



DER Potential Study

*Stakeholder Session 1:
Preliminary Project Plan & DER Pre-
Assessment*

September 22nd 2021



In partnership with:



Speakers



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AGENDA & MEETING OBJECTIVES

1

Introduction

- Introduce study and project team

2

Preliminary Project Plan

- Review key project tasks and timelines

Q&A 

3

DER Pre-Assessment

- Review and gather feedback on assessment

Q&A 

4

Key Study Parameters

- Review parameter types, gather feedback

5

Wrap-up & Next Steps

- Timelines and discussion

Q&A 

1. Introduction

- Project Team
- Study Context and Objectives



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Mobility

Services



Quantify Opportunities



Design Strategies



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Study Context and Objectives

Study Context:

- There is increasing adoption of DERs by customers, grid operators, and service providers (at least 5,000 MW* of DERs deployed in Ontario to-date)
- DERs can provide benefits to customers and the electricity system
- By enabling DERs to provide wholesale services, system costs can be reduced and opportunities for customers and investors can be increased

Study Objectives:

- Identify the key DER technologies most relevant to the Ontario context and their corresponding use-cases
- Assess the technical, economic and achievable potential for these DERs over the next 10 years
- Develop recommendations on focus areas, priorities, timing and key considerations for DER integration efforts in Ontario

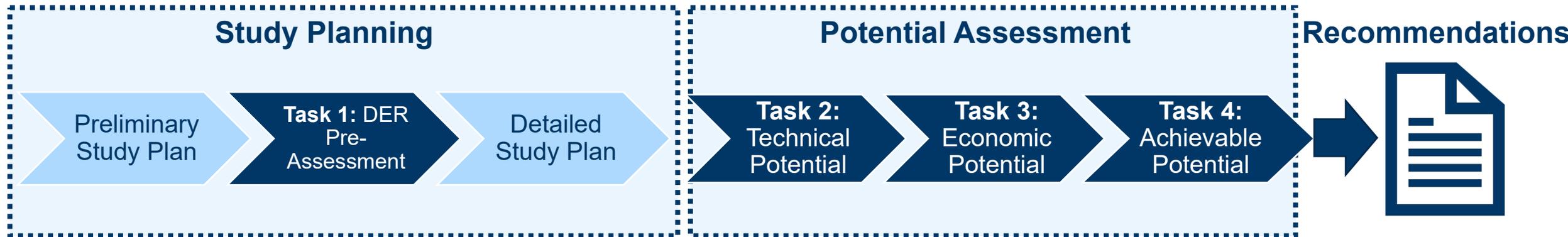
*That IESO has visibility to as a result of markets, procurements, programs, and the Industrial Conservation Initiative

2. Preliminary Project Plan

- Study Overview
- Tasks
- Timelines

The study's scope can be broken out into two stages:

- **Study Planning** activities that set out the study's workplan, scope, methodology and key parameters
- **Potential Assessment** activities to identify the technical, economic and achievable potential of DERs



Task 1: DER Pre-Assessment

1

Measure Assessment

- Develop a comprehensive list of DER measures and highlight their key operational characteristics
- Assess the feasibility of each measure to deliver different grid services

2

Measure Screening

- Perform a qualitative assessment of measures
- Short-list the high-value and/or high-potential measures most applicable in Ontario

3

Selection of Assessed DERs

- Select a final list of DER measures to be included in the study based on IESO and stakeholder input
- Outline, for each measure, methodology to be used to assess potential, description of market size, applicability under market rules, and baseline levels of adoption/participation in Ontario



The Approach and outcomes of the Measure Assessment and Measure Screening will be discussed in Section 3 of today's presentation.

Task 2: Technical Potential Assessment (1/3)

1

Market Characterization:

- Define the corresponding market size and estimate future growth over the study period
- Apply market data from 2019 Conservation Achievable Potential Study (APS) and other IESO/OEB resources
- Apply more detailed market adoption analysis for key measures (e.g. EVs, solar) if determined that this will offer high value to the study

2

DER Use-Cases:

- Define up to 10 use-cases that represent the most likely groupings of grid services / applications that DERs can contribute to
- Define a primary, secondary and tertiary service/application for each use case, and map each measure to applicable use cases

3

Measure Characterization:

- Define key measure characteristics (e.g. technical parameters, costs, operational factors, etc.)
- Assess the technical capability and practicality of each DER to contribute to different grid services
- Develop dispatch profiles for three representative days (peak, weekday, weekend) for each of the three seasons (summer, winter, shoulder) based on the assigned use-case and the measure's capabilities



Feedback Process: A more detailed review of the methodologies to assess technical, economic, and achievable potential will be provided in the November stakeholder session, including opportunities for feedback.

Task 2: Technical Potential Assessment (2/3)

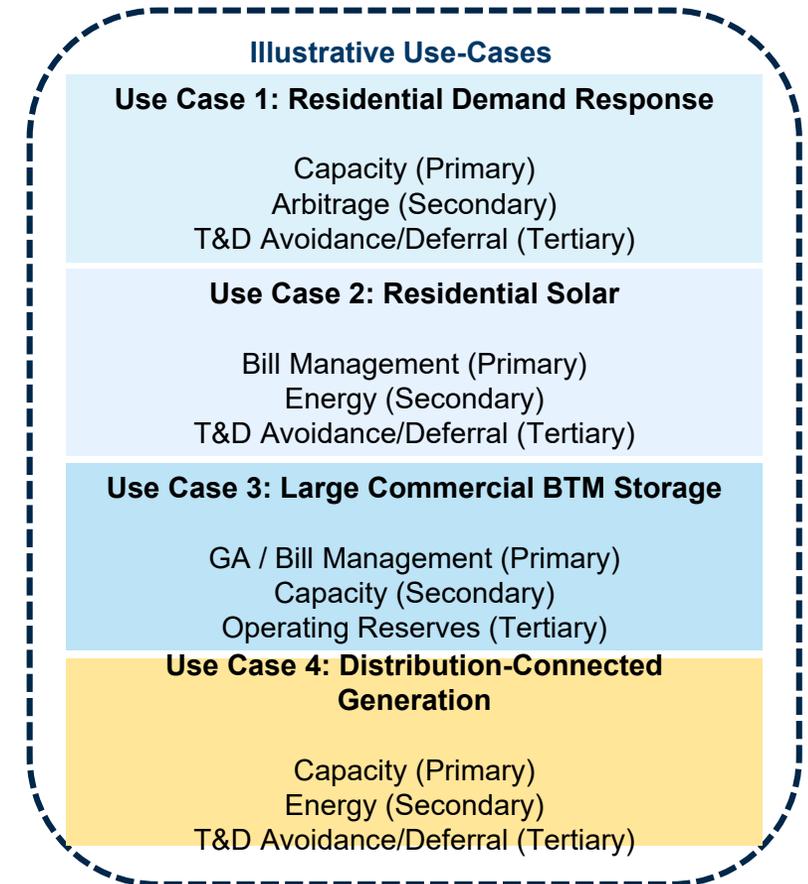
Market Characterization: Additional Insights

- **An accurate assessment of DER opportunities requires information about current and forecasted equipment stocks**
- **Key information sources to be used to estimate size of equipment markets over the study period includes:**
 - Data from the Achievable Potential Study
 - Residential End Use Survey (REUS) and Commercial End Use Survey (CEUS)
 - Other market data and studies conducted by IESO/OEB
 - Various other technology-specific data sources pertaining to the stock and size of market

Task 2: Technical Potential Assessment (3/3)

DER Use Cases: Additional Insights

- To capture the diversity of DER applications, we will define up to 10 use-cases that capture archetypal groupings of grid services / applications
- Each will include a primary application, which serves as the economic driver for adoption of a given DER, as well as possible secondary and tertiary applications
- Use cases will reflect the most common DER applications based on value and existing & anticipated market trends
- To be further developed building on team's knowledge, insights from the DER survey, discussions with IESO and input from stakeholders



Task 3: Economic Potential Assessment (1/2)

1

Benefit-Cost Framework

- Define the benefit and cost streams to be used to assess the cost-effectiveness of DERs in Ontario
- Apply a modified Total Resource Cost (TRC) test

2

Avoided Costs

- Develop key costs (e.g. avoided energy, carbon, capacity) building on available data and outlook (APO/APS)
- Develop five-minute dispatchability adder (statistical analysis of standard deviation of Market Clearing Price (MCP) from Hourly Ontario Energy Price (HOEP))
- Estimate avoided T&D costs (assess load growth and system capacity from regional plans to identify changes in timing and/or magnitude of system needs)

3

Cost-Effectiveness and Economic Potential

- Assess and screen individual measure-level cost-effectiveness and economic potential
- Assess and calculate optimized province-wide economic potential based on relative cost-effectiveness of different measures and any market constraints
- Assess economic potential under three scenarios that reflect varying policy, regulatory, market and/or technology conditions

Task 3: Economic Potential Assessment (2/2)

Avoided Costs: Additional Insights

- **To capture the value of five-minute dispatchability without increasing computational complexity of the study, the following approach will be used:**
 - **Quantify the value of five-minute dispatchability**
 - Statistical analysis of the distribution of Market Clearing Prices (MCPs)
 - Standard deviation of MCPs from the Hourly Ontario Energy Price (HOEP)
 - Develop hourly avoided cost adders that capture the value of 5-minute dispatchability
 - **Determine which DERs have the necessary operational flexibility to leverage benefits of five-minute price signals**
 - Assess the ability of DERs to meet five-minute dispatch signals
 - Develop an appropriate derating factor to be applied to the avoided cost adders based on technical capability, operational constraints and practicality of 5-minute dispatch
 - Capture Operating Reserve (OR) benefits if the DER can meet OR activation and operating requirements

Task 4: Achievable Potential Assessment

1

Assess Incremental Adoption

- Capture natural adoption of DERs based on participant cost-effectiveness
- Capture incremental DER adoption likely to result from the improved economics / incremental participant benefits to be incurred from participation in IAMs

2

Estimate DER Market Participation:

- Assess the portion of DERs that are likely to participate in IAMs
- Consider appropriate market access pathways (e.g. aggregated vs. direct participation)

3

Apply Achievable Potential Scenarios

- Assess and calculate optimized market-wide achievable potential based on customer cost-effectiveness and any market constraints
- Assess achievable potential under three scenarios that reflect varying policy, regulatory, market and/or technology conditions (same scenarios applied for economic potential)

Task 5: Recommendations

Outputs

Technical, economic and achievable potential for DERs in Ontario over the next 10 years

- Key Metrics
 - MW nameplate capacity
 - MW capacity reductions
 - MWh energy savings
 - Tonnes emission reductions
- Breakdown by:
 - DER Technology / Measure
 - Market Sector / Segment
 - Use-Case / Wholesale Service

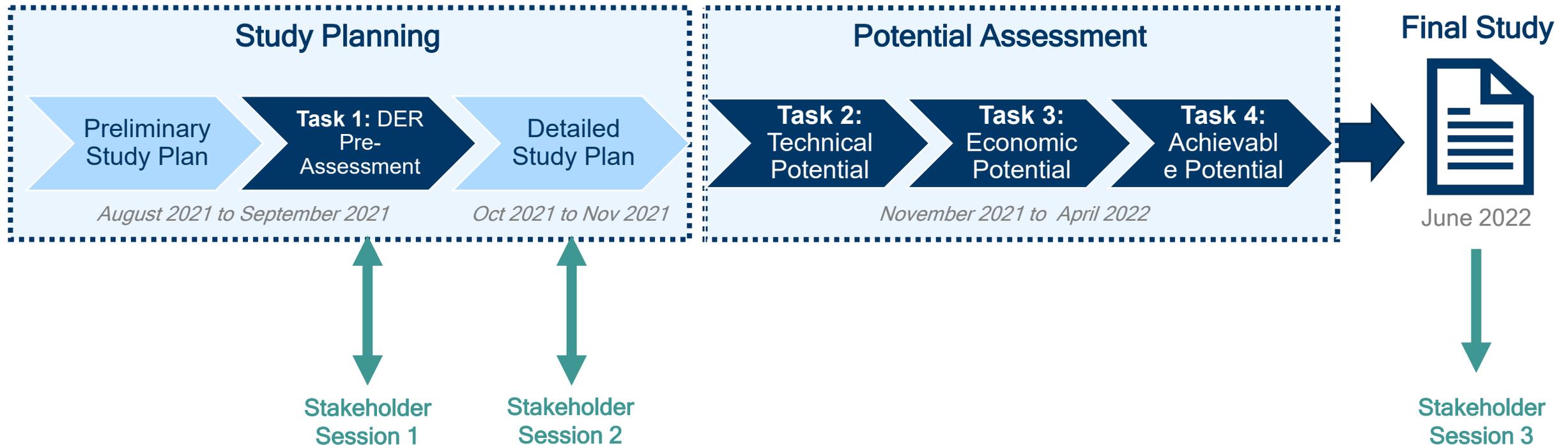
→ Outcomes

Insights and recommendations to support IESO in unlocking the identified potential by highlighting:

- The potential, competitiveness and use-cases of DERs
- Barriers and challenges facing DER Integration
- Recommended market enhancements and analysis of the corresponding implications
- Recommended strategies for capturing value from DERs through non-market pathways, where more effective
- Recommended areas for further study

Timelines: Overview

- **Study Planning:** August 2021 to November 2021
- **Potential Assessment:** November 2021 to April 2022
- **Final Report:** June 2022



Timelines: Stakeholder Sessions

Stakeholder Session 1: Preliminary Plan & DER Pre-Assessment (September 22)

- Introduce project team
- Share overview of the context and objectives of the study
- Share and solicit feedback on Preliminary Project Plan
- Share and solicit feedback on DER Pre-Assessment
- Solicit input to inform the development of key study parameters

Stakeholder Session 2: Detailed Study Plan (week of November 22, exact date TBD)

- Present detailed study plan, highlighting methodology, key inputs and assumptions
- Solicit feedback from stakeholders on detailed project plan
- Solicit input to inform the development of key study assumptions

Stakeholder Session 3: Final Results Presentation (June, exact date TBD)

- Present final results and recommendations to stakeholders
- Solicit input on recommendations and areas for further study



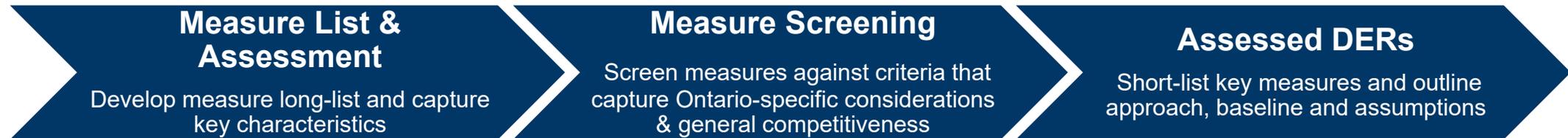
1st Q & A Break

3. DER Pre-Assessment

- Overview
- Measure List
- Measure Assessment and Screening
- Promising DERs

Overview

Objective: Identify DER technologies that are most relevant to the Ontario context and likely to represent opportunity areas with high value and/or uptake for consideration in the study scope



Scope: The pre-assessment includes the following DER categories:

- Demand Response (DR) measures
- Behind-the-meter (BTM) Battery Storage
- Front-of-the-Meter (FTM) Battery Storage
- BTM Solar Photovoltaics (PV)
- FTM Solar Photovoltaics (PV)
- Other (e.g. other FTM / BTM generation / storage)

Comprehensive list of DER technologies developed through:

- Dunsky's measure database
- A scan of DER studies conducted in other jurisdictions
- Review of load flexibility opportunities across key end-uses and sectors

General approach:

- Consider permutations of the technologies for different segments, enabling devices, and control strategies (among other factors)
- Apply additional granularity in areas of high potential and/or where variation results in a substantially different measure cost and/or impact

Measure Assessment and Screening (1/4)

For each measure/technology, capture key characteristics including:

- **Enabling Device** (*embedded, smart switch/device, none / manual*)
- **Device Control Strategy** (*direct control, scheduled, not applicable*)
- **Dispatchability** (*yes / no*)
- **Service provision pathway** (*Direct participation, aggregated participant, non-market, multiple pathways*)
- **Ability to contribute to energy, capacity, operating reserve and/or frequency regulation services** (*Feasible and demonstrated, technically feasible with operational constraints and/or limited demonstration, not feasible*)
- **Technology maturity** (*emerging, commercially available, mature*)
- **Expected cost / performance enhancements** (*yes / maybe / no*)
- **Demonstrated use in Ontario or other markets** (*yes / no*)

Measure Assessment and Screening (2/4)

For each measure/technology, qualitative ranking (low / mid / high) against the following criteria:

- Alignment with system needs and characteristics (resource adequacy, system flexibility, regulation)
- Expected opportunity size (based on market size and magnitude of end-use)
- Potential for GHG reductions
- Expected cost-effectiveness (based on results from other studies)
- Market readiness (based on technology maturity, expected cost and performance enhancements)
- Alignment with customer preferences
- Relevance to study objectives / scope



Feedback Process: Over the next two weeks, we are seeking feedback from stakeholders about the appropriateness of screening criteria. Are there additional criteria that should be considered?

Measure Assessment and Screening (3/4)

Example measure screening: Behind-the-Meter (BTM) Storage

BTM Storage	Alignment with System Needs and Characteristics	Opportunity Size	Potential for delivering GHG reductions	Expected Cost-Effectiveness	Market readiness	Alignment with customer goals	Relevance to Study Objectives/ Scope
Score	High	High	High	Mid	High	Mid	High

- **Recommendation:** Include
- **Rationale:** BTM storage is a flexible resource that can provide valuable grid services. Cost reductions are expected over the study period which will support cost-effective deployment.

Measure Assessment and Screening (4/4)

Example measure screening: Short-duration storage (flywheel, capacitor bank, etc.)

BTM Storage	Alignment with System Needs and Characteristics	Opportunity Size	Potential for delivering GHG reductions	Expected Cost-Effectiveness	Market readiness	Alignment with customer goals	Relevance to Study Objectives/ Scope
Score	Low	Low	Low	Low	Mid	Mid	Mid

- **Recommendation:** Don't include
- **Rationale:** Expensive technology and limited applicability (regulation)

Promising DERs: Overview

The next slides highlight key outcomes of the assessment. Detailed list and assessment are available in the attached appendix.

- The “promising DERs” represent recommendations to the IESO
- IESO will determine the final “Assessed DERs” (i.e. ones to include in the study) based on stakeholder input and other considerations

The measures are grouped into three lists*:

- Residential BTM
- Non-Residential BTM
- FTM Resources

List of Acronyms

- **ASHP:** Air-Source Heat Pump
- **BTM:** Behind-the-meter
- **CAES:** Compressed Air Energy Storage
- **CHP:** Combined Heat and Power
- **C&I:** Commercial & Industrial
- **DG:** Distributed Generation
- **DMSHP:** Ductless Mini-Split Heat Pump
- **DR:** Demand Response
- **EV:** Electric Vehicle
- **FTM:** Front-of-the-meter
- **GSHP:** Ground-Source Heat Pump
- **HDV:** Heavy-Duty Vehicle
- **LDV:** Light-Duty Vehicle
- **MDV:** Medium-Duty Vehicle
- **V2B:** Vehicle-to-Building
- **V2G:** Vehicle-to-Grid

*Further market segmentation will be completed for the assessment of potential – this grouping is only for ease of pre-assessment.

Promising DERs: Residential BTM Resources (1/2)

Measures that passed qualitative screening:

Measure Group	Measure
Distributed generation	BTM solar with smart inverter
HVAC	AC thermostat Dual-fuel space heating (with and without smart switch) ASHP/DMSHP/GSHP smart thermostat
Other load flexibility	Behavioural-based flexibility
Passenger EV charging	Smart EV chargers V2G V2H

Measure Group	Measure
Pools and spas	Pool pump
Smart appliances	Smart clothes dryer
Storage	BTM battery storage
Thermal storage	Thermal storage for cooling Thermal storage for heating
Water heating	HP water heater with smart switch Resistance water heater with smart switch HP water heater with smart switch Smart resistance water heater Smart HP water heater



Feedback Process: Over the next two weeks, we are seeking feedback from stakeholders about the pre-assessment. Are there measures that passed that **should not** be included in the study? Why or why not?

Promising DERs: Residential BTM Resources (2/2)

Examples of measures that did not pass qualitative screening

Measure Group	Measure	Rationale
Passenger EV charging	EV charger with smart switch	Prevalence of smart charging as well as in-vehicle charging capabilities likely to limit market for non-smart EV chargers
Passenger EV charging	EV Telematics	Limited market opportunity over the study period
Pools and spas	Resistance pool heaters	Limited market opportunity given the small market size
Pools and spas	Hot tub/spa	Limited ability to contribute to system needs & low opportunity size
Smart appliances	Clothes dryer smart switch	Measure typically not found to be cost-effective
Smart appliances	Smart fridge/freezer	Measure typically not found to be cost-effective



Feedback Process: Over the next two weeks, we are seeking feedback from stakeholders about the pre-assessment. Are there measures that did not pass that **should** be included in the study? Why or why not?

Measures that passed qualitative screening:

Measure Group	Measure
Distributed generation	Back-up Generation BTM Solar with Smart Inverters
Lighting controls	Lighting controls
Pools and spas	Spa/Hot Tubs
EV fleet charging	LDV Fleet EV Smart Chargers LDV Fleet V2B LDV Fleet V2G MDV Fleet EV Smart Chargers MDV Fleet V2B MDV Fleet V2G HDV Fleet EV Smart Chargers HDV Fleet V2B HDV Fleet V2G Off Road EVs Smart Chargers Buses EV Smart Chargers Buses V2G

Measure Group	Measure
HVAC	Large C&I HVAC Control Small C&I Smart Thermostat Small C&I ASHP/DMSHP/GSHP Smart Thermostat
Other load flexibility	District Cooling/Heating Flexibility Non-Residential Process Flexibility Irrigation Pump Controls Refrigeration Controls Greenhouses: Grow Lights
Storage	BTM Battery Storage
Thermal storage	Commercial HVAC Thermal Storage Thermal Storage for Refrigeration Applications
Water heating	Large C&I Dual-Fuel Water Heating Large C&I Hot Water Small C&I Hot Water

Examples of measures that did not pass qualitative screening

Measure Group	Measure	Rationale
Distributed generation	Biomass/Biogas	Offers mid-level benefits, with low market opportunities & cost-effectiveness
Distributed generation	CHP	Limited range of grid services, low cost-effectiveness, and high GHG impacts
Storage	Short-duration Storage (flywheel, Capacitor Bank, etc.)	Expensive technology and limited applicability (regulation)
Water heating	Small C&I Dual-Fuel Water Heating	Limited market opportunity and GHG reductions
Distributed generation	Natural Gas Fuel Cell	Limited market opportunity and GHG reductions
Pools and spas	Pool Pumps	Limited ability to contribute to system needs

Promising DERs: FTM Resources (1/2)

Measures that passed qualitative screening:

Measure Group	Measure
Distributed generation	FTM Solar FTM Small-scale Hydro

Measure Group	Measure
Storage	FTM Battery Storage

Promising DERs: FTM Resources (2/2)

Examples of measures that did not pass qualitative screening

Measure Group	Measure	Rationale
Distributed generation	FTM Biomass/Biogas	Limited expected cost-effectiveness and market opportunities given the competition for biomass feedstock
Distributed generation	FTM Small-scale Wind	Limited market opportunity given the small market size
Storage	CAES	Typically deployed as larger transmission connected assets to leverage economies for scale
Storage	Power-to-Gas (Hydrogen)	Limited market readiness and not expected to be commercially mature by the end of the study period
Storage	Flywheel	Limited ability to contribute to system needs and minimal cost-effectiveness compared to other storage measures
Storage	Electrothermal Storage	Typically deployed as larger transmission connected assets to leverage economies for scale

Promising DERs: Additional Considerations

During the methodology development and potential assessment:

- Measures may be grouped subject to data availability (e.g. combined C&I curtailment if commercial baseline data does not permit split by end-use)
- Measures where opportunity sizes are limited and/or where variations have similar characteristics may be captured through “blended” measures (e.g. Smart Thermostat for ASHP/DMSHP as a single measure, grouping by control strategy etc.)

Next Steps:

- Finalize list of Assessed DERs to be included in the study based on stakeholder input and IESO’s decision
- Outline approach, baseline and key assumptions for each Assessed DER



2nd Q & A Break

4. Key Study Parameters

- Scenarios
- Other Parameters

Scenarios

The Economic and Achievable Potential assessments will be conducted under three scenarios that reflect varying policy, regulatory and market conditions, and the impact of these conditions on potential

- We are **seeking input** from stakeholders about which factors to include in the assessment. Some examples from studies in other jurisdictions:
 - Carbon pricing (e.g. varying levels of carbon price forecasts)
 - Incentives (e.g. varying degrees of financial support for the adoption of certain technologies)
 - Changes in market participation rules (e.g. hybrid resources participation, small resource participation)
 - Technology cost curves (e.g. rate at which technology costs are expected to decline)
 - Energy prices (e.g. varying forecasts for price of electricity, natural gas, other fuels)
- **What factors are the most relevant drivers in Ontario (and should be included in scenarios)?**



Feedback Process: Over the next two weeks, we are seeking input from stakeholders on which factors to prioritize in the scenario assessments. In November we will present our proposed selections.

Other Parameters

To support the development of other study parameters that will impact the technical, economic, and achievable potential assessment, we will be seeking input from stakeholders in the November 2021 stakeholder meeting to inform key study parameters including (but not limited to):

- Use cases
- Benefit-cost framework
- Regional granularity
- Study inputs & assumptions
- Study outputs



Feedback Process: In November, we will present our proposed selections as part of the Detailed Study Plan and seek stakeholder input to finalize study parameters.

5. Wrap-up & Next Steps

- Requested input/feedback
- Next Steps

Requested Input/Feedback from Stakeholders



Feedback requested over the next three weeks:

- **Pre-assessment screening criteria:** Are there any screening criteria missing that warrant inclusion?
- **Pre-assessment results:** Do the short-listed technologies capture appropriate DERs given the study time horizon? Are there measures that have been screened out that should be included and why? Alternatively, are there measures that should be screened out and why?
 - *Note: Aiming to include measures expected to have high value/uptake over study period*
- **Scenarios:** Which factors should be varied between scenarios? Do you have suggestions on how such factors should be varied across three scenarios?
 - *Note: Aiming to prioritize factors expected to be most influential in driving DER value/uptake in Ontario*

Next Steps

- **Stakeholders:**

- Please use the feedback form found under the September 22 entry on the [DER Potential Study webpage](#) to provide feedback and send to engagement@ieso.ca by October 13, 2021

- **Dunsky & IESO:**

- Review and respond to stakeholder comments
- Finalize measure list
- Develop detailed project plan
- Present detailed plan to stakeholders on the week of November 22nd 2021.



3rd Q & A Break



Thank You

Questions or feedback can be directed to: engagement@ieso.ca

Materials relating to this project, including this presentation and feedback questionnaire, are available at the IESO DER Potential Study engagement page at the link below:

<https://www.ieso.ca/en/Sector-Participants/Engagement-Initiatives/Engagements/DER-Potential-Study>

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