant may not be scheduled or inject/withdraw beyond the limit of the connection point.

ICAP is submitted by the participant based on the nameplate physical generating capacity of the technology/resource adjusted, if applicable, for anticipated non-fuel ambient conditions such as temperature. For example, participants will reflect in the submitted ICAP if their resource has different output capability given the same amount of fuel based on ambient temperatures. For clarity, ICAP does not consider fuel availability (such as expected wind or solar availability), which the IESO estimates by using historical data.

The ADRF is different for different resource types. The table below provides the expected inputs for the UCAP capacity qualification methodologies for various resource types in the IESO's 2022 CA:

⁵ For more information on the [IESO's introduction to the UCAP methodology \(www.ieso.ca\)](#)

| Resource | ICAP | ADRF |
|---------------------------------|--|---|
| Dispatchable Thermal Generation | | Equivalent forced outage rate demand (EFOR _d) value based on five (5) years of historical EFOR _d data |
| Dispatchable Hydro | For all Resources: Seasonal ICAP values submitted by CA Participant during capacity qualification process | Production data and scheduled OR data that coincides with the top 200 hours of highest Ontario demand per season, over the most recent five (5) years |
| Dispatchable Storage | | EFOR _d of 5% |
| Dispatchable Load | | One (1) year of historical bid data that coincides with the top 200 hours of highest Ontario demand per season |

UCAP capacity qualification for VG is not included in the CA at this time. When included, and if a UCAP methodology is utilized, the methodology for VG may include ICAP with ADRF based on production data and foregone energy, i.e. energy that was available but curtailed by the IESO, that coincides with the top 200 hours of highest demand per season, over the most recent five (5) years.

For new resources, where sufficient historical resource data is unavailable, historical zonal fleet median data for resources of the same technology may be utilized to determine the ADRF where that data exists.

The exact methodology and calculation for a given facility will depend on the acquisition mechanism; the methodology for the CA may not be identical to the methodology for a given RFP. The capacity qualification methodologies for upcoming RFPs are yet to be determined. If the capacity qualification methodologies or framework utilized by the IESO change in the future, these changes will be reflected in the relevant acquisition mechanism.

4.1.2 Performance Obligation & Assessment (POA)

The POA design element describes performance obligations for a hybrid facility, where those obligations will be specified, and how they will be assessed.

The intent of the POA process is to assess/quantify the extent to which energy market must-offer obligations were met by resources that have a capacity obligation to the IESO under a CA or other acquisition mechanism. The aim is to ensure the capacity being acquired under a given acquisition mechanism is achievable and can be delivered in the real-time market (RTM), thereby contributing to

resource adequacy on a basis consistent with what was procured. The POA is aligned with the capacity qualification process (described in the previous section) so participants are treated fairly and compensation is appropriate. Alignment between the POA and capacity qualification also avoids discrepancies between expected and actual resource availability that could impact reliability of the system.

Energy must-offer requirements ensure that procured capacity is made available to the energy market during the relevant obligation period under the acquisition mechanism. Availability performance is assessed by determining if the quantity offered into the energy market over the obligation period was greater than or equal to the procured capacity over that same obligation period. The ability of the resource to deliver energy up to its ICAP is assessed through a capacity performance check test. Charges may apply when a resource is unable to achieve pre-defined availability and capacity test performance criteria. Availability and capacity test performance criteria also consider the underlying characteristics of the resources.

4.2 Authorization and Registration Module

The design elements under this module clarify how a market participant completes IESO authorization and registration requirements to participate in the IAMs. This module addresses (i) requirements for prospective market participants to become authorized to participate in the IAMs; (ii) requirements for registration of facilities and associated resources; and (iii) registration of revenue meter installations.

Detailed information on existing IESO processes and rules can be found on the IESO webpages: [Connecting to Ontario's power system which describes the connection process](#); and in [IESO market rules and market manuals](#).

4.2.1 Market Registration and Class of Market Participant

The market registration and class of market participant design element outlines the requirements for authorizing the market participant for a hybrid facility, and is part of the connection process. A hybrid facility includes two (2) or more resources behind a single connection point, with multiple technology types under the facility.

The IESO has a number of market participation roles for each resource, such as the registered market participant (RMP), the metered market participant (MMP), the operator and the owner. Market participation roles are outlined in Market Manual 1.5 Market Registration Procedures. This design element will also specify the class of market participant for a market participant with a hybrid facility under Chapter 2, Section 2.1.1 of the market rules, thereby determining if a new class of market participant will be required. The class of market participant in the market rules is generally aligned with Ontario Energy Board (OEB) licences to participate in the IAMs.

For example, if the OEB issues a generation licence for the resource, the "generator" class of market participant is applicable; if the OEB issues a storage licence for the resource, the "electricity storage participant" class of market participant is applicable; and so on.

4.2.2 Prudential Security

The prudential security design element discusses potential changes to the prudential security framework for hybrid facilities. Prudential security is assessed for the market participant with due consideration/estimates based on its authorization types and resources that participate in the market. The assessment of prudential security is performed for the RMP.

The initial provision of prudential security is part of the connection process and is required by the IESO for a market participant that will owe money, typically as a result of energy withdrawals being greater than injections over a given period. The prudential security amount is estimated based on expected injections, withdrawals and market prices, and the amount is updated as required over time. If the market participant is not expected to owe money, prudential security is not required. For clarity, the total prudential security requirement for a market participant is assessed based upon the expected net amount owed, considering all resources under that market participant.

Storage is a net consumer of energy (unless it is not charging over a given period); the market participant for the storage facility usually owes money as a result of efficiency losses incurred between charging and discharging the technology. Since storage resources are a significant component of a hybrid facility, it will be important to ensure the prudential security amounts are adequate.

Pre-market renewal, the prudential security requirement considers the estimated uniform market clearing price (MCP), and the average daily net injection/withdrawal. Due to efficiency losses associated with storage, there are generally net withdrawals from the grid with amounts owed by the market participant, and therefore, prudential security may be required. The calculated prudential security amount must be posted by the market participant. Note that other charges that are applicable to a resource, such as uplifts and GA under Ontario Regulation 429/04⁶ are also considered in the prudential security calculation. Further details on uplifts and GA are found in the Market Settlement module of this document.

Post-market renewal, there will be a locational marginal price (LMP) for the storage injecting resource and another LMP for the storage withdrawing resource. The LMP values may be different for the two (2) resources (e.g., \$20/MW for the storage withdrawing resource and \$21/MW for the storage injecting resource). As a result of the changes to pricing post-market renewal, the calculation for prudential security requirements will be performed at a resource level and then totalled for the hybrid facility. Net withdrawals from the grid are still generally expected, likely with amounts owed by the market participant. The calculated prudential security amount must be posted by the market participant.

Generation resources are typically net suppliers of energy. The IESO usually makes payments to the market participant for the generation resource, and therefore, prudential security associated with generation resources is usually not required. Prudential security is determined in a manner similar to storage, by netting injections and withdrawals (e.g. station service) for the resource. Since the generation resource is modelled as a single resource, there price applied to the resource is the same for both injections and withdrawals.

⁶ The Ministry of Energy is responsible for Ontario Regulations 429/04; any change to this regulation is incorporated in the settlement of the IAMs.

4.2.3 Connection Assessment & Approval (CAA) / System Impact Assessment (SIA)

The CAA process including SIA allows the IESO to assess the impact of new or modified connections to the ICG on the reliability of the integrated power system. Additionally, it allows the IESO to identify the upgrades required to mitigate the adverse impact on system reliability as a result of a new or modified connection. Grid connection requirements are contained in Chapter 4 of the market rules and in Market Manual 1.4. Provisions of the transmission system code (TSC) and distribution system code (DSC) continue to apply. A transmission customer impact assessment (TxCIA) may need to be performed by the transmitter under the TSC for transmission-connected facilities, and a distribution connection impact assessment (DxCIA) may need to be performed by the distributor under the DSC for distribution-connected facilities.

The length of time to perform the SIA is highly dependent on the specific change being made, considering factors such as the type of new equipment, size of the potential load (for charging the energy storage device) and total output of the facility. For example, if the changed equipment at an existing connection point includes new inverters, the SIA is likely to become more complex and may require additional time to complete.

The timelines are also dependent on the quality of the data provided by the connection applicant to the IESO. The SIA process can take anywhere between a few months to a little over one (1) year, while the entire connection process (from application to commissioning equipment and validating performance) can range from a few months for small modifications to existing facilities, to more than three years for major modifications or new facilities. The IESO works with market participants and connection applicants to ensure that the SIA can be completed in as timely a manner as possible. The SIA may need to be updated as the facility is being designed and built, to reflect any changes to the project or equipment.

An expedited SIA (ESIA) allows the connection assessment process to begin based on a pre-existing cost recovery agreement, if one exists, without signing a more comprehensive SIA agreement and without a deposit. ESIA is intended for simple modifications to existing facilities, and was designed to facilitate a quicker start to the SIA process for connection applicants that have a relatively large number of simple projects (generally, transmitters or distributors replacing equipment "like-for-like" and existing load or generation customers performing small modifications that don't impact their maximum load or generation. However, the SIA process itself is not altered; its scope continues to be identifying any potentially adverse impact on the reliability of the integrated power system. Section 9.2 of Market Manual 1.4 is used to determine if a project qualifies for an ESIA or not. For example, if an existing participant adds a facility or capacity of less than 10 MW, it may qualify for an ESIA. Regardless of whether it is determined that a project should proceed through an ESIA or full SIA, the volume of work to complete the assessment is determined by the complexity of the project and its intended connection area. Every assessment must be done thoroughly to ensure that the reliability of the integrated power system is maintained.

Note that pre-market renewal, a facility may be connected at a location where some spare capability is still available on the transmission system. However, the facility was originally assessed for connection only up to a maximum capacity indicated by the connection applicant, so there is no confirmation if any spare capability exists and if that spare capability is sufficient to accommodate the increase in capacity the connection applicant may seek. Exceeding the approved capacity could damage the transmitter's equipment or place the power system in an unsustainable state that could

lead to loss of supply, blackout, etc. As a result, unless the higher capacity is approved via the CAA process, the participant must ensure that the net schedule, as determined through bids and offers, remains within the capacity that was approved through the original SIA.

4.2.4 Resource Size

The resource size design element defines the minimum size for market participation for a hybrid facility. The minimum resource size determines the minimum MW capacity that can be permitted to participate in the IAMS and provide other grid services.

Both pre- and post-market renewal, the IESO requires a minimum capacity of 1 MW for all resources. For example, a generation resource must be able to inject at least 1 MW and storage resources must be able to inject or withdraw at least 1 MW.

As a requirement of the IESO market rules, a market participant may submit dispatch data for a resource with a quantity less than 1 MW as long as the largest submitted quantity is at least 1 MW. Therefore, a resource can be dispatched at a quantity less than 1 MW, but must have a minimum capability to inject or withdraw 1 MW of energy in order to participate in the IAMS.

4.2.5 Ratio of Storage-to-Generation Capacity

This design element determines if the IESO will require a minimum storage-to-generation capacity ratio for the resources or technologies within a hybrid facility. Both pre- and post-market renewal, there are no requirements for a minimum capacity ratio between resources or technologies under the same facility.

Design decisions must consider the potential advantages of prescribing a minimum ratio for the purpose of improving the operation of the hybrid facility, thereby improving reliability of the grid and the overall value proposition of the hybrid facility.

4.2.6 Facility Registration

The facility registration design element determines if the resources associated with a hybrid facility must be dispatchable. This design element determines any other registration and data requirements for new and existing resources under the hybrid facility.

Facility registration is part of the connection process.

Both pre- and post-market renewal, technical information is provided to the IESO by the market participant in order to register equipment that is connecting to the ICG. The IESO reviews all information submitted to ensure any connection obligation identified in the SIA has been fulfilled. It confirms that the facility is represented and modelled by IESO systems in a manner that accurately reflects operational, market and settlement requirements. The IESO registers new resources (e.g. new dispatchable or non-dispatchable load and generation resources). The IESO also determines the telemetry points for operational visibility of the facility, enabling direct measurement and monitoring in RT.

4.2.7 Revenue Meter Registration (RMR)

The revenue meter registration (RMR) design element describes the requirements for wholesale revenue metering installations for a hybrid facility. RMR is part of the connection process.

Metering is the basis for deriving settlement charges and payments that apply to MMPs at the delivery point for a resource. All quantities of energy bought or sold by market participants must be measured and recorded by registered wholesale meter installations associated with a delivery point. Each metering installation must be registered with the IESO so the metering data collected is timely, accurate and can be used as the basis for settlement with the MMP.

Wholesale revenue metering requirements are contained in Chapter 6 of the market rules and in series 3 of the market manuals (Metering).

Both pre- and post-market renewal, one (1) bi-directional revenue meter is registered for the two (2) resources associated with the storage facility, and one (1) bi-directional revenue meter is registered for a generation resource.

4.3 Grid and Market Operations Module

The design elements under this module clarify how the hybrid facility will participate in energy and OR markets from day-ahead (DA) through to RT, as described in Chapter 7 of the market rules and in a number of IESO market manuals. This module specifically addresses market participation for hybrid facilities, submission and revision of dispatch data, changes to other data inputs and MPM.

Detailed information on existing IESO processes and rules can be found in [IESO market rules and market manuals](#).

4.3.1 Dispatch Data and Other Data Inputs

The dispatch data and other data inputs design element outlines the data requirements for resources participating under a hybrid facility model from DA to RT. Dispatch data consists of offers, bids and other data that is submitted to the IESO by market participants with dispatchable resources. This data, as well as other inputs from market participants, is used by the IESO to dispatch resources and set prices. This design element addresses any new or revised dispatch data submissions or other data inputs required for a hybrid facility.

Pre-market renewal, dispatch data is submitted into the day-ahead commitment process (DACP). Generation resources intending to participate in the RTM must submit standing dispatch data or initial dispatch data into the DACP. Dispatchable storage resources (both the injecting and withdrawing resources) are also required to submit dispatch data into the DACP in order to participate in the RTM. The obligation to submit dispatch data will be the same in the DAM post-market renewal as under the DACP pre-market renewal.

Submitting dispatch data in the DA timeframe establishes the availability declaration envelope (ADE) for the storage withdrawing resource, storage injecting resource and generation resource for every hour meaning that the resource is not permitted to bid or offer a quantity after the DA timeframe in a given hour that is above the quantity bid or offered in DA for that hour. The ADE construct will not change post-market renewal.

The IESO requires resources to accurately reflect their capability in dispatch data. IESO approval is required when dispatch data revisions are necessary to reflect capability for any dispatch hour within two (2) hours of that dispatch hour, known as the “mandatory window”. Increases/decreases in quantity are also permitted to prevent endangering the safety of any person, damage to equipment or the environment, or violation of any applicable law; these are known as “SEAL” reasons. A decrease in dispatch data quantity is allowed during the mandatory window for storage resources with limitations due to SoC.

The following requirements apply both pre-market renewal and post-market renewal, except where stated:

- VG are dispatchable quick start generation resources that are allowed to operate based on ambient conditions in RT, but are required to follow dispatch instructions to reduce output if their offer is uneconomic or if needed to respect security constraints. VG are not allowed to offer OR.
 - The IESO’s centralized forecast⁷ is utilized for VG scheduling from DA to RT.
 - Post-market renewal in the DAM, VG will be allowed to provide the new hourly “forecast quantity” parameter to establish DAM schedules based on their own forecast; otherwise, the centralized forecast quantity will apply.
- Dispatchable quick start generation resources that are not VG must comply with dispatch instructions, and are allowed to offer OR.
- Dispatchable non-quick start generation resources⁸, such as combined cycle generation resources, must comply with dispatch instructions, and are allowed to offer OR.
 - Post-market renewal, these resources will be required to submit the new daily “lead time” and “ramp up energy to MLP” dispatch data parameters, and may also submit the new hourly “start-up offer” and “speed-no-load offer” dispatch data.
- Dispatchable storage resources must comply with dispatch instructions and are allowed to offer OR.
 - Storage must manage SoC limitations through their dispatch data. The maximum daily energy limit (DEL) dispatch data parameter may be used to help storage injecting resources to represent their availability, given the uncertainty of their SoC between DA and RT, which will be more critical post-market renewal given DAM financially binding schedules. The maximum DEL can be updated after the DA timeframe.
 - Storage technology is charged through the IAMs; the storage withdrawing resource bids to consume, and may be dispatched to withdraw from the grid through the market.
 - To avoid conflicting schedules for charging and discharging, there is a “no-overlap” rule for bids and offers for storage resources; all bid prices submitted by a storage withdrawing resource must be less than all offer prices submitted by a storage injecting resource for the corresponding hour. For clarity, although storage utilizes two (2) resources to participate in the IAMs, there is in fact only one (1) technology, which is not able to charge and discharge at the same time.

⁷ The centralized forecast does not apply to non-VG quick start resources or any other resource.

⁸ The design does not consider nuclear generation, which is not expected to participate under a hybrid model.

- OR offers are not allowed if there is a simultaneous bid and offer for energy from the storage injecting resource and the storage withdrawing resource in the same dispatch hour, to avoid conflicting energy dispatch and OR activation.
- Storage may only offer OR from the storage injecting resource if it is exclusively offered for energy as an injecting resource for the entire dispatch hour, the storage withdrawing resource does not bid to withdraw energy from the RTM, the storage withdrawing resource does not offer OR in the subsequent dispatch hour, and the remaining duration of service for the storage injecting resource is greater than or equal to 130 minutes.
- Storage may only offer OR from the storage withdrawing resource if it is exclusively offered for energy as a withdrawing resource for the entire dispatch hour, the storage injecting resource does not offer to inject energy from the RTM, the storage injecting resource does not offer OR in the subsequent dispatch hour, and the remaining duration of service for the storage withdrawing resource is greater than or equal to 70 minutes.

4.3.2 Market Power Mitigation (MPM)

MPM refers to actions necessary to prevent market participants from taking advantage of their market power in a local market. A market thrives when there is open competition among many market participants. If competition is restricted, participants could raise and maintain prices above the level that would prevail under competition, leading to inefficient market outcomes and higher costs.

Mitigation could be required for either economic or physical withholding. Economic withholding occurs when a resource in a constrained area offers at a price higher than the allowed conduct threshold in relation to their resource-specific reference level (i.e., the conduct test) and this offer increases the LMP by more than the allowed impact threshold when compared to the LMP using resource-specific reference price (i.e., the impact test). Physical withholding occurs when a resource offers a quantity below the allowed conduct threshold in relation to their resource-specific reference quantity (i.e., the conduct test) and the LMP increases by more than the allowed impact threshold when compared to the LMP using resource-specific reference quantity (i.e., the impact test).

Pre-market renewal, all MPM (for economic withholding only) is carried out after it occurs for both energy and OR markets i.e., ex-post, and therefore is based on actual values rather than estimates.

Post-market renewal, with the alignment of price and dispatch under the single schedule market (SSM), after-the-fact mitigation for economic withholding will no longer be viable. MPM post-market renewal will continue to apply to both energy and OR markets. MPM mitigates economic withholding market power before-the-fact, i.e., ex-ante, in order to prevent economic withholding. Only when the IESO deems competition to be restricted, offer prices that fail the conduct and impact tests for market power will be replaced by their resource-specific reference levels prior to the determination of dispatch schedules and market prices. The IESO will also perform ex-ante tests on non-financial dispatch data parameters (e.g., minimum loading point) to identify operational data that is too restrictive compared to the applicable reference level, and will only accept non-financial dispatch data parameters that pass these tests. Note that these tests of non-financial dispatch data parameters will be performed at the time of submission.

If the IESO deems competition to be restricted, mitigation for physical withholding of energy and OR post-market renewal will be conducted ex-post to assess each resource's production and capacity, as this is not possible before-the-fact.

The IESO will also perform tests during settlements to assess the impact of submitted dispatch data on payments related to generation guarantees and make-whole payments.

The methodology to establish reference levels and reference quantities will be consistent across all resources based on technology type; however, the reference levels and reference quantities will be unique to each resource. The IESO together with participants will establish the reference levels and reference quantities for their resources participating in the energy and the OR markets; the initial set of reference levels and reference quantities will be established during facility registration.

The MPM design element strives to ensure that market participants with hybrid facilities are not able to take advantage of market power that they may have in a local market.

4.4 Settlement Module

The design elements under this module clarify market settlement to ensure that participants with hybrid facilities understand how their participation will be reflected on their settlement statements and invoices. This module addresses market settlement, uplifts and GA.

More information on these topics can be found on the [IESO Settlement Process](#). Detailed information on existing IESO processes and rules can be found in [IESO market rules and market manuals](#).

4.4.1 Market Settlement

The IESO uses settlement-ready data to determine revenues owed to suppliers, charges applied to consumers, and associated electricity charges. The IESO uses the data from the settlement process to produce preliminary settlement statements, final settlement statements and invoices for participants.

This design element determines if any changes to the settlement process are required for the settlements of hybrid facilities.

The market settlement process delivers a detailed breakdown of all the financial calculations performed by the IESO concerning a market participant's activity in the IAMs. Settlement services allow market participants to review and reconcile these calculations in order to determine the accuracy of invoices issued by the IESO. Pre-market renewal, IESO employs a two-schedule market design providing a uniform MCP that is used to establish the province-wide hourly Ontario energy price (HOEP) for the RTM. Along with determining RTM energy and OR payments to suppliers and uplifts to consumers to financially balance the market, the two-schedule market design gives rise to congestion management settlement credits (CMSC) payments and the corresponding CMSC uplifts.

Pre-market renewal, market settlement is primarily applicable towards RTM and OR market activities. The DACP utilizes submitted dispatch data, but does not result in market prices and associated schedules. Instead, the DACP is a reliability process used to schedule and commit resources a day in advance of the dispatch day, resulting only in payments and charges related to those commitments, as described in Market Manual 9.5 Settlement for the Day-Ahead Commitment Process.

The obligation to submit dispatch data will be the same in the DAM post-market renewal as under the DACP. However, the DAM has a SSM design with LMPs and settlement implications. Resources that participate in DAM will receive a financially binding schedule for energy and OR that may result in charges (consumers) or payments (suppliers) for the DA schedule based on their DAM LMP. Deviations between the RT schedule and the DA schedule will be settled based on their RTM LMP. This settlement process is called the two-settlement system, which includes DAM settlement amounts and RTM balancing settlement amounts. The SSM design will eliminate CMSC payments and the corresponding CMSC uplifts.

Additionally, market renewal introduces make-whole payments. Make-whole payments apply to circumstances in DAM and in the RTM where a resource is either “scheduled up” to produce or consume more energy than is economic at the LMP (incurring an operating cost loss), or is “scheduled down” to produce or consume less energy than is economic at the LMP (incurring an opportunity cost). When this occurs, the market participant may receive compensation with a make-whole payment, and this payment will provide appropriate incentives for participation in the IAMs.

4.4.2 Uplift Charges

The total cost of electricity charged to consumers should equal the actual cost to dispatch that electricity. In some instances, there is an imbalance between the two. In these situations, an uplift mechanism is used to balance the market by either recovering revenue from consumers/exporters (energy withdrawn from the ICG) if it has been determined that they have been under charged, or providing credits if they have been over charged.

Uplift charges are referenced in section 4.4.1 as they relate to market settlement. The uplift charges design element determines if any changes to uplift charges are required for the settlement of hybrid facilities.

4.4.3 Global Adjustment (GA)

GA is a component of the commodity cost of electricity. GA covers the cost of building new electricity infrastructure in the province, maintaining existing resources, as well as providing conservation and energy efficiency programs, if these costs are not fully recovered through IESO market revenues. More information on GA can be found on the [IESO Settlement Process](#) webpage.

GA amounts are paid by market participants based on their energy consumption. The amounts paid by loads are determined based on Ontario Regulation 429/04, which is under the responsibility of the Ontario Ministry of Energy.

All customers in Ontario pay GA charges and are billed based on their classification. Customers that participate in the Industrial Conservation Initiative (ICI), referred to as Class A customers, pay their share of GA based on their peak demand factor (PDF). A customer’s PDF is based on their percentage contribution (i.e., the quantity of energy withdrawn from the IESO controlled grid or distribution system of a local distribution company) during the top five (5) peak hours of the corresponding 12-month base period (May 1 to April 30). All other customers, referred to as Class B customers, pay their share of GA based on their monthly consumption multiplied by the applicable Class B rate for that month.

The GA design element ensures that settlement for the hybrid facility models is consistent with the IESO settlement process that incorporates the GA regulation.

With respect to a hybrid facility, GA amounts are applicable to storage load/withdrawing resource for charging from the grid and to injecting resources that consume for station service. A Class B storage load that is recognized as a “electricity storage facility” under the regulation is eligible to be reimbursed for injections to the grid at the Class B rate. The storage load may be eligible for Class A treatment after the first base period.

5. Decisions and Implementation Considerations

The sections below describe the decisions for each design element in the four (4) design modules, enabling the co-located hybrid facility model (“Co-located Model”) and the integrated hybrid facility model (“Integrated Model”) to participate in the IAMs.

5.1 Capacity Module

The sections below describe the decisions for each design element under the capacity module.

5.1.1 Capacity Qualification

Co-located Model

For procurement or capacity auctions that use UCAP methodologies for capacity qualification, capacity will be qualified utilizing UCAP methodologies specific to the applicable resource types in order to separately qualify the capacity for each injecting resource of the co-located hybrid facility. In other words, for a co-located hybrid facility with VG and storage, the VG UCAP methodology will be used to qualify capacity for the generation resource and the storage UCAP methodology will be used to qualify capacity for the storage resource. UCAP will be equal to ICAP reduced by the ADRF for the resource type. The total ICAP for the resources under the hybrid facility cannot be greater than the limit at the connection point to the grid.

The total hybrid facility capacity contribution will not be utilized for settlement or for POA because the resources will be completely separate in providing capacity and meeting their obligations. The capacity contribution of the individual resources will be utilized for settlement and POA. For clarity, although not used for settlement or POA, the total qualified capacity for the co-located hybrid facility will be equal to the qualified generation capacity plus the qualified storage capacity, and will not be greater or lesser than the sum of the parts.

The sum of the UCAPs for the individual resources appropriately reflects the total capacity for the hybrid facility, subject to the limit at the connection point. Although the resources are located behind the same connection point to the grid, they have no interaction with each other in the market; they provide separate dispatch data, receive separate dispatch instructions and are separately settled. For this reason, the capacity qualification to assess UCAP will be separate for each resource, and this methodology is not expected to change over time.

There are no implementation considerations for capacity qualification for the co-located hybrid facility model; the methodologies specific to the existing resource types will be described and utilized under the applicable acquisition mechanism.

Integrated Model

For procurement or capacity auctions that use UCAP methodologies for capacity qualification, capacity will be qualified utilizing UCAP methodologies specific to the applicable underlying technology types in order to qualify the capacity for combined generation resource of the integrated hybrid facility. In other words, for an integrated hybrid facility that has a combined generation resource with underlying VG and storage, the VG UCAP methodology will be used to qualify capacity for the generation technology and the storage UCAP methodology will be used to qualify capacity for the storage technology. UCAP will be equal to ICAP reduced by the ADRF for the technology type. The total ICAP for the underlying technologies of the hybrid facility cannot be greater than the limit at the connection point to the grid.

The capacity for the combined generation resource includes capacity from the generation technology and the storage technology. As a reasonable starting point, the IESO expects the total qualified capacity for the combined generation resource to be equal to the sum of the individual UCAPs for the generation and storage, subject to the limit at the connection point.

The IESO recognizes that the generation and storage are coupled behind a single revenue meter, and there can be interactions between the injecting technologies that could impact capacity value. As a result, the capacity value may be greater or lesser than the sum of the parts by an unknown amount that can only be determined based on historical data for the resource or fleet. Until that data is available, the underlying technologies will be separately qualified for capacity, and the sum of the qualified capacity for those technologies will represent the capacity contribution for the combined generation resource of the integrated hybrid facility, subject to the limit at the connection point. This total capacity value will be utilized for settlement and for POA for the integrated hybrid facility because there is one combined resource providing capacity and meeting the obligation.

The capacity qualification methodology may evolve as historical production and availability data for the combined generation resource or the fleet become available through participation in the energy market.

There are no implementation considerations for capacity qualification for the integrated hybrid facility model; the methodologies specific to the existing technology types will be described and utilized under the applicable acquisition mechanism.

5.1.2 Performance Obligation & Assessment (POA)

Co-located Model

For resources that have a capacity obligation, there will be a separate POA for each individual resource under the co-located hybrid facility. The performance obligations will reflect the characteristics of the underlying resources/ technology types. The obligations will be specified through the relevant acquisition mechanism (CA or RFP). Performance will be assessed for each resource separately, and will not be assessed for the hybrid facility in total.

There are no implementation considerations for POA for the co-located hybrid facility model; the methodologies specific to the existing resource types will be described and utilized under the applicable acquisition mechanism.

Integrated Model

For resources that have a capacity obligation, there will be a single POA for the combined generation resource for all contributing technologies under the integrated hybrid facility. The performance obligation will reflect the characteristics of the underlying technology types. The obligations will be specified through the relevant acquisition mechanism (CA or RFP, where applicable). Performance will be assessed for the hybrid facility as a whole.

There are no implementation considerations for POA for the integrated hybrid facility model; the methodologies specific to the existing technology types will be described and utilized under the applicable acquisition mechanism.

5.2 Authorization and Registration Module

The sections below describe the decisions for each design element under the authorization and registration module.

5.2.1 Market Registration and Class of Market Participant

Co-located Model

There must be only one (1) RMP, one (1) MMP and one (1) operator across all resources (generation resource, storage injecting resource and storage withdrawing resource) under the co-located hybrid facility. However, the RMP, MMP and operator could be different from each other. The owner could be different for the generation resource and the storage resources, and could be different from the RMP, MMP and operator, noting that the storage injecting resource and the storage withdrawing resource must have the same owner.

It is also possible that the RMP, MMP, operator and owner could be the same entity for all resources; there are many possible combinations.

See example in the table below for additional clarity on the maximum flexibility for assigning entities to the various market participation roles.

| Market Participation Role | Generation resource | Storage Injecting Resource | Storage Withdrawing Resource |
|---------------------------|---------------------|----------------------------|------------------------------|
| RMP | X | X | X |
| MMP | Y | Y | Y |
| Operator | Z | Z | Z |
| Owner | A | B | B |

For the purpose of this design, the IESO assumes that a new OEB licence type will not be required for the co-located hybrid facility; therefore, the authorization requirements are designed based on the status quo. As a result, it is expected that the market participant with a co-located hybrid facility will continue to participate under the existing OEB licences for the underlying technologies (generator and electricity storage participant). With the expectation that no new OEB licence will be required, there will be no requirement for a new class of market participant under Chapter 2 of the market rules. However, it is the obligation of the market participant to ensure that they comply with all applicable OEB or other licensing requirements, and to provide this information to the IESO at the time of authorization. If a new OEB licence is required, the IESO may include a new class of market participant in the market rules.

Changes to include references to hybrid facilities and to identify and enforce the requirements for the same entity across resources are required in governing documents.

Integrated Model

There must be only one (1) RMP, one (1) MMP, one (1) operator, and (1) owner across all resources (generation resource and load resource) under the integrated hybrid facility. However, the RMP, operator, MMP and owner can be different from each other.

It is also possible that the RMP, MMP, operator and owner could be the same entity for all resources; there are many possible combinations.

See example in the table below for additional clarity on the maximum flexibility for assigning entities to the various market participation roles.

| Market Participation Role | Generation resource | Storage Withdrawing Resource |
|---------------------------|---------------------|------------------------------|
| RMP | X | X |
| MMP | Y | Y |
| Operator | Z | Z |
| Owner | A | A |

For the purpose of this design, the IESO assumes that a new OEB licence type will not be required for the integrated hybrid facility; therefore, the authorization requirements are designed based on the status quo. As a result, it is expected that the market participant with an integrated hybrid facility will continue to participate under the existing OEB licences for the underlying technologies (generator and electricity storage participant). With the expectation that no new OEB licence will be required, there will be no requirement for a new class of market participant under Chapter 2 of the market rules. However, it is the obligation of the market participant to ensure that they comply with all applicable OEB or other licensing requirements, and to provide this information to the IESO at the time of authorization. If a new OEB licence is required, the IESO may include a new class of market participant in the market rules.

Changes to include references to hybrid facilities and to identify and enforce the requirements for the same entity across resources are required in governing documents and the IESO tools.

5.2.2 Prudential Security

Co-located Model

The IESO prudential security framework will assess the prudential security requirements for the resources under the co-located hybrid facility model, and therefore no changes to the framework are required.

The total prudential security requirement will continue to be assessed at a market participant level based upon the expected net amount owed by the market participant, considering all resources under that market participant. Since the market participant for the generation resource and storage resources under the hybrid facility will be the same, it's possible that no prudential security will be required for the hybrid facility. In the example above, if the storage and generation resources comprised a co-located hybrid facility, the market participant would be owed money due to net injections, and the prudential security requirement would be \$0. However, if lower injections or GA charges or other charges resulted in the expectation of a net charge to the market participant, prudential security will be required.

There are no implementation considerations for the Prudential Security design element for the co-located hybrid facility model; the existing processes will be utilized. Minor changes to include references to hybrid facilities may be required in governing documents.

Integrated Model

The IESO prudential security framework will assess the prudential security requirements for the resources under the integrated hybrid facility model, and no changes to the framework are required.

The total prudential security requirement will continue to be assessed at a market participant level based upon the expected net amount owed by the market participant, considering all resources under that market participant. Since the market participant for the generation resource and load resource under the hybrid facility will be the same, it's possible that no prudential security will be required for the hybrid facility. In the example above, if the storage and generation technologies are registered as a combined generation resource and a separate load resource in order to comprise an integrated hybrid facility, the market participant would be owed money due to net injections, and the prudential security requirement would be \$0. However, if lower injections or GA charges or other charges resulted in the expectation of a net charge to the market participant, prudential security will be required.

There are no implementation considerations for the Prudential Security design element for the integrated hybrid facility model; the existing processes will be utilized. Minor changes to include references to hybrid facilities may be required in governing documents.

5.2.3 Connection Assessment & Approval (CAA) / System Impact Assessment (SIA)

Co-located Model

No change will be required to the existing CAA/SIA process to enable co-located hybrid facilities. As a result of any new or modified connection to the ICG, the IESO will perform a SIA as specified by the

CAA process, market rules and market manuals. Under the provisions of section 1 of Market Manual 1.4, converting an existing facility into a hybrid facility will be considered a “modified connection” and, as such, it will be subject to the CAA process. A hybrid facility consisting of a new generation resource and new storage resources will be considered “a new connection”

For all new or modified connections, the IESO will need to assess impacts of the new connection or of the modifications to the existing connection to the reliability of the integrated power system.

Provisions of the TSC and DSC continue to apply.

There are no implementation considerations for the CAA/SIA design element for the co-located hybrid facility model; the existing processes will be utilized. Minor changes to include references to hybrid facilities may be required in governing documents.

Integrated Model

No change will be required to the existing CAA/SIA process to enable integrated hybrid facilities. Any new or modified connection to the ICG will require an SIA as specified by the CAA process, market rules and market manuals.

Under the provisions of section 1 of Market Manual 1.4, converting an existing facility into a hybrid facility will be considered a “modified connection” and, as such, it will be subject to the CAA process.

A hybrid facility consisting of a new combined generation resource and new storage withdrawing resource for grid charging will be considered a “new connection”.

For all new or modified connections, the IESO will need to assess impacts of the connection or of the modifications to the existing connection to the reliability of the integrated power system.

Provisions of the TSC and DSC continue to apply.

There are no implementation considerations for the CAA/SIA design element for the integrated hybrid facility model; the existing processes will be utilized. Minor changes to include references to hybrid facilities may be required in governing documents.

5.2.4 Resource Size

Co-located Model

The minimum resource size requirement for the co-located hybrid facility will maintain the status quo by requiring at least 1 MW of energy capability for each resource under the facility. For the co-located hybrid facility, there will be a minimum capacity requirement of 1 MW for the generation resource and 1 MW for the storage resources. Therefore, the hybrid facility will have at least 2 MW of injection capability and 1 MW of withdrawal capability.

There are no implementation considerations for the resource size design element for the co-located hybrid facility model. Minor changes to include references to hybrid facilities may be required in governing documents.

Integrated Model

The minimum resource size requirement for the integrated hybrid facility will maintain the status quo for the storage withdrawing resource by requiring at least 1 MW of energy capability. For the

combined generation resource under the integrated hybrid facility, there will be a minimum capacity requirement of 1 MW for storage injections and 1 MW for generation injections, to ensure that either technology meets the minimum size threshold and can participate even when the other technology has an outage. Therefore, the hybrid facility will have at least 2 MW of injection capability and 1 MW of withdrawal capability.

There are no implementation considerations for the resource size design element for the integrated hybrid facility model. Minor changes to include references to hybrid facilities may be required in governing documents.

5.2.5 Ratio of Storage-to-Generation Capacity

Co-located Model

For the co-located hybrid facility, there is no reason to require a minimum storage-to-generation ratio because the storage and generation resources will participate in the IAMs separately. Since the resources are each required to meet their individual dispatch instructions, and charging behind the meter will not be allowed under this model, the size of the storage relative to the generation does not advantage or disadvantage the market participant or the grid.

In any case, the IESO will not prescribe a minimum storage-to-generation capacity ratio⁹. This decision provides flexibility to asset owners to make these decisions considering all factors relevant to their project, aligning with the approach of other jurisdictions.

There are no implementation considerations for the ratio of storage-to-generation capacity design element for the co-located hybrid facility model.

Integrated Model

For the integrated hybrid facility, a minimum storage-to-generation ratio could help the market participant comply with dispatch instructions for the combined generation resource due to the underlying storage and generation technologies that are being utilized to meet dispatch. Storage can be charged behind-the-meter under this model; therefore, the size of the storage relative to the generation could provide an advantage to the market participant or to the grid. The market participant will be more likely to be able to comply with dispatch instructions if the storage technology has a larger capacity to discharge when fuel is not available for the generation technology. Further, it will be more cost effective if storage capacity is large enough to store surplus energy from the generation technology that would otherwise be curtailed through dispatch instructions if not needed by the grid.

However, the IESO will not prescribe a minimum capacity ratio⁹ for the integrated hybrid facility so that asset owners have the flexibility to make these decisions considering all factors relevant to their project. This decision aligns with the approach of other jurisdictions.

There are no implementation considerations for the ratio of storage-to-generation capacity design element for integrated hybrid facility model.

⁹ Future procurements may identify a ratio of generation to storage as a parameter; this requirement is subject to procurement design, and is not part of the requirements to participate in the IAMs.

5.2.6 Facility Registration

Co-located Model

For the co-located hybrid facility, all resources will be dispatchable, submitting dispatch data and following IESO dispatch instructions. The process to register the facility and finalize telemetry for the co-located hybrid facility will be unchanged. New data may be required during facility registration, to be determined during the implementation phase.

There may be minor changes required to existing tools to include new identifiers for the facility as a “hybrid facility”, and some additional new data may be required. Minor changes to include references to hybrid facilities may be required in governing documents.

Integrated Model

For the integrated hybrid facility, all resources will be dispatchable, submitting dispatch data and following IESO dispatch instructions. The process to register the facility and finalize telemetry for the integrated hybrid facility will be unchanged. New data may be required during facility registration, to be determined during the implementation phase.

There may be minor changes required to existing tools to include new identifiers for the facility as a “hybrid facility” and for the generation resource as a “hybrid generation resource”, and some additional new data may be required. Minor changes to include references to hybrid facilities may be required in governing documents.

5.2.7 Revenue Meter Registration (RMR)

Co-located Model

There will be no change to the pre-market renewal RMR process or requirements for a co-located hybrid facility. One (1) revenue meter measuring both injections and withdrawals will be registered for the two (2) resources associated with the storage facility, and one (1) revenue meter will be registered for a generation resource. As part of the RMR process, the location of the meters will be considered to assess any impacts on settlement.

There are no implementation considerations for the RMR design element for the co-located hybrid facility model.

Integrated Model

There will be no change to the pre-market renewal RMR process or requirements for an integrated hybrid facility. One (1) revenue meter will be registered for the two (2) resources associated with the hybrid facility, that is, the combined generation resource and the storage withdrawing resource. In other words, one (1) bi-directional revenue meter will facilitate settlement of the withdrawals from the storage load and the injections from the combined storage and generation technologies.

There are no implementation considerations for the RMR design element for the integrated hybrid facility model.

5.3 Grid and Market Operations Module

The sections below describe the decisions for each design element under the grid and market operations module.

5.3.1 Dispatch Data and Other Data Inputs

Co-located Model

Since co-located hybrid facilities will participate under existing generation and storage resource types, the obligation to submit dispatch data will not change. There will be no new or additional dispatch data required for participation in the IAMs (energy or OR), and the generation and storage resources will remain completely separate for submission of dispatch data and the resulting dispatch instructions. For clarity, the dispatch data parameters and participation rules for energy and OR markets that apply to generation and storage resources both pre- and post-market renewal will apply to the generation and storage resources under a co-located facility. VG is not eligible to provide OR.

There will be no change in the utilization of the IESO's centralized forecast within the calculation engines that determine schedules and dispatch instructions as a result of introducing the co-located hybrid facility model.

The pre-market renewal approach for dispatch data revisions, including changes within the mandatory window, will also remain the same.

Under the market rules, market participants are responsible for managing their bids and offers so that their equipment is not overloaded due to the net schedule at the connection point. For example, the resources under the co-located hybrid facility may have a total injecting capacity greater than the limit at the connection point, and may offer that capacity with an offsetting bid to withdraw/charge from the grid. The net bid/offer quantity must be less than or equal to the connection point limit, and the participant will need to ensure that the resulting net schedule is also less than or equal to the connection point limit.

The no-overlap rule will continue to apply to the bid and offer from the storage resources (bid prices submitted by a storage withdrawing resource must be less than all offer prices submitted by a storage injecting resource for the corresponding hour); however, the bid price for the storage withdrawing resource may overlap with the offer price for the generation resource, which are completely separate technologies and resources, to allow storage charging from the grid at the same time as the generation injects to the grid.

All storage charging must be dispatched through the market and will not be allowed behind-the-meter directly from the generation resource since the generation and storage resources are separately metered and settled. As mentioned above, changes within the mandatory window will also be consistent with the pre-market renewal approach, and the storage resource will be able to adjust or remove their bids or offers within the mandatory window due to SoC reasons.

The requirement to manage bids and offers to avoid overloading equipment and achieve a feasible net schedule at the connection point is expected to impact market rules and market manuals. There are no other implementation considerations for the dispatch data and other data inputs design element for the co-located hybrid facility model.

Integrated Model

Since integrated hybrid facilities will participate under existing generation and storage resource types, the obligation to submit dispatch data will reflect the requirements for these existing resource types. There will be no new or additional dispatch data required for participation in the IAMs (energy or OR), and the two (2) resources will remain completely separate for submission of dispatch data and the resulting dispatch data instructions. For clarity, the dispatch data parameters and participation rules for energy markets that apply to non-VG quick start generation resources and to a storage withdrawing resource both pre- and post-market renewal will apply to the combined generation resource and storage withdrawing resource under an integrated facility. The OR quantity offered by the combined generation resource must not be greater than the non-VG capacity, due to VG fuel uncertainty. The OR quantity offered by the storage withdrawing resource must not be greater than the storage withdrawing capacity. Additional OR participation rules are noted below.

The IESO's centralized forecast does not apply to the combined generation resource under this model, even if the underlying generation technology is wind or solar. For further clarity, a release dispatch instruction will not be provided for the combined generation resource for an integrated hybrid facility with underlying VG technology. The combined generation resource will be a dispatchable quick start generation resource that must bid/offer into the IAMs considering the underlying technologies, and comply with dispatch instructions. The pre-market renewal approach for dispatch data revisions, including changes within the mandatory window, will remain the same. For clarity, reduction in the bid quantity for the storage withdrawing resource or the offer quantity for the combined generation resource will be allowed within the mandatory window for reasons related to storage SoC limitations.

The no-overlap rule will apply to the bid from the storage withdrawing resource and the offer price from the combined generation resource (bid prices submitted by a storage withdrawing resource must be less than all offer prices submitted by the combined generation resource for the corresponding hour), in order to avoid conflicting dispatches.

Storage charging will be allowed behind-the-meter directly from the generation resource since the generation and storage technologies share a meter for settlement. Storage may also charge by dispatch of the storage withdrawing resource through the market.

OR participation rules for the resources under the integrated hybrid facility reflect the OR participation rules for stand-alone storage resources, since storage will be an underlying resource for both the combined generation resource and storage withdrawing resources.

- OR offers will not be allowed from either the combined generation resource or the storage withdrawing resource if there is a simultaneous bid and offer for energy for these resources in the same dispatch hour, to avoid conflicting energy dispatch and OR activation.
- Storage may only offer OR from the combined generation resource if it is exclusively offered for energy as an injecting resource for the entire dispatch hour, the storage withdrawing resource does not bid to withdraw energy from the RTM nor offer OR in the subsequent dispatch hour, and the remaining time that the combined generation resource is able to inject is greater than or equal to 130 minutes.
- Storage may only offer OR from the storage withdrawing resource if it is exclusively offered for energy as a withdrawing resource for the entire dispatch hour, the combined generation resource does not offer to inject energy from the RTM nor offer OR in the subsequent

dispatch hour, and the remaining duration of service for the storage withdrawing resource is greater than or equal to 70 minutes.

There are other no implementation considerations for the dispatch data and other data inputs design element for the integrated hybrid facility model.

Note that a rule relating to the net bid/offer quantity and schedule at the connection point will not be required for the integrated model. The combined generation resource cannot inject at the same time that storage withdraws because the storage injecting technology will be part of the combined generation resource, and storage cannot inject and withdraw at the same time.

5.3.2 Market Power Mitigation (MPM)

Co-located Model

Consistent with other Ontario dispatchable resources, co-located hybrid facilities will be subject to MPM. Mitigation of economic withholding and non-financial dispatch data (ex-ante), settlement mitigation of generation offer guarantee and make-whole payments, and mitigation of physical withholding (ex-post) will be performed for hybrid facilities that are in a constrained area utilizing conduct and impact tests. Resource-specific reference levels and reference quantities will be developed for the storage injecting resource and the generation resource in consultation with the market participant using established methodologies for each technology. Except for OR ramp rates and OR offer quantity, dispatch data for the storage withdrawing resource will not be subject to MPM. The maximum DEL parameter will also not be subject to MPM.

There are no implementation considerations for the MPM design element for the co-located hybrid facility model.

Integrated Model

Consistent with other Ontario dispatchable resources, integrated hybrid facilities will be subject to MPM. Mitigation of economic withholding and non-financial dispatch data (ex-ante), settlement mitigation of make-whole payments, and mitigation of physical withholding (ex-post) will be performed for hybrid facilities that are in a constrained area utilizing conduct and impact tests. The combined generation resource will be considered a new technology type for MPM due to multiple underlying technologies, requiring a unique methodology to determine the reference levels and reference quantities. The resource-specific reference levels and reference quantities will be developed in consultation with market participants, considering the underlying technologies and the operation of the facility. Except for OR ramp rates and OR offer quantity, dispatch data for the storage withdrawing resource will not be subject to MPM. The maximum DEL parameter will also not be subject to MPM.

The IESO will consult with sector participants during the implementation phase to develop supplemental content for the market rules and market manuals, as required. Once market rules/manuals are effective, the IESO will carry out reference level consultations with each market participant to determine reference levels and reference quantities for their combined generation resource.

5.4 Settlement Module

The sections below describe the decisions for each design element under the settlement module.

5.4.1 Market Settlement

Co-located Model

There are no changes required to market settlement design for the co-located hybrid facility model. The three (3) resources under this model participate separately in the IAMs under existing resource types: storage resources and generation resource. The two (2) dispatchable storage resources (for injection and withdrawal), and the dispatchable generation resource will be subject to separate settlement.

There are no implementation considerations for the market settlement design element for the co-located hybrid facility model.

Integrated Model

There are no changes required to market settlement design for the integrated hybrid facility model. The two (2) resources under this model participate separately in the IAMs under existing resource types: storage withdrawing resource and combined generation resource. The dispatchable storage withdrawing resource and the dispatchable generation resource will be subject to separate settlement.

There are no implementation considerations for the market settlement design element for the integrated hybrid facility model.

5.4.2 Uplift Charges

Co-located Model

There are no changes required to uplift charges for the co-located hybrid facility model. Uplifts will continue to be applicable to energy withdrawn from the ICG, including withdrawals for charging of storage. Note that if the generation resource of the co-located model is dispatched to inject at the same time the storage withdrawing resource is dispatched for charging from the grid, uplift will still be applicable to the storage withdrawing resource.

There are no implementation considerations for the uplift charges design element for the co-located hybrid facility model.

Integrated Model

There are no changes required to uplift charges for the integrated hybrid facility model. Uplifts will continue to be applicable to energy withdrawn from the ICG, including withdrawals for charging of storage. Charging will also be allowed behind-the-meter, from the generation technology to the storage technology under the combined generation resource, and will not be subject to uplifts.

There are no implementation considerations for the uplift charges design element for the integrated hybrid facility model.

5.4.3 Global Adjustment (GA)

Co-located Model

There are no impacts or changes to the settlement process with respect to GA amounts for the co-located hybrid facility model because this model utilizes the existing resource types for storage and generation, which are already addressed under the regulation. The regulation reimburses GA incurred by eligible electricity storage facilities based on the quantity of energy that was withdrawn, temporarily stored, and then reinjected back into the ICG or distribution system of a licensed distributor. Further, the storage load may be eligible for Class A treatment after the first base period, limiting the impact of GA.

There are no implementation considerations for the GA design element for the co-located hybrid facility model. Note that any future changes to the GA regulation as initiated by the Ministry of Energy may impact settlement for withdrawals by resources under the co-located hybrid facility model.

Integrated Model

There are no impacts or changes to the settlement process with respect to GA amounts for the integrated hybrid facility model because this model utilizes the existing resource types for load and generation, which are already addressed under the regulation.

However, the storage technology under the combined generation resource of the integrated hybrid model shares a meter with the generation technology, and there will be no differentiation between injections from the generation versus storage. As a result, the storage technology does not meet the definition for an electricity storage facility under the regulation, and the storage load for charging from the grid will not be eligible to be reimbursed at the Class B rate for GA based on the quantity of energy that was withdrawn, temporarily stored, and then reinjected back into the ICG or distribution system of a licensed distributor. The storage load may be eligible for Class A treatment after the first base period, limiting the impact of GA. Further, the market participant may charge storage behind the meter, which is not subject to GA.

The IESO recognizes that the GA regulation may need to be updated to consider the integrated hybrid facility where it appears the Class B reimbursement does not apply to grid-charging of storage resources. This issue has been identified by the IESO to the Ministry of Energy.

There are no implementation considerations for the GA design element for the integrated hybrid facility model. Note that any future changes to the GA regulation as initiated by the Ministry of Energy may impact settlement for withdrawals by resources under the integrated hybrid facility model.

6. Energy and Operating Reserve (OR) Market Participation

The following sections describe the timeframes in the renewed market, and how the co-located and integrated hybrid facilities will participate in the energy and OR markets during those timeframes. This content is for informational purposes only and will explain how the decisions in the previous sections apply to the market timeframes. In addition, this section explains how hybrid facilities can navigate through the timeframes while considering the applicable operational procedures and market rules.

6.1 Description of Market Timeframes

6.1.1 Day-Ahead (DA)

The DAM provides financially binding schedules for participating resources a day in advance of operation. Typically, most of the supply will be scheduled by the DAM calculation engine, and the RT market (RTM) will be used to balance any deviations that occur between DA and RT. The DAM provides a high level of financial and operational certainty to market participants as well as to the system operator. This certainty enables market participants to manage their financial risk and system operators to schedule a cost-effective and reliable supply of electricity.

Resources that receive capacity obligations from the CA, are contracted or are rate regulated have incentives to participate in the DAM. Other resources can choose if they want to submit bids or offers into the DAM.

Market participant requirement:

Between 06:00 to 10:00 eastern prevailing time (EPT), the day before the dispatch day, participants should review market conditions and their facility's capabilities to submit energy bids and offers, through price-quantity pairs, into the IESO DAM. Bids and offers are used by the IESO in the DAM calculation engine to determine financially binding schedules for the dispatch day. The MW quantities submitted by the participant also sets the ADE value for the resource, which is the upper limit of their participation for the next day.

After the submission window closes, the DAM calculation engine will run between 10:00 and 13:30 EPT. The IESO will publish the DAM schedules; participants should review their results to prepare for the dispatch day.

6.1.2 Pre-Dispatch (PD)

PD is the timeframe between clearing of the DAM until RT operations, during which optimization of bids and offers will be performed to address changes in system conditions. The IESO's PD calculation engine will use multi-hour optimization which considers previous and subsequent hours for all bids and offers, including three (3) part offers, for each dispatch hour. Multi-hour optimization will also consider resource operating restrictions for all applicable resources. The PD calculation engine runs every hour to provide advisory prices and schedules to market participants.

Market participant requirement:

20:00 eastern standard time (EST) DA to two (2) hours before dispatch hour (referred to as the mandatory window), participants should continuously monitor the market (prices, demand, advisory notices, etc.) and their facility's capabilities and make changes to their energy bids or offers as appropriate. Any changes required by the participant to their dispatch instructions within the mandatory window must be communicated to the IESO immediately.

6.1.3 Real-Time (RT)

During RT, the IESO transmits dispatch instructions to market participants for the required amount of energy to be injected or withdrawn from the ICG.

The RT calculation engine considers resource and system constraints to determine dispatch instructions, LMPs and the Ontario zonal price for each five-minute dispatch interval. The RT calculation engine also determines advisory schedules for the subsequent ten (10) intervals, known as multi-interval optimization.

Market participant requirement:

Resources will receive dispatch instructions, and dispatchable facilities are expected to respond to these dispatch instructions by meeting the required energy injection or withdrawal no later than the end of the applicable five (5) minute dispatch interval, or within 10 or 30 minutes for an OR activation (depending on the OR class). Participants are expected to follow their latest dispatch instruction until receiving another from the IESO, which can occur every five (5) minutes.

6.1.4 Settlement

Resources that participate in the IAMs are settled by the IESO using settlement-ready data to determine revenues owed to suppliers, charges applied to consumers, and associated electricity charges.

Under the renewed market, the DAM has an SSM design with LMPs for energy and OR. Resources that participate in DAM will receive a financially binding schedule for energy and OR that may result in charges (for consumers) or payments (for suppliers) for the DA schedule based on their DAM LMP. Deviations between the RT schedule and the DA schedule will be settled based on their RTM LMP. This settlement process is called the two-settlement system.

Market participant requirement:

A market participant is required to be enabled for settlement before participating in the IAMs, however, the settlement process itself takes place after a resource has been scheduled in the market. Once active in the markets, a participant could be required to pay an invoice to the IESO if requested, or meet specific timing requirements if the participant intends to dispute the settlement amount based on a review of preliminary and final statements sent to them.

6.2 Co-located Hybrid Facility Participation

This section walks through the market timeframes in the context of a co-located hybrid facility, in order to clarify and reinforce market participation given the design features that have been previously described.

To reiterate, the generation and storage technologies in a co-located hybrid facility operate independently under three (3) separate dispatchable resources: a generation resource, a storage injecting resource and a storage withdrawing resource.

The generation and storage resources under a co-located facility will be dispatchable. It is expected that the resources will submit bids and offers into the IAMs (energy and OR) in the same manner as other dispatchable resources of the same resource type.

The key market participation design features as previously described are listed below, and will be required under the market rules. The participant must ensure that these rules are adhered to from DA until RT.

- The net bid/offer quantity for the generation and storage resources must be less than or equal to the connection point limit, and the participant needs to ensure that the resulting net schedule is also less than or equal to the connection point limit.
- All storage charging must be dispatched through the market and will not be allowed behind-the-meter directly from the generation resource.
- The no-overlap rule will continue to apply to the bid and offer from the storage resources: bid prices submitted by a storage withdrawing resource must be less than all offer prices submitted by a storage injecting resource for the corresponding hour; however, for clarity, the bid price for the storage injecting resource may overlap with the offer price for the generation resource, which are completely separate technologies and resources, to allow storage charging from the grid at the same time as the generation resource injects to the grid. OR participation rules for the storage and generation resources under the co-located hybrid facility are the same as participation rules for storage and generation resources that are not part of a co-located hybrid facility. VG is not eligible to provide OR due to fuel uncertainty.

6.2.1 Day-Ahead (DA)

Generation resource

The participant submits energy and OR offers, as applicable for the generation technology type, and receives financially binding DAM schedules for energy and OR. Participants should be aware of any DAM participation requirements set out in contractual or CA obligations, as well as ensuring they offer for all hours the generation resource aspires to participate in the RTM, noting that this offer will set the ADE.

For VG, the offer quantity represents the total facility capability, allowing the VG to participate in the RTM and setting the ADE; however, the IESO will utilize either the centralized forecast or the participant's own forecast to determine the financially binding schedule. This element of the DAM reflects fuel uncertainty for VG. The forecast quantity provides an indication of expected production for the next day. The VG financially binding schedule will be limited to the lesser of the forecast quantity and the offer quantity.

Storage Resources

The participant submits energy offers for the storage injecting resource, energy bids for the storage withdrawing resource for charging from the grid, and/or OR offers for either resource. The participant receives financially binding DAM schedules for energy and OR for the storage resources.

Participants should be aware of any DAM participation requirements set out in contractual or CA obligations, as well as ensuring they bid or offer for all hours the storage withdrawing resource or storage injecting resource aspire to participate in the RTM, noting that this bid or offer will set the ADE.

The storage injecting resource may utilize the maximum DEL to manage their DAM schedule, considering energy limitations and SoC. For example, a 25 MW, four-hour storage resource that expects to be fully charged at the beginning of the dispatch day can submit a maximum DEL of 100 MWh into the DAM, to avoid infeasible scheduling.

6.2.2 Pre-Dispatch (PD)

Generation resource

Through the PD timeframe, participants will continue to manage their offers to reflect resource capabilities and changing market conditions. Generation resources will receive advisory schedules throughout the PD timeframe.

For VG, the forecast quantity parameter does not apply after the DAM timeframe; therefore, VG are not required to update this parameter. The PD engine utilizes the lesser of the IESO centralized forecast and the VG energy offer to determine schedules. Updated offers for VG are primarily used to reflect forced outages and de-rates to reflect maximum facility capability for RT.

Storage Resources

Through the PD timeframe, participants will continue to manage their bids and offers to reflect resource capabilities and changing market conditions.

The participant must self-manage SoC for storage; therefore, expected SoC for upcoming hours should be considered, and bids or offers must be updated accordingly to avoid infeasible dispatch. Storage resources will be allowed to reduce their bid quantity and offer quantity within the mandatory window due to SoC limitations that arise during that period such that the resource is unable to comply with dispatch instructions. Maximum DEL may also be updated during PD, and will be considered in determining schedules.

6.2.3 Real-Time (RT)

Generation resource

A generation resource must respond to dispatch instructions no later than the end of the applicable five (5) minute dispatch interval, or within 10 or 30 minutes for an OR activation (depending on the OR class).

For VG, a dispatch instruction may indicate that they can operate based on ambient conditions ("release" dispatch instruction). At other times, either for reliability or economic reasons, VG may receive a "mandatory" dispatch instruction requiring the resource to limit output to a certain MW

level. The mandatory dispatch may be lower than ambient conditions would produce, and the resource is not authorized to exceed the mandatory dispatch level until they receive a new release dispatch instruction or a different mandatory dispatch instruction.

Storage Resources

A storage resource must respond to dispatch instructions no later than the end of the applicable five (5) minute dispatch interval, or within 10 or 30 minutes for an OR activation (depending on the OR class). Storage resources must self-manage its SoC; therefore, expected SoC for upcoming hours should be considered based on RT injections or withdrawals, and bids or offers must be updated accordingly to avoid infeasible dispatch.

6.2.4 Settlement

Generation resource

Generation resources are settled based on their DAM financially binding schedule and RT injections, referred to as first and second settlement, respectively. All dispatchable generation resources are subject to two-settlement.

Settlement implications due to a power purchase agreement or other contracts and obligations are outside of energy and OR market settlement, and should be considered by participants.

Storage Resources

Storage resources are settled based on their DAM financially binding schedule and RT injections or withdrawals, referred to as first and second settlement, respectively. All dispatchable generation and dispatchable loads, including the storage injecting resource and the storage withdrawing resource, are subject to this two-settlement. Although storage resources share a revenue meter, they are settled separately for injections and withdrawals, as they are two (2) distinct resources participating in IAMs. The storage withdrawing resource will be subject to GA and uplifts that are applicable when charging from the grid.

6.3 Integrated Hybrid Facility Participation

This section walks through the market timeframes in the context of an integrated hybrid facility, in order to clarify and reinforce market participation given the design features that have been previously described.

To reiterate, the generation and storage technologies in an integrated hybrid facility operate under two (2) separate dispatchable resources: a combined quick start generation resource that integrates the generation and storage injecting technologies, and a storage load/withdrawing resource. Both resources must meet five-minute dispatch instructions.

The generation and storage resources under an integrated facility will be dispatchable. It is expected that the resources will submit bids and offers into the IAMs (energy and OR) in the same manner as other dispatchable resources of the same resource type.

The key market participation design features as previously described are listed below, and will be required under the market rules. The participant must ensure that these rules are adhered to from DA until RT.

- Storage charging will be allowed behind-the-meter directly from the generation resource, and storage may also be charged by dispatch of the storage withdrawing resource through the market.
- The no-overlap rule will apply to the bid from the storage withdrawing resource and the offer price from the combined generation resource: bid prices submitted by a storage withdrawing resource must be less than all offer prices submitted by the combined generation resource for the corresponding hour, in order to avoid conflicting dispatches.
- OR offers will not be allowed from either the combined generation resource or the storage withdrawing resource if there is a simultaneous bid and offer for energy for these resources in the same dispatch hour.
- Storage may only offer OR from the combined generation resource if it is exclusively offered for energy as an injecting resource for the entire dispatch hour, and the storage withdrawing resource does not bid to withdraw energy from the RTM nor offer OR in the subsequent dispatch hour, and the remaining time that the combined generation resource is able to inject is greater than or equal to 130 minutes.
- Storage may only offer OR from the storage withdrawing resource if it is exclusively offered for energy as a withdrawing resource for the entire dispatch hour, and the combined generation resource does not offer to inject energy from the RTM nor offer OR in the subsequent dispatch hour, and the remaining duration of service for the storage withdrawing resource is greater than or equal to 70 minutes.
- OR participation rules for the resources under the integrated hybrid facility reflect the participation rules for stand-alone storage resources, since storage will be an underlying resource for both the combined generation resource and storage withdrawing resources. The OR quantity offered by the combined generation resource must not be greater than the non-VG capacity, due to VG fuel uncertainty. The OR quantity offered by the storage withdrawing resource must not be greater than the storage withdrawing capacity.

6.3.1 Day-Ahead (DA)

Combined Generation resource

The participant submits energy and OR offers for the combined generation resource, and receives financially binding DAM schedules for energy and OR. Multiple offer laminations can be utilized to reflect the underlying technologies of the combined generation resource. Participants should be aware of any DAM participation requirements set out in contractual or CA obligations, as well as ensuring they offer for all hours the combined generation resource aspires to participate in the RTM, noting that this offer will set the ADE.

Note that the centralized forecast and the forecast quantity parameter does not apply to the combined generation resource even if VG is one of the underlying technologies.

Storage Withdrawing Resource

The participant submits energy bids and OR offers for the storage withdrawing resource, and receives financially binding DAM schedules for energy and OR. Participants should ensure they bid for

all hours the storage withdrawing resource aspires to participate in the RTM, noting that this bid will set the ADE.

6.3.2 Pre-Dispatch (PD)

Combined Generation resource

Through the PD timeframe, participants will continue to manage their offers to reflect resource capabilities and changing market conditions. The combined generation resource will receive advisory schedules throughout the PD timeframe.

For a combined generation resource where VG is an underlying technology, participants may have forecast information with which to update their offers to better reflect changing capability. The participant must self-manage SoC for the underlying storage technology; therefore, expected SoC for upcoming hours should be considered, and offers must be updated accordingly to avoid infeasible dispatch. The participant will be allowed to reduce the combined generation resource offer quantity within the mandatory window due to SoC limitations that arise during that period such that the resource is unable to comply with dispatch instructions.

Storage Withdrawing Resource

Through the PD timeframe, participants will continue to manage their bids to reflect resource capabilities and changing market conditions. For an integrated hybrid facility, the participant may adjust the storage withdrawing resource bid, either to charge behind-the-meter or to charge from the grid, depending on the capability of the generation technology. Again, the participant must self-manage SoC for the underlying storage technology; therefore, expected SoC for upcoming hours should be considered, and bids must be updated accordingly to avoid infeasible dispatch. The participant will be allowed to reduce the bid quantity within the mandatory window due to SoC limitations that arise during that period such that the resource is unable to comply with dispatch instructions.

6.3.3 Real-Time (RT)

Combined Generation resource

A generation resource must respond to dispatch instructions no later than the end of the applicable five (5) minute dispatch interval, or within 10 or 30 minutes for an OR activation (depending on the OR class). The participant can use any combination of the generation and storage technologies to meet the dispatch instructions for the combined generation resource. Injections to the grid from storage and charging of storage by the generation technology behind-the-meter will impact the SoC in future hours, and may require adjustment to offers.

Storage Withdrawing Resource

A storage withdrawing resource must respond to dispatch instructions no later than the end of the applicable five (5) minute dispatch interval, or within 10 or 30 minutes for an OR activation (depending on the relevant OR class). Withdrawals from the grid and charging of storage by the generation technology behind-the-meter will impact the SoC in future hours, and may require adjustment to bids.

6.3.4 Settlement

Combined Generation resource

Generation resources are settled based on their financially binding schedule and RT injections, referred to as first and second settlement, respectively. All dispatchable generation resources are subject to two-settlement.

Storage Withdrawing Resource

Loads are settled based on their financially binding schedule and RT withdrawals, referred to as first and second settlement, respectively. All dispatchable loads, including the storage withdrawing resource, are subject to two-settlement.

Although the combined generation resource and storage withdrawing resources under the integrated hybrid facility share a revenue meter, they are settled separately, as they are two (2) distinct resources participating in IAMs. The storage withdrawing resource will be subject to GA and uplifts that are applicable when charging from the grid. However, the market participant may charge the storage behind the meter, which is not subject to GA.

**Independent Electricity
System Operator**

1600-120 Adelaide Street West
Toronto, Ontario M5H 1T1

Phone: 905.403.6900

Toll-free: 1.888.448.7777

E-mail: customer_relations@ieso.ca

ieso.ca

 [@IESO_Tweets](https://twitter.com/IESO_Tweets)

 [linkedin.com/company/IESO](https://www.linkedin.com/company/IESO)