
FEBRUARY 24, 2022

Hybrid Integration Project: Design – Hybrid Facility Participation Models

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Agenda

- Recap
- Design for Hybrid Facility Participation Models
- Next Steps

Purpose



- Present the proposed design for hybrid facility participation in IESO markets for the two foundational models
- Solicit stakeholder feedback to formalize design

Project Recap

- As part of the Enabling Resources Program, the IESO is developing hybrid models to participate in the IESO-administered markets, in consultation with stakeholders:

Month		Key Activity
Jan 2022	✓	Present "day-in-the-life" participation models
Feb 2022		Present draft design models for stakeholder discussion; discuss feedback
March 2022		Address stakeholder feedback, as required; finalize design models
Q2 2022		Publish Hybrid Design Document

- In January, stakeholders noted questions about capacity qualification and market power mitigation; in response, the IESO has included more information on these items for today's discussion.

Approach Recap

- The IESO is utilizing two models for its design – 1) Co-located and 2) Integrated; the models are based on existing IESO resource types
- The IESO is leveraging the design for participation of existing resource types as the starting point in the hybrid design work
- The key areas of design are:



Capacity Participation Module



- The design elements under this module clarify how participants provide capacity to the IESO, ensuring that resources are available to meet peak electricity demand on the system.
- This module addresses:
 - the proposed capacity qualification methodology; and
 - performance obligation assessment.



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 IESO-administered markets.
- This module addresses:
 - requirements for prospective market participants to become authorized to participate in the IESO-administered markets; and
 - requirements for registration of facilities and associated resources, as well as registration of revenue meter installations.



Grid & Market Operations Module



- The design elements under this module clarify how the hybrid facility will be able to participate in energy and operating reserve markets, from day-ahead through to real-time.
- This module addresses:
 - managing participation for hybrid facilities;
 - submission and revision of dispatch data;
 - changes to other data inputs; and
 - market power mitigation.



Market Settlement Module



- The design elements under this module clarify market settlement so that participants with hybrid facilities understand how their participation will be reflected on their invoice.
- This module addresses:
 - settlement under the renewed market;
 - uplifts; and
 - global adjustment.

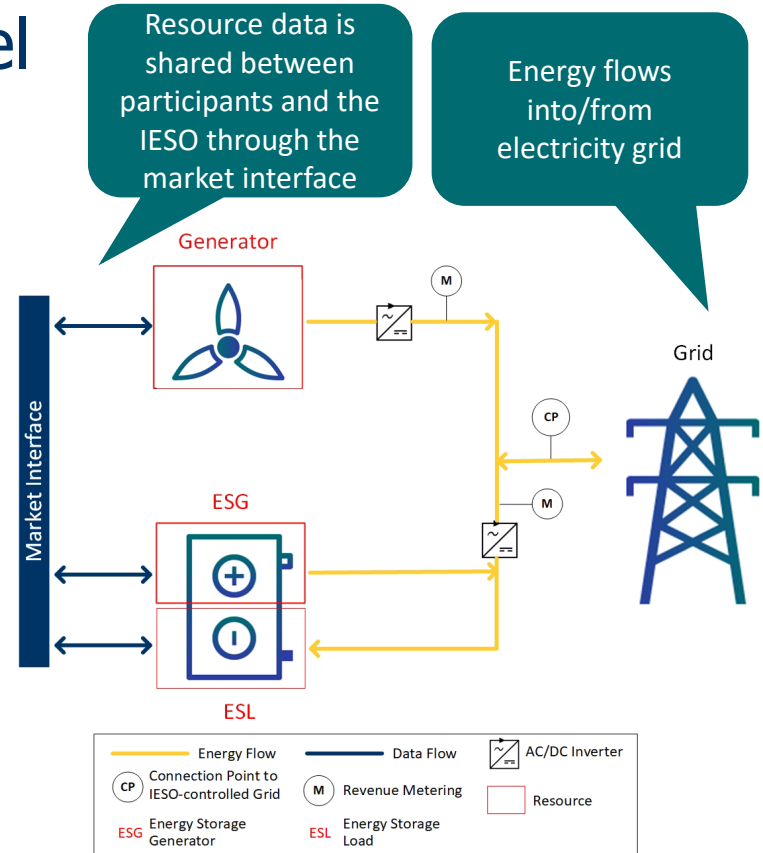




Design for Co-Located Hybrid Facility Model

Co-Located Hybrid Facility Model

- Each hybrid facility would be registered in the markets as three separate resources:
 1. A dispatchable generator (one resource)
 2. An energy storage resource (two resources) - using the interim storage design which models a storage facility as two resources at the same site including 1) a dispatchable load and 2) a dispatchable generator
- Three resources would bid/offer into the market separately (one from the generator resource and two from the storage resource) and be settled separately



Design Introduction – Co-Located Model



- Resources will be fully dispatchable (meet IESO instructions in 5 minutes) and eligible to participate in capacity, energy and operating reserve markets, as technologies/resource types currently allow.
- As current, VG operate based on ambient conditions, with requirement to follow mandatory dispatch instructions.
- Since these resources will be operating separately and participating under existing resource models with limited interdependencies, the design is relatively straight-forward.

Capacity Participation Overview

- Under procurement mechanisms, capacity qualification will ensure that resources are available to meet peak electricity demand on the system.
- Capacity typically qualified through UCAP methodologies (see appendix).
- VG capacity qualification is expected to be based on ICAP with availability de-rating factor based on production data and foregone energy that coincides with the top 200 hours of highest demand.
- The IESO is currently consulting with stakeholders through a separate engagement: <https://www.ieso.ca/en/Sector-Participants/Engagement-Initiatives/Engagements/Resource-Adequacy-Engagement>

Capacity Participation Module – Co-Located

Design Element

Design Decision and Key Details

Capacity Qualification

- The IESO foresees utilizing the current unforced capacity (UCAP) methodologies for qualifying the capacity for each resource of the hybrid (storage and generation).
 - Sum of each resources' capacity is the total hybrid capacity contribution.

Performance Obligation Assessment (POA)

- Energy must-offer and/or availability / capacity performance obligations will be specified in relevant procurement mechanism, aligning with underlying technology characteristics.

Authorization and Registration Module – Co-Located

Design Element

Design Decision

Registration and Class of Market Participant (MP)

- One registered MP (RMP), one operator and one metered MP (MMP) across all resources under hybrid facility is required to ensure co-ordination of operations and settlement.
- The RMP, operator and MMP can be different entities.
 - For example, the RMP is "ABC" for the generator, storage injecting resource and storage withdrawing resource; MMP can be "XYZ" for the generator, storage injecting resource and storage withdrawing resource.
- Owner can be different across resources.
- Obligation of MP to ensure compliance with all applicable OEB requirements; however, IESO expects MP will be able to participate under existing OEB licenses for storage/generator; therefore, no new class of MP under market rules.

Prudential Security (PS)

- No changes required to PS framework: there will be resource-specific assessments, but total security is assessed at MP level.
 - No security is expected (subject to GA treatment) for hybrids since it is likely to have net injections.

Authorization and Registration Module – Co-Located 2

Design Element

Design Decision

Connection Assessment & Approval (CAA) including System Impact Assessment (SIA)

- No change to CAA process. Hybrid facilities will require an SIA as per the existing CAA process.
 - Extend the coverage of rules/manuals to hybrid facilities.
 - As current, CAA is required when a new resource is added at connection point (CP).
 - Complexity of assessments depends on various factors such as type of new equipment, size of potential load, combined output of the facility.
 - Eligibility for expedited SIA will be determined as per applicable rules/manuals.
 - Additional technical & performance requirements will be identified during SIA.

Resource Size

- Maintain status quo minimum capacity of 1 MW for generation resource and 1 MW for storage resources (for both injection and withdrawal).
 - Therefore, the hybrid facility will have at least 2 MW of injection capability.

Authorization and Registration Module – Co-Located 3

Design Element

Design Decision

Ratio - storage to generation capacity

- Ratio of storage to generation capacity not prescribed.
 - As current, resources must comply with dispatch to ensure system reliability, with risk mitigation through performance testing.

Facility Registration

- All resources under the hybrid facility will be dispatchable.
 - Minor changes to existing facility registration tools may be required.

Revenue Meter Registration

- No change to revenue meter registration process, rules or manuals.
 - Separate meters for storage and generator, no change.
 - Will consider location of meters in registration process, as this may impact settlement.
-

Grid and Market Operations Module – Co-Located

Design Element

Design Decision

Dispatch Data and Other Data Inputs

- No changes to dispatch data, dispatch data revision rules, data inputs or the outage submission process.
 - VG may use their own forecast quantity in DAM, otherwise centralized forecast quantity will apply.
 - Storage may utilize maximum daily energy limit (DEL) to manage its schedule from DAM to real-time.
 - IESO requires resources to accurately reflect their capability in their offers; however, under specific conditions such as forced outage, all resources are allowed to make changes in mandatory window. In addition:
 - Reduction in bid/offer quantity in mandatory window is allowed for storage state-of-charge; and
 - VG operate based on ambient conditions in real-time, with requirement to follow mandatory dispatch instructions (reduce output) for line security constraints.
- Net offer & bid quantity must be less than the connection point limit to ensure that equipment is not overloaded due to the net schedule.
 - Storage charging must be dispatched through the market.

Market Power Mitigation Overview

- 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
- MPM is the way the IESO assesses and responds to attempts to exercise market power

Market Power Mitigation Overview 2

- Under the renewed market, the IESO together with participants will establish reference levels, and the IESO will perform conduct and impact tests to assess the exercise of market power.
- The reference price represents marginal/opportunity cost.
- If the offer price is outside the allowed threshold in a constrained area (conduct test) and market price is impacted (impact test), the offer price will be replaced with the reference level before dispatch schedules and market prices are determined.
- For more information: December 17, 2021 MRP implementation materials: [Implementation Engagement \(ieso.ca\)](https://www.ieso.ca/implementation-engagement)

Grid and Market Operations Module – Co-Located 2

Design Element

Design Decision

Market Power Mitigation (MPM)

- Consistent with all Ontario dispatchable resources, hybrid facilities will be subject to MPM.
 - Mitigation of economic withholding (ex-ante) and physical withholding (ex-post) will be performed for hybrid facilities that are in a constrained area, utilizing conduct and impact tests.
- Technology-specific reference price/quantity (reference levels) will be required for all resources as per MRP design and will be developed in consultation with stakeholders.
 - The methodologies to determine reference levels for storage and for generation have been discussed with stakeholders under MRP (link on previous slide).
 - The maximum daily energy limit parameter is not subject to MPM.

Market Settlement Module – Co-Located

Design Element

Design Decision

Settlement under MRP

- No changes are required to MRP design.
 - Each resource will be subject to separate settlement, as per MRP design for each resource type, including DAM two-settlement and make-whole payments.

Uplift Charges

- No change. Uplifts are applicable to energy withdrawn from IESO controlled grid
 - Under the long-term storage design, it is recommended that uplift not be applicable to energy withdrawn for the purpose of re-injection, and this would apply to storage under hybrids as well, noting that implementation may require further analysis and refinement.

Market Settlement Module – Co-Located 2

Design Element

Design Decision

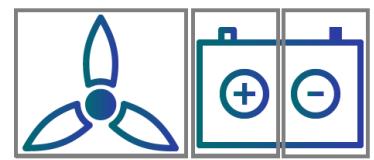
Global Adjustment (GA)

- No impact or changes.
 - As per the Ontario Regulation 429/04, GA is applicable to all load facilities including the storage charging from the grid.
 - Load may be Class A, where GA charge is based on a “peak demand factor”, or Class B, based on a \$/MWh rate for all withdrawals.
 - Storage is treated as Class B; however, a facility may be treated as Class A once eligibility is determined during the first base period.
 - Class B Storage may be reimbursed for injections into the grid, as per the regulation.



Energy and Operating Reserve Market Participation: Co-located Model

Timeline – Co-located: Day-ahead



Generation

Participant submits energy and OR offers (if generator is eligible for OR), and receives a DAM schedule

- Bid/offer into the DAM, establishing the ADE for real-time market and fulfilling any contractual or capacity obligations
- VG may override the IESO centralized forecast by providing their own forecast quantity for evaluation by the DAM engine, which can limit the DAM schedule

Storage

Participant submits energy offers, energy bids for charging from the grid, and/or OR offers, and receives DAM schedules

- Bid/offer into the DAM, establishing the ADE for real-time market and fulfilling any contractual or capacity obligations; maximum daily energy limit (DEL) may be utilized
- Schedules for charging are managed by the participant through the IESO market interface with their bids (not BTM)

Timeline – Co-located: Pre-dispatch



Generation

Participant offers are adjusted to reflect resource capabilities and market conditions

- Generator is scheduled throughout pre-dispatch
- VG quantity evaluated by the pre-dispatch engine is based on the lesser of the IESO centralized forecasted value and the VG energy offer

Storage

Participant bids and offers are adjusted to reflect resource capabilities and market conditions

- Considering energy limitations and managing state-of-charge (SoC), storage can reduce their bid and offer quantities in mandatory window (within two hours of the start of the dispatch hour) due to SoC limitations that arise during that period
- Changes to maximum DEL are allowed

Timeline – Co-located: Real-time



Generation

Participant delivers upon their IESO dispatch schedule

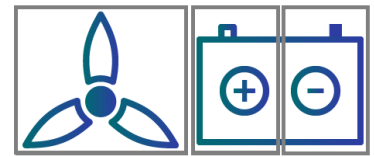
- Generation resource must comply with 5-minute dispatch instructions by injecting
- VG operate based on ambient conditions, but are also required to follow mandatory dispatch instructions (reduce output) either due to reliability or economics

Storage

Participant delivers upon their IESO dispatch schedules

- Storage resources must comply with 5-minute dispatch instructions, by injecting or withdrawing/charging

Timeline – Co-located: Settlement



Generation

Participant settled based on DAM position as well as RT injection

- Generation is subject to DAM two-settlement and, if applicable, they should consider the implications of their power purchase agreement

Storage

Participant settled based on DAM position as well as RT injection or withdrawal

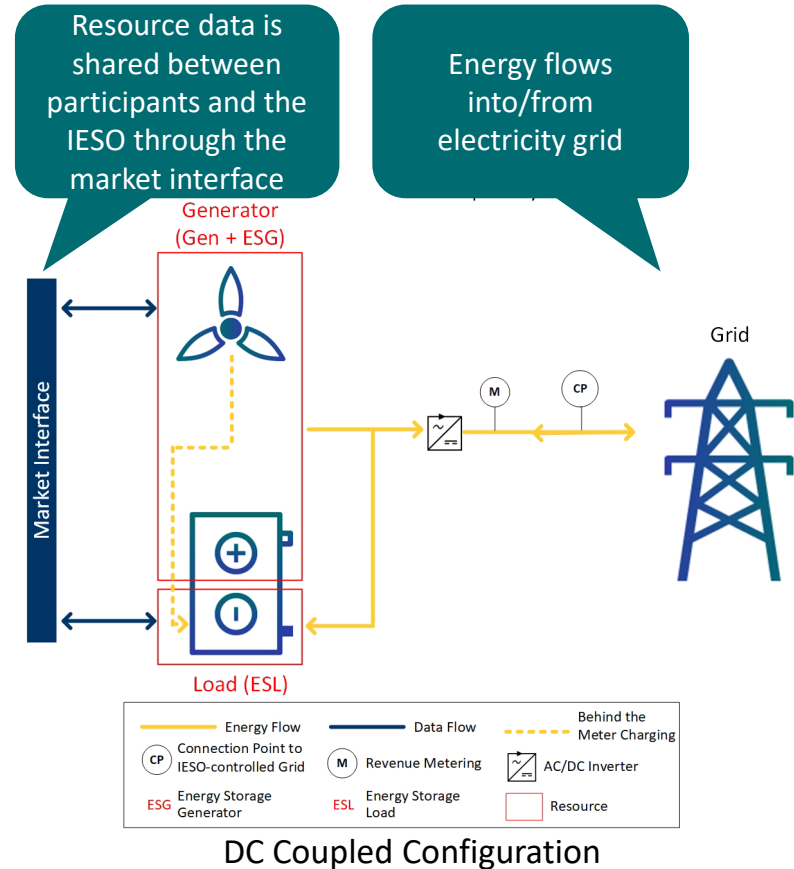
- Storage is subject to DAM two-settlement
- Settled separately for the injecting resource and withdrawing/load resource
- Uplifts and global adjustment (GA) are applicable to a storage resource when withdrawing/charging from the grid as a load



Design for Integrated Hybrid Facility Model

Integrated Hybrid Facility Model

- Registered in the markets as two separate resources:
 - A generator resource registered together with a storage resource and represented as one larger generator resource, resulting in a new combined quick start generation facility at a single connection point with a single offer into the market
 - A dispatchable load resource used to allow charging from the grid
- Market participant responsible for managing all aspects of their energy offer/bid and forecasting



Design Introduction - Integrated Model



- Resources will be fully dispatchable (meet IESO instructions in 5 minutes) and eligible to participate in capacity, energy and operating reserve markets, as technologies/resource types currently allow.
- VG will no longer operate based on ambient conditions in real-time, but rather as part of the combined generator under the quick-start generation model.
- Combining storage and generation technologies to develop one combined generation resource, along with a load resource for grid charging, results in more complexity for the design.

Capacity Participation Module – Integrated

Design Element

Design Decision

Capacity Qualification

- The IESO foresees utilizing the current unforced capacity (UCAP) methodologies for qualifying the capacity from storage technology and generation technology underlying the combined generator.
 - Sum of capacity from underlying technologies is the total hybrid capacity contribution.
 - This capacity qualification methodology may evolve as historical data for the combined generator (availability / production) becomes available through participation in the energy market.

Performance Obligation Assessment (POA)

- Energy must-offer and/or availability / capacity performance obligations will be specified in relevant procurement mechanism, aligning with underlying technology characteristics.
 - Single POA for combined generator for all contributing technologies.

Authorization and Registration Module – Integrated

Design Element

Design Decision

Registration and Class of Market Participant (MP)

- One registered MP (RMP), one operator and one metered MP (MMP) across all resources under hybrid facility is required to ensure co-ordination of operations and settlement.
- The RMP, operator and MMP can be different entities.
 - For example, the RMP is "ABC" for the combined generator and the load; MMP can be "XYZ" for the combined generator and the load.
- Owner can be different across resources.
- Obligation of MP to ensure compliance with all applicable OEB requirements; however, IESO expects MP will be able to participate under existing OEB licenses for storage/generator; therefore, no new class of MP under market rules.

Prudential Security (PS)

- No changes required to PS framework: there will be resource-specific assessments, but total security is assessed at MP level.
 - No security is expected (subject to GA treatment) for hybrids since it is likely to have net injections.

Authorization and Registration Module – Integrated 2

Design Element

Design Decision

Connection Assessment & Approval (CAA) including System Impact Assessment (SIA)

- No change to CAA process. Hybrid facilities will require an SIA as per the existing CAA process.
 - Extend the coverage of rules/manuals to hybrid facilities.
 - CAA with full, non-expedited SIA is required for a completely new facility.
 - As current, CAA is required when new resource added at connection point (CP).
 - Complexity of assessments depends on various factors such as type of new equipment, size of potential load, combined output of the facility.
 - Eligibility for expedited SIA will be determined as per applicable rules/manuals.
 - Additional technical & performance requirements will be identified during SIA.

Resource Size

- Maintain status quo minimum capacity of 1 MW for load resource (withdrawal).
- Combined generation resource must have minimum capacity of 1 MW storage injections and 1 MW generation injections, to ensure that either technology meets the minimum size threshold and can participate even when the other technology has an outage.
 - Therefore, hybrid facility will have at least 2 MW of injection capability.

Authorization and Registration Module – Integrated 3

Design Element

Design Decision

Ratio - storage to generation capacity

- Ratio of storage to generation capacity not prescribed.
 - As current, resources must comply with dispatch to ensure system reliability, with risk mitigation through performance testing.
-

Facility Registration

- All resources under the hybrid facility will be dispatchable.
 - Minor changes to existing facility registration tools may be required.
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Revenue Meter Registration

- No change to revenue meter registration process, rules or manuals.
 - Single meter for hybrid facility.
-

Grid and Market Operations Module – Integrated

Design Element

Design Decision

Dispatch Data and Other Data Inputs

- No changes to dispatch data, dispatch data revision rules, data inputs or outage submission process.
 - Centralized forecast can be provided for informational purposes only.
 - Participant must determine combined generator offer, including underlying technologies such as VG, and must comply with dispatch instructions.
 - VG no longer operate based on ambient conditions in real-time, but rather as part of the combined generator under the quick-start generation model.
 - IESO requires resources to accurately reflect their capability in their offers; however, under specific conditions such as forced outage, all resources are allowed to make changes in mandatory window. In addition, reduction in bid/offer quantity in mandatory window allowed for storage SoC.
- Overlapping bid/offer from load & combined generator not allowed.
 - Storage charging may be dispatched through the market or BTM.
- OR offer not allowed if there is a simultaneous bid & offer for energy from load & combined generator, consistent with storage model.
- Combined generator offer quantity for OR is limited to non-VG capacity.

Grid and Market Operations Module – Integrated 2

Design Element

Design Decision

Market Power Mitigation (MPM)

- Consistent with all Ontario dispatchable resources, hybrid facilities will be subject to MPM.
 - Mitigation of economic withholding (ex-ante) and physical withholding (ex-post) will be performed for hybrid facilities that are in a constrained area, utilizing conduct and impact tests.
- Combined generator is considered a new technology for MPM due to multiple underlying technologies.
 - The IESO will consult with stakeholders during the implementation phase to determine technology-specific reference levels (price and quantity), and to discuss other considerations.

Market Settlement Module – Integrated

Design Element

Design Decision

Settlement under MRP

- No changes are required to MRP design.
 - Each resource will be subject to separate settlement, as per MRP design for each resource type, including DAM two-settlement and make-whole payments.

Uplift Charges

- No change. Uplifts are applicable to energy withdrawn from IESO controlled grid
 - Under the long-term storage design, it is recommended that uplift not be applicable to energy withdrawn for the purpose of re-injection, and this would apply to storage under hybrids as well, noting that implementation may require further analysis and refinement.
- Charging BTM is not subject to uplifts.

Market Settlement Module – Integrated 2

Design Element

Design Decision

Global Adjustment (GA)

- As per the Ontario Regulation 429/04, GA is applicable to all load facilities including the storage charging from the grid.
 - Load may be Class A, where GA charge is based on a “peak demand factor”, or Class B, based on a \$/MWh rate for all withdrawals.
- Storage technology shares a meter with the generator, so does not meet the definition for a ‘storage facility’ under the regulation and will not be reimbursed for injections during first base period. However:
 - the storage load may be eligible for Class A treatment after the first base period, limiting the impact of GA; and
 - the participant may also charge storage BTM, which is not subject to GA.



Energy and Operating Reserve Market Participation: Integrated Model

Timeline – Integrated: Day-ahead



Combined Generator

Participant submits offers for injections to the grid, and receives DAM schedule

- Can submit multiple offer laminations for a single generator (combined generator technologies) to reflect price sensitivities
- Offer quantity establishes the ADE and fulfills any contractual or capacity obligations
- Will have further discussion on how an integrated resource can manage their ADE to optimize energy participation

Energy Storage Load

Participant submits bids for charging from the grid, and receives DAM schedule

- Can submit multiple bid laminations for a single load (storage load) to reflect price sensitivities
- Bid quantity establishes the ADE and fulfills any contractual or capacity obligations

Timeline – Integrated: Pre-dispatch



Combined Generator

Participant adjusts offers to reflect resource capabilities and market conditions

- Can update offer into the real-time market, in order to pursue energy and OR opportunities for the generator
- Participant needs to keep offers updated to reflect capabilities

Energy Storage Load

Participant adjusts bids to reflect resource capabilities and market conditions

- Load can update bid into the real-time market, in order to pursue energy and OR opportunities for the load
- Participant needs to keep offers updated to reflect capabilities

Timeline – Integrated: Real-time



Combined Generator

Participant delivers upon their IESO dispatch schedule

- Combined generation resource must comply with 5-minute dispatch instructions by injecting

Energy Storage Load

Participant delivers upon their IESO dispatch schedule

- Load resource must comply with 5-minute dispatch instructions by withdrawing/charging

Timeline – Integrated: Settlement



Combined Generator

Participant settled based on DAM position as well as RT injection

- Separate settlement for combined generation resource

Energy Storage Load

Participant settled based on DAM position as well as RT withdrawal

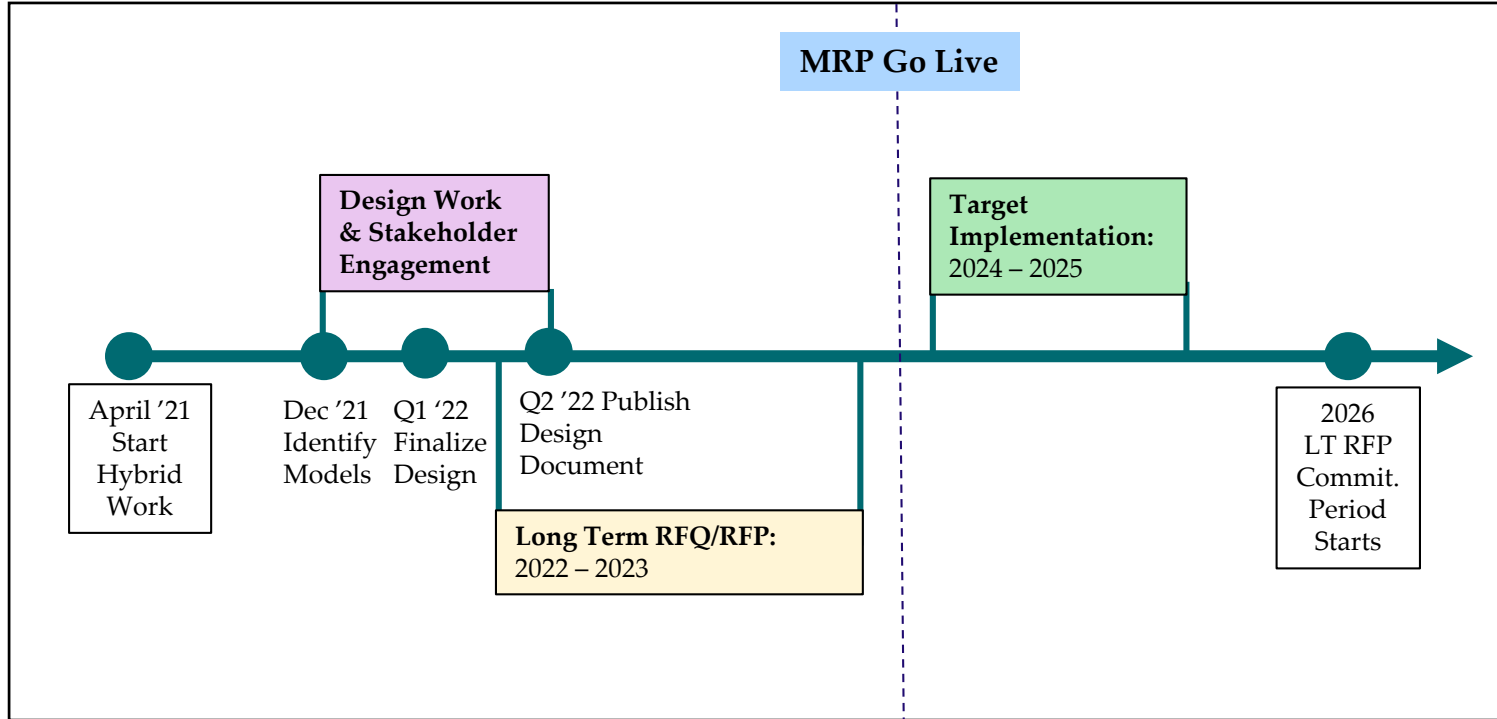
- Separate settlement for load resource
- Uplifts and GA are applicable to the load resource when withdrawing/charging from the grid



Next Steps

- The IESO believes the design of these models can enable efficient participation of hybrid resources in the IESO-administered markets, and is interested to hear if any areas need refinement or additional clarity.
- The IESO will use stakeholder feedback from this meeting to determine what discussion is required to finalize the design for the two identified models.
- The design will be completed and reviewed with stakeholders in March 2022, in advance of the LT RFQ/RFP deadlines, followed by publishing of the design document in Q2.

Timelines for Hybrid Integration Project



Stakeholder Feedback



- IESO questions:
 - Did you see any concerns from a participation perspective for co-located or integrated facilities?
 - Are there any dependencies between resources or technologies that make up the hybrid models that the IESO should be further accounting for?
- Please use the feedback form found under the February 24, 2022 entry on the [Hybrid Integration Project webpage](#) to provide feedback and send to engagement@ieso.ca by March 17, 2022
- The IESO is able to meet with stakeholders to clarify information presented today, as well as discuss specific participant questions

IESO Available Information



- Additional details on existing participation models can be found through the following links
 - VG and quick-start generation participation:
 - MRP high level and detailed design documents - <https://www.ieso.ca/en/Market-Renewal>
 - Storage participation:
 - Interim storage design and long term design vision - <https://www.ieso.ca//en/Sector-Participants/Engagement-Initiatives/Engagements/Completed/Energy-Storage-Advisory-Group>

Thank You

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Appendix: Capacity Auction Enhancements

The information in this table describes the current inputs used in the UCAP capacity qualification methodologies for the IESO's Capacity Auction.

Resource	ICAP	Availability De-Rating Factor	PAF
Dispatchable Thermal Generation	<ul style="list-style-type: none"> Seasonal ICAP (Installed Capacity) values provided by Capacity Auction Participant during capacity qualification process 	<ul style="list-style-type: none"> Equivalent Forced Outage Rate demand (EFOR_d) value based on five years of historical EFOR_d data 	<ul style="list-style-type: none"> PAFs (Performance Adjustment Factors) will be based on assessed performance from the Summer 2023 and Winter 2023/24 Obligation periods for qualification in the December 2024 Capacity Auction.
Dispatchable Hydro		<ul style="list-style-type: none"> Production data and scheduled operating reserve data that coincides with the top 200 hours of highest Ontario demand per season, over the most recent five years 	
Dispatchable Storage		<ul style="list-style-type: none"> EFOR_d of 5% 	
Dispatchable Load		<ul style="list-style-type: none"> One year of historical bid data that coincides with the top 200 hours of highest Ontario demand per season 	