Ontario DER Impact Study

Results and Implications

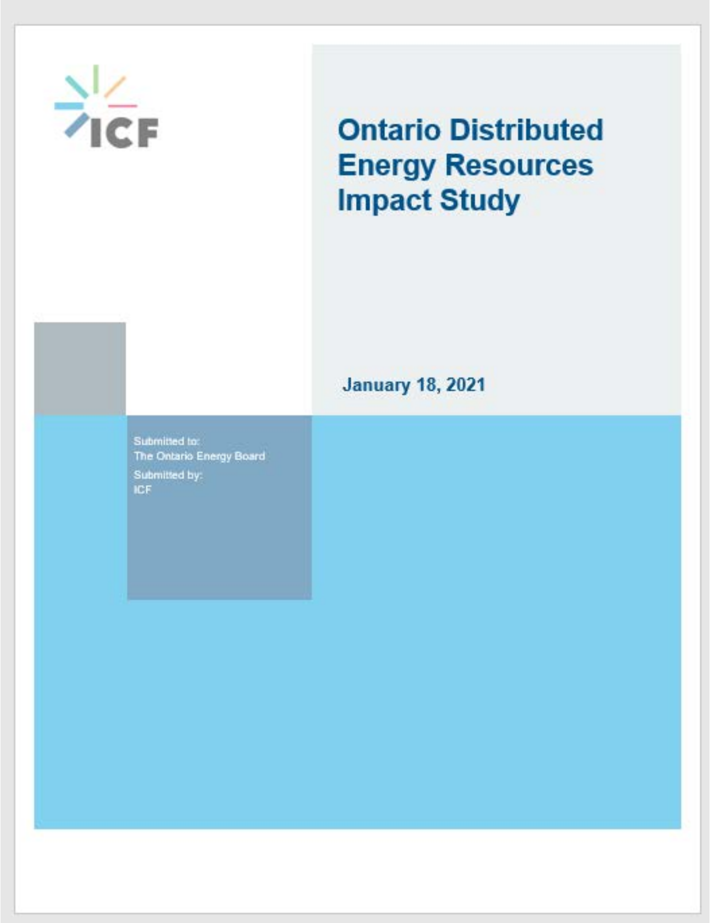
February 3, 2021

Agenda

- **Purpose of the Study**
- **10-year projections of solar PV and battery energy storage**
  - Approach
  - Results
- **Implications and recommendations**
  - Process Impacts
  - Operations & Planning Impacts
  - Market Impacts
  - Timeline

Study Purpose

- **Conduct province-level projections** of distributed (a) solar photovoltaic (PV) and (b) battery energy storage adoption for the 2021–2030 period
- **Analyze the implications** of solar PV and battery energy storage deployment in Ontario
- **Provide recommendations** that can help inform the pace and sequencing of regulatory responses and supporting actions in the province



ICF's ***DER Impact Study*** report was released by the OEB on January 18, 2021

The report is available on the OEB's Responding to DERs consultation webpage:

https://www.oeb.ca/industry/policy-initiatives-and-consultations/responding-distributed-energy-resources-ders

Approach: Parameters

2 Technologies
- Solar PV
- Battery Energy Storage

4 Customer Classes
- Residential
- Small Business
- Class A
- Non-RPP Class B

3 Scenarios
- Low
- Mid
- High

Approach: Scenarios

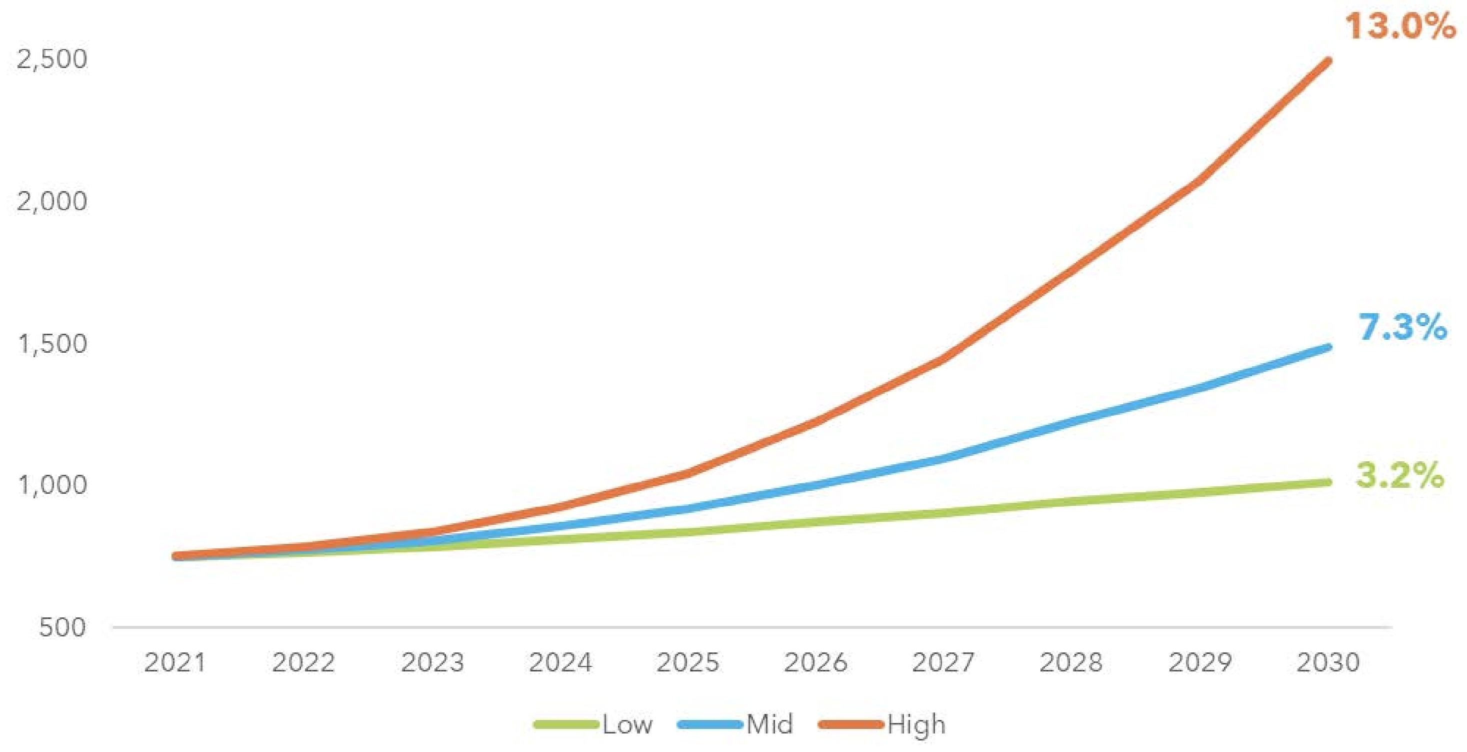
	Low	Mid	High
Solar Costs	NREL ATB 2020 *Conservative* forecast	NREL ATB 2020 *Moderate* forecast	NREL ATB 2020 *Advanced* forecast
Storage Costs	Wood Mackenzie Research *High* Cost Case	Wood Mackenzie Research *Mid* Cost Case	Wood Mackenzie Research *Low* Cost Case
Tariffs	Escalated at 80% of Mid Scenario escalation rate	Escalated in accordance with 2017 LTEP projections	Escalated at 120% of Mid Scenario escalation rate
Policy	DER integrated into IAMs and deployed through other initiatives at slow pace	DER integrated into IAMs and deployed through other initiatives at moderate pace	DER integrated into IAMs and deployed through other initiatives at rapid pace
COVID-19	Extended impacts and slow recovery with extensive permanent demand reduction	Moderately paced recovery with some permanent demand reduction	Best case recovery with little to no permanent demand reduction

Approach: Customer Value Streams

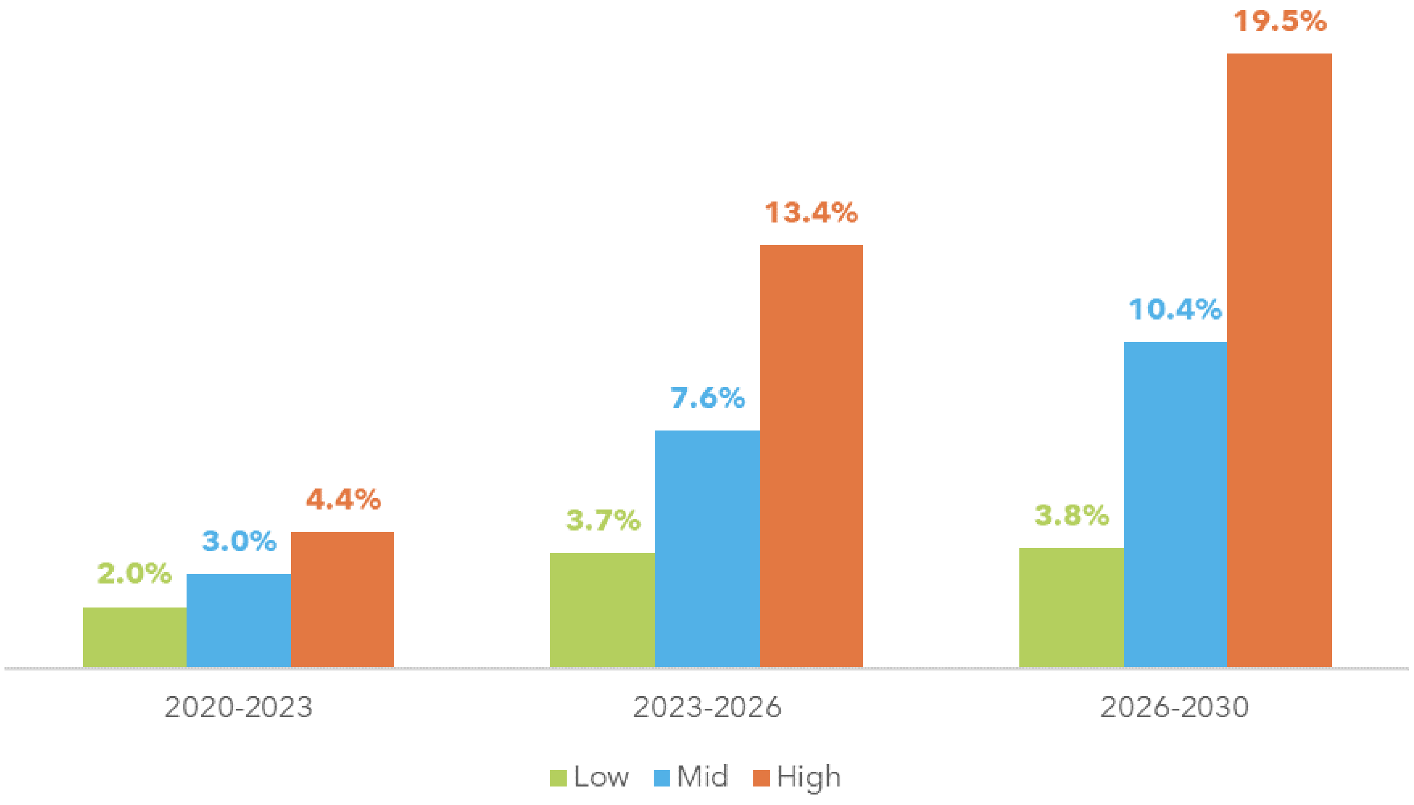
Technology	Customer Class	Avoided Energy Costs	Wholesale Market Energy Revenues	ToU Bill Management	Backup Power	Avoided Global Adjustment Charges
Solar	All	✓	✓			
Storage	Residential & Small Business			✓	✓	
	Non-RPP Class B		✓		✓	
	Class A		✓		✓	✓

Solar PV Projections: By Scenario

Cumulative Capacity (MW)

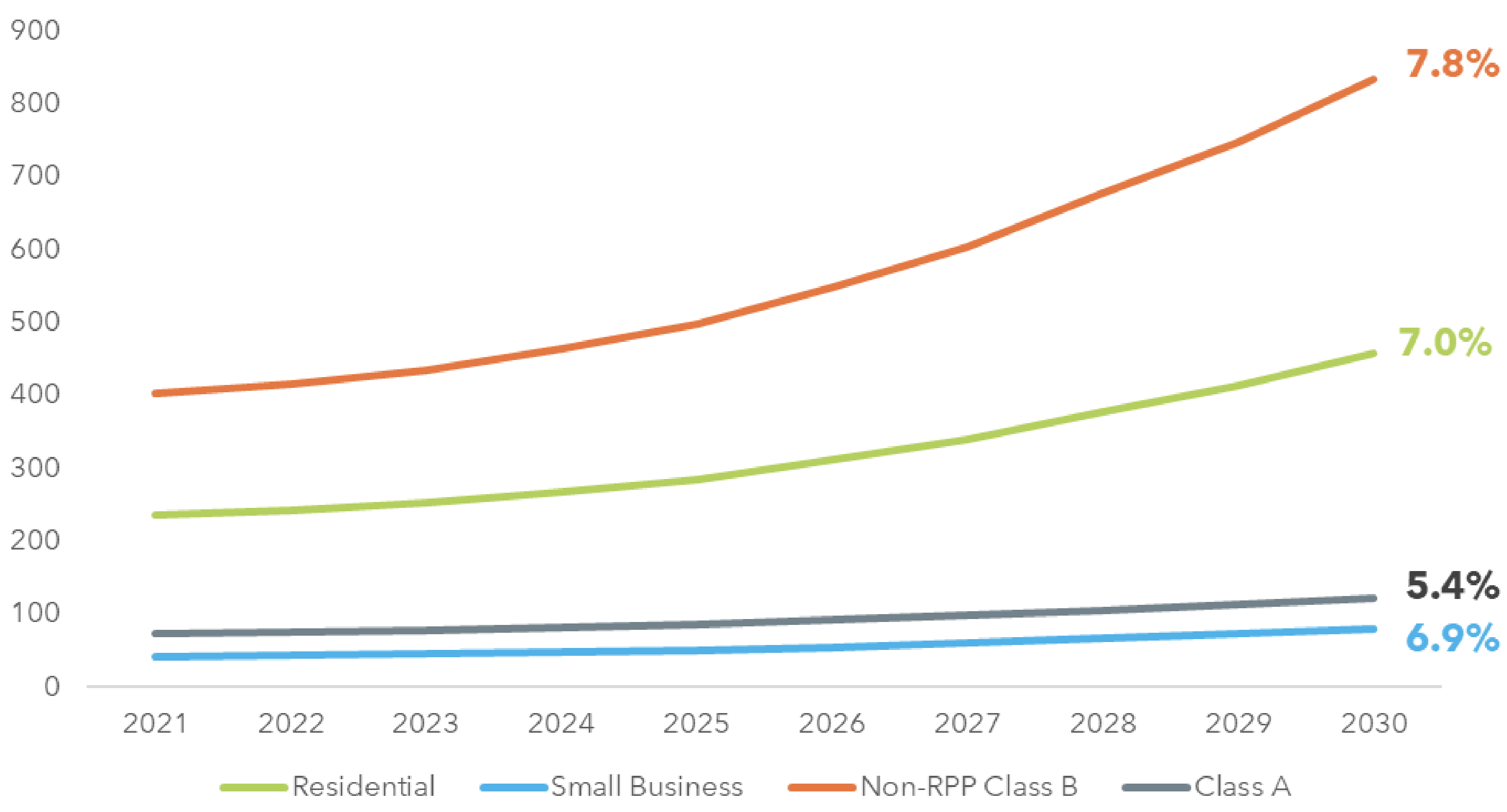


Compound Annual Growth Rates (Capacity)

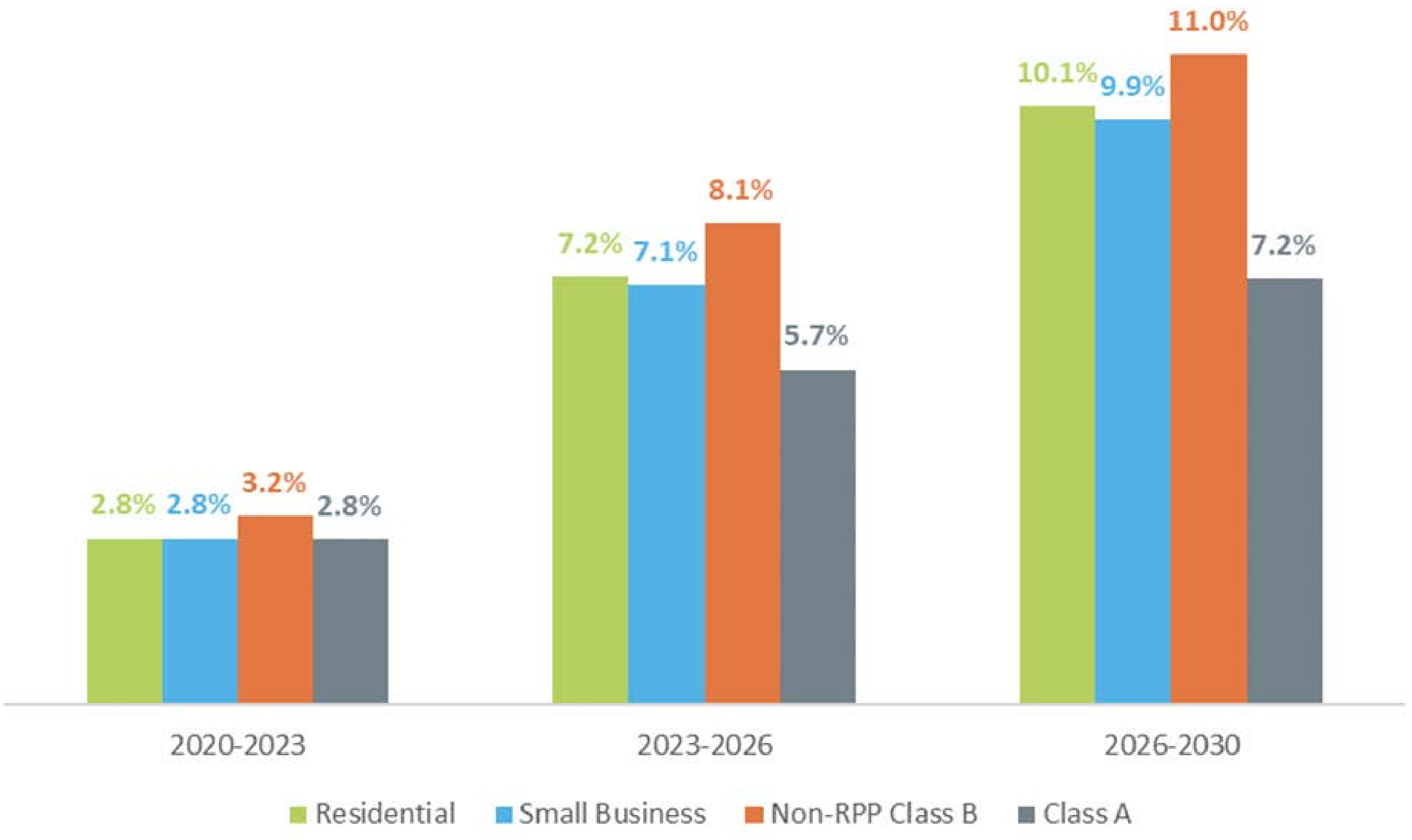


Solar PV Projections: By Customer Class, Mid Scenario

Cumulative Capacity (MW)

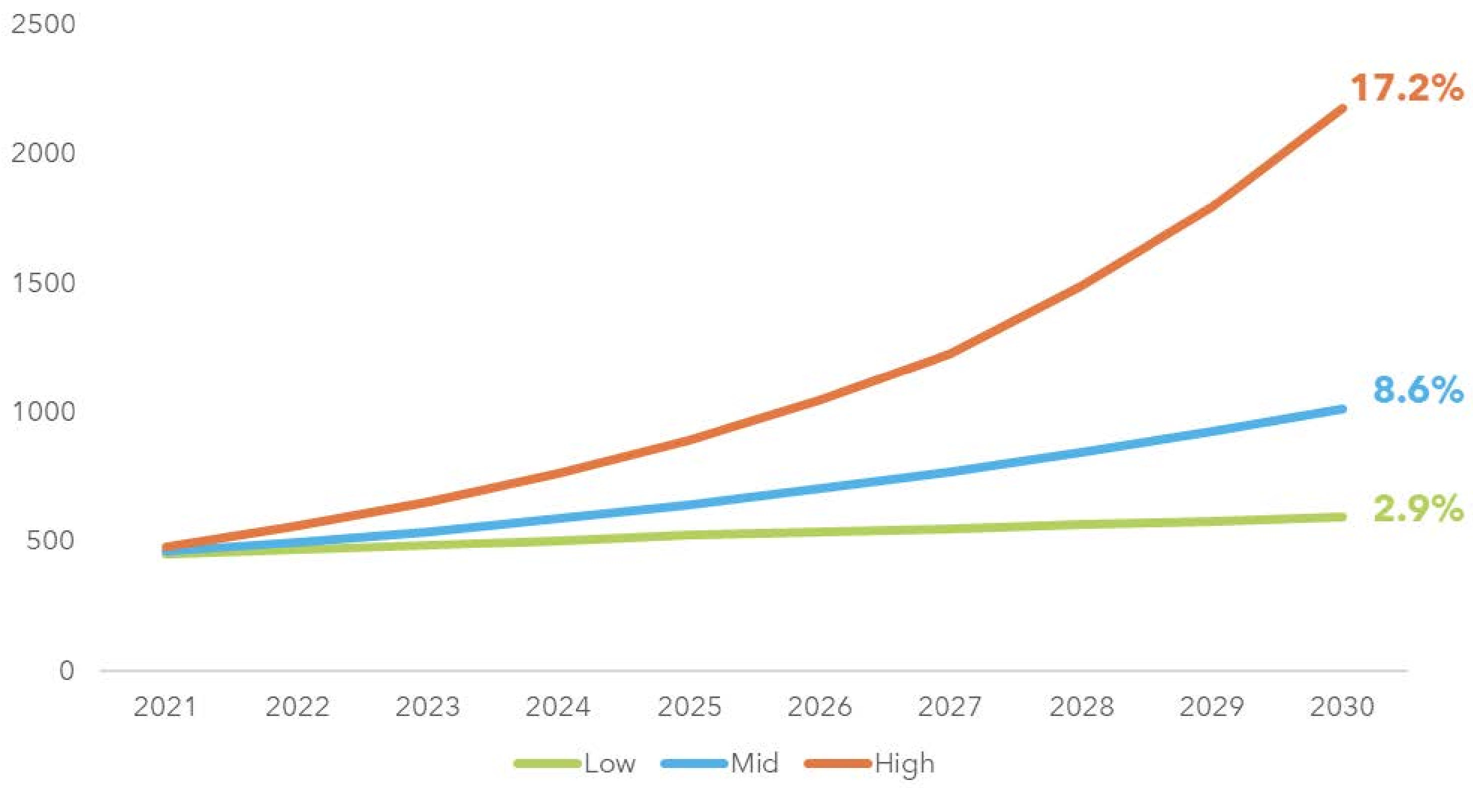


Compound Annual Growth Rates (Capacity)



Storage Projections: By Scenario

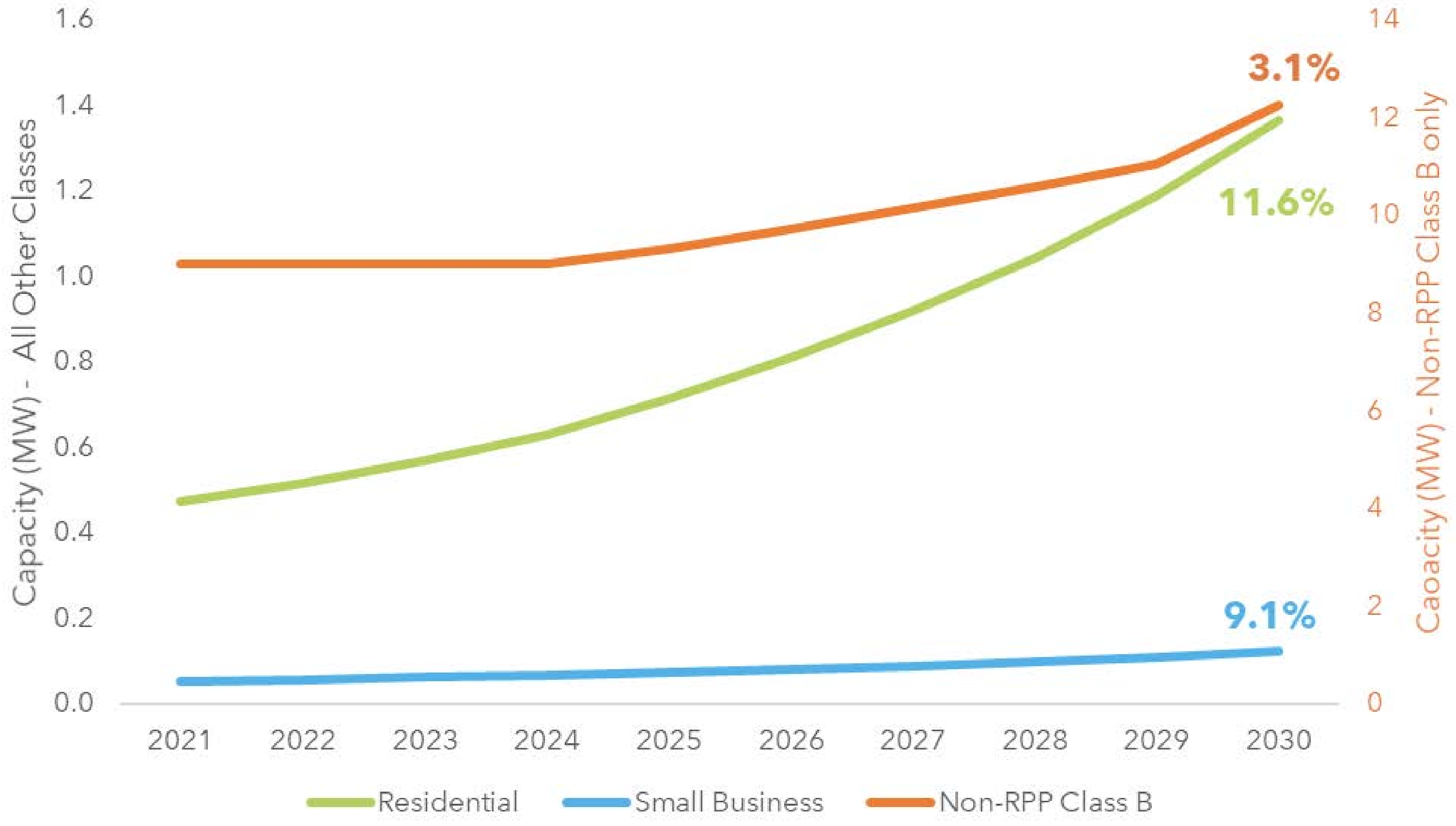
Cumulative Capacity (MW)

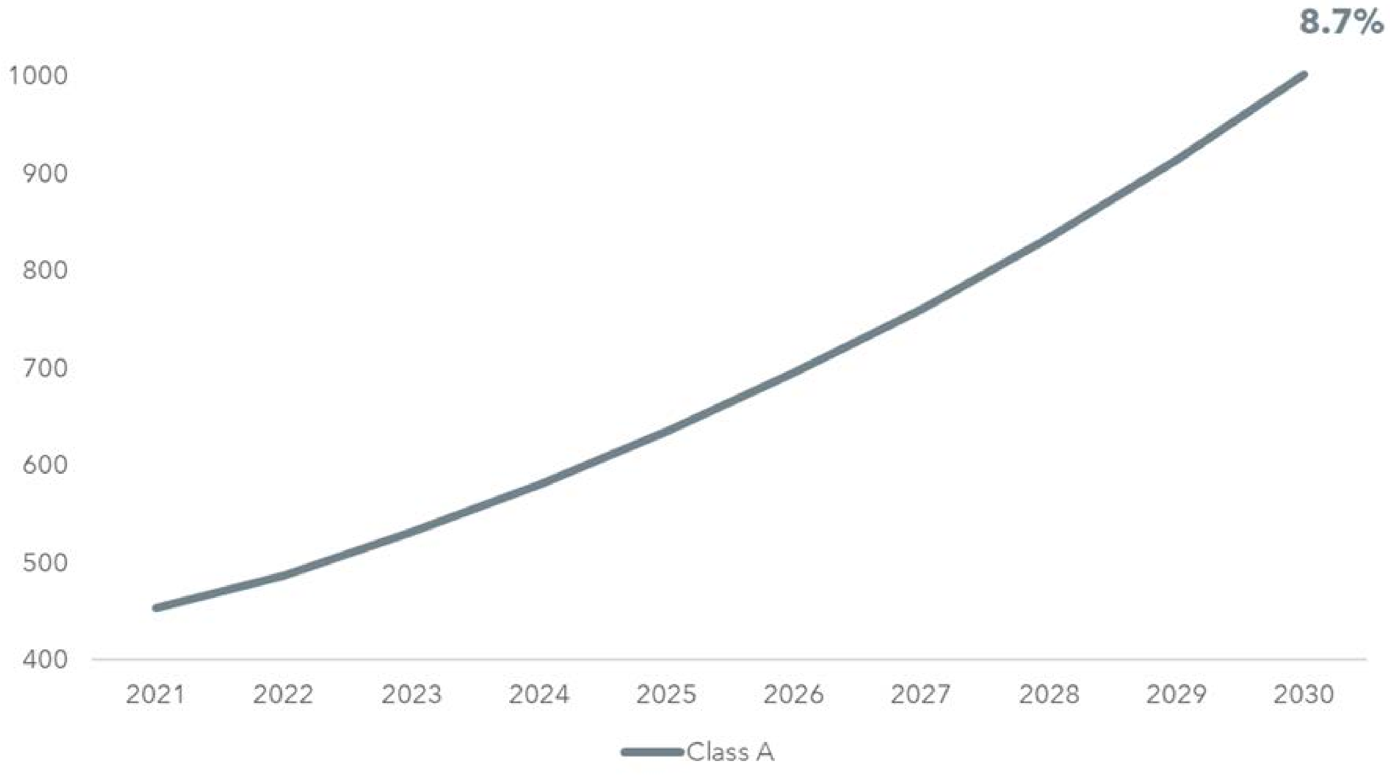


Compound Annual Growth Rates (Capacity)

Storage Projections: By Customer Class, Mid Scenario

Cumulative Capacity (MW)





Increased DER adoption in Ontario could lead to…

Process Impacts

- Potential for the combination of more DER connection requests, increased DER complexity, and flexible grid operations to present new ways of handling connections

Operations & Planning Impacts

- Potential for utilities to not be fully prepared to incorporate future, significantly greater levels of DER into distribution operations
- Potential for utilities to not be fully prepared to incorporate future, significantly greater levels of DER into planning practices
- Inability to productively handle increased scale and complexity of data

Market Impacts

- Opportunities for new or enhanced electric distribution market value streams for customers and utilities
- Opportunities for new or enhanced wholesale electric market value streams for customers and the system
- Heightened transmission-distribution coordination challenges

Implication 1.1

Process Impact

Potential for the combination of more DER connection requests, increased DER complexity, and flexible grid operations to present new ways of handling connections

Description

- DER complexity is increasing: connection arrangements can involve various DER configurations (e.g., non-export, export) and technology pairings (notably PV+storage)
- The ability to dynamically adjust DER settings can enable DER connections to respond to local system conditions and provide grid services without unnecessary costs, system investments, or curtailment
- A need may emerge to develop robust, replicable, and transparent methodologies to assess the risk of curtailment within flexible connection arrangements

Recommendation

- Investigate the feasibility of flexible connections that allow for dynamic adjustments of DER generator settings according to distribution circuit and system conditions

Implication 2.1

Operations & Planning Impact

Potential for utilities to not be fully prepared to incorporate future, significantly greater levels of DER into distribution operations

Description

- Increasing DER penetration could drive the need for new operational capabilities and enhanced situational awareness into grid parameters
- Consistent standard implementation (such as CSA C22.3 No.9) can enable DER to provide grid-supportive functions and respond to operating conditions
- Defining clear objectives, technical standards, and functional requirements early can maximize the value of new operational systems and tools

Recommendations

- Assess new frameworks for LDCs to evaluate the prudency and cost-effectiveness of monitoring and control investments and grid modernization investments
- Organize technical workshops to generate discussion on implementation timelines and characteristics, share knowledge, and provide further support for LDC field pilots and projects on advanced capabilities

Implication 2.2

Operations & Planning Impact

Potential for utilities to not be fully prepared to incorporate future, significantly greater levels of DER into planning practices

Description

- Increased DER adoption could drive the need for expanded planning processes and enhanced tools
- New planning practices can assist in identifying the right system investments, inform changes to existing processes, and quantify the benefits of DER to customers and the system

Recommendations

- Convene stakeholders and hold discussions to develop frameworks to integrate DER into the fabric of electric distribution planning
- Formulate guidance for LDCs on enhanced distribution planning practices under high DER penetration

Implication 2.3

Operations & Planning Impact

Inability to productively handle increased scale and complexity of data

Description

- Communication pathways between DER owners and LDCs are critical to ensuring the safe and reliable operation of the distribution system
- Data on grid parameters, device status, and operating conditions will be increasingly important for grid planning and operations
- A shared data hub between DER owners/operators, aggregators, LDCs, and the IESO could enable load flexibility services from DER to the bulk grid

Recommendations

- Encourage the LDCs to coalesce around common reporting requirements and best practices for data from DER
- Advocate that the LDCs and IESO consider DER data-sharing initiatives within the context of ongoing activities
- Work with DER developers, LDCs, and the IESO to assess the need for centralized data hubs, as well as the types of data housed in these repositories, to provide timely information to all parties

Implication 3.1

Market Impact

Opportunities for new or enhanced electric distribution market value streams for customers and utilities

Description

- Electric distribution markets can help source services such as capacity deferral, reliability, resiliency, power quality, and voltage management from DER
- Increasing DER penetration could require a renewed focus on options within the LDC toolkit to guide and incentivize DER performance to align with system value and requirements, while also providing DER owners/operators with commensurate value for those services

Recommendation

- Work with the LDCs to determine how potential DER growth trajectories within their respective territories may impact which DER use cases provide the greatest system value at the distribution level

Implication 3.2

Market Impact

Opportunities for new or enhanced wholesale electric market value streams for customers and the system

Description

- With limited visibility into distribution systems, ISOs and RTOs are exploring ways to account for increasing levels and expanding capabilities of DER
- Select LDCs with more advanced capabilities may be more ready to manage DER, while others may still need the IESO to take a centralized role in the participation of DER in the IAMs
- There is currently no aggregation participation model for non-dispatchable resources (such as distributed solar resources) in the IAMs

Recommendations

- Account for the diversity of LDC capabilities by developing guidelines and requirements that govern LDC performance in the coordination of DER participation in the IAMs that align with the OEB guiding principles
- Work with the IESO to identify how potential DER growth trajectories may impact which DER use cases provide the greatest system value at the bulk power levels

Implication 3.3

Market Impact

Heightened transmission-distribution coordination challenges

Description

- Scalability of DER participation in wholesale markets may raise concerns of tier bypassing and hidden coupling as well as introduce operational risks that could impact grid reliability
- Allowing for stacking of services across several domains can present greater economic value for the DER but could result in unintended duplicative compensation for provision of a single service through multiple revenue streams

Recommendations

- Convene a forum to provide guidelines on the design of a distribution-level market that can effectively coordinate with the IAMs on the prioritization of services and the allocation of roles and responsibilities
- Collaborate with the IESO and LDCs to explore ways to place appropriate measures on DER participation in IAMs that minimize the risks for duplicative compensation

Timing of Recommended Actions

Based on the Mid Scenario; actions could be accelerated or decelerated if the future more closely resembles the High or Low Scenarios, respectively

Process

Operations & Planning

Market

2021-2023

- Common DER data requirements and best practices
- Local DER projections and distribution value
- Frameworks for integration of DER into distribution planning
- Workshops to support advanced LDC operational capabilities

2024-2026

- New frameworks for evaluating monitoring, control, and grid mod investments
- Consideration of DER data-sharing initiatives
- Guidance on enhanced distribution planning practices
- Guidelines for LDC performance in the coordination of DER participation in the IAMs

2027-2030

- DER projections and bulk system value
- Investigation of flexible connections
- Exploration of duplicative compensation risk mitigation
- Consideration of centralized data hubs
- Distribution market coordination with the IAMs

Thank You.

Appendix

Approach: Residential Tariffs / Prices

Scenario	Low	Mid	High
RPP Bills & Supply Costs	Increase annually at 80% of the escalation rate in the Mid scenario rates.	RPP supply costs increase annually at rates similar to the rate of change in HOEP and GA components per the LTEP 2017 projections. The projections indicate an increase in HOEP and a decrease in GA costs. The baseline ToU rates for residential customers used to calculate the projections are the November 2020 rates and the baseline OER applied to the RPP bill is 33.2%. The impact of the OER was reduced in the projections to account for the lower GA rates (due to the GA decrements as per the 2020 Ontario Budget Announcement as well as the application of LTEP assumptions) by a proportion that ensured that the total RPP bills were still increasing at 2% per year.	Increase annually at 120% of the escalation rate in the Mid scenario rates.
Distribution Costs	Increase by 2% annually during the study period, using November 2020 data as the baseline.		

Approach: C&I Tariffs / Prices

<table>
<tr><th>Scenario</th><th>Low</th><th>Mid</th><th>High</th></tr>
<tr><td>Baseline (for both solar and storage)</td><td>Baseline assumptions for HOEP and GA values are the same as in the Mid scenario, with the same reductions in GA rates and including persistence for the duration of the study period. Forward-looking variations between Mid and Low are handled via the mechanisms desribed in the projection methodology.</td><td>The baseline HOEP and GA rates are the pre-COVID-19 rates from 2019 but with reduced GA rates for both non-RPP Class B and Class A customers as per the 2020 Ontario Budget Announcement. Based on the illustrative examples provided in the Budget, this translates into a 22% and a 23% reduction in GA rates for Class A and non-RPP Class B rates, respectively. It is assumed that this persists for the duration of the study period.</td><td>Baseline assumptions for HOEP and GA values are the same as in the Mid scenario, with the same reductions in GA rates and including persistence for the duration of the study period. Forward-looking variations between Mid and High are handled via the mechanisms described in the projection methodology.</td></tr>
<tr><td>Solar</td><td>The changes in HOEP and GA rates for non-RPP Class B and Class A are assumed to be 80% of the rate of average forecasted changes in the HOEP and GA rates from 2021-2030 in the LTEP 2017. The analysis assumes that the ICI hiatus will terminate at the end of 2020. Baseline years for HOEP and GA values are the same as in the Mid scenario.</td><td rowspan="2">HOEP and GA rates for non-RPP Class B and Class A vary annually at the average annual % change of forecasted rates from 2021-2030 in the LTEP 2017. The baseline HOEP and GA rates used to calculate the increases are the pre-COVID-19 rate from 2019. The analysis assumes that the ICI hiatus will terminate at the end of 2020.</td><td>The changes in HOEP and GA rates for non-RPP Class B and Class A are assumed to be 120% of the rate of average forecasted changes in the HOEP and GA rates from 2021-2030 in the LTEP 2017. The analysis assumes that the ICI hiatus will terminate at the end of 2020. Baseline years for HOEP and GA values are the same as in the Mid scenario.</td></tr>
<tr><td>Storage</td><td>The changes in HOEP and GA rates for non-RPP Class B and Class A are assumed to be 120% of the rate of average forecasted changes in the HOEP and GA rates from 2021-2030 in the LTEP 2017. The analysis assumes that the ICI hiatus will terminate at the end of 2020. Baseline years for HOEP and GA values are the same as specified in the Mid scenario.</td><td>The changes in HOEP and GA rates for non-RPP Class B and Class A are assumed to be 80% of the rate of average forecasted changes in the HOEP and GA rates from 2021-2030 in the LTEP 2017. The analysis assumes that the ICI hiatus will terminate at the end of 2020. Baseline years for HOEP and GA values are the same as in the Mid scenario.</td></tr>
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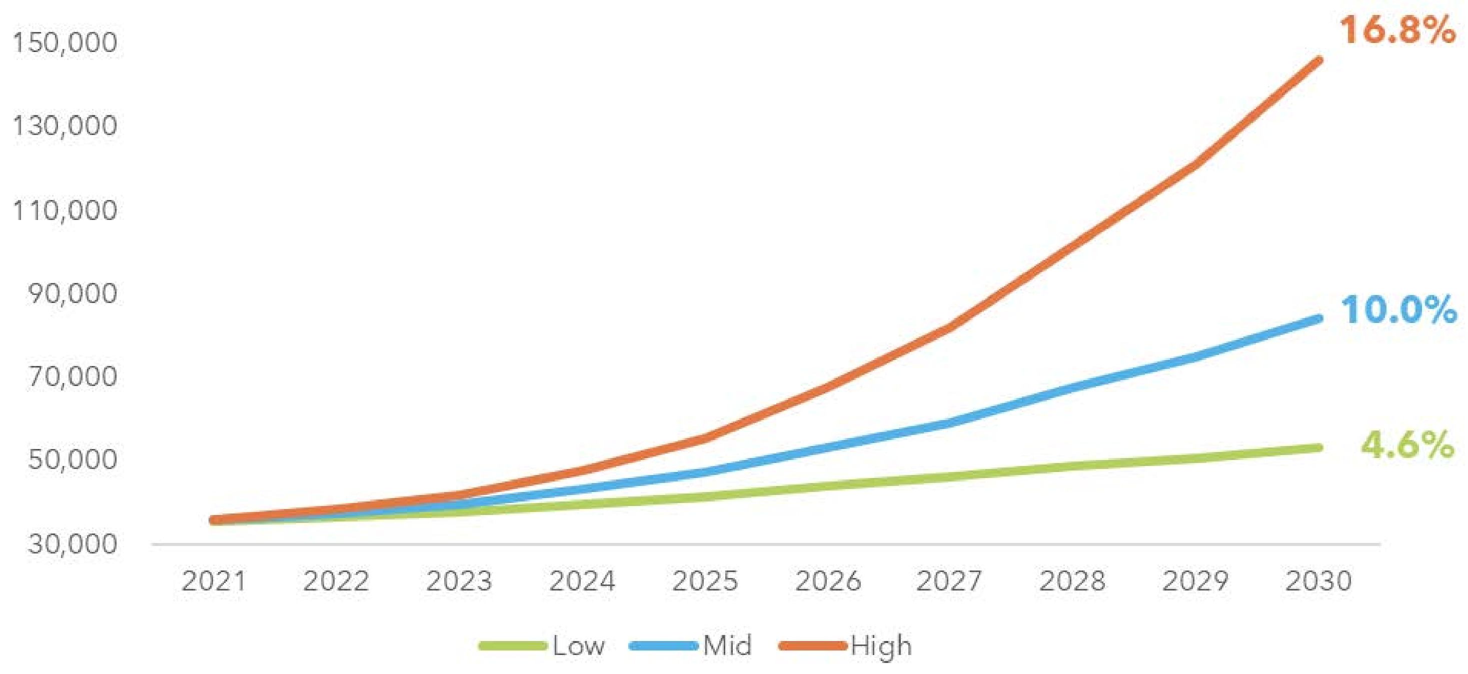
Solar PV Projections: By Scenario

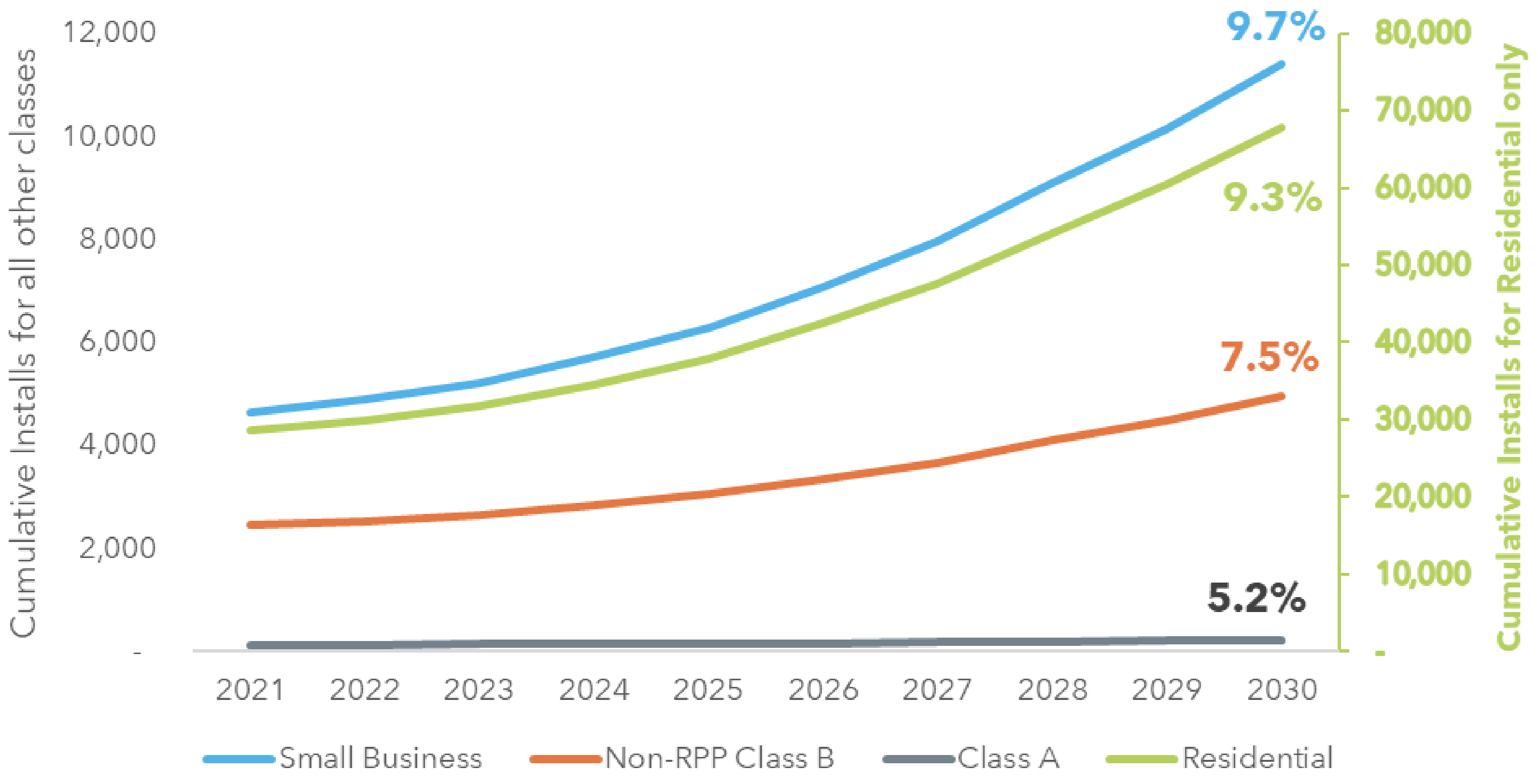
Cumulative Installations



Year	Low	Mid	High
2021	35,540	35,775	36,029
2022	36,542	37,363	38,323
2023	37,930	39,745	41,929
2024	39,729	43,188	47,839
2025	41,617	47,369	55,600
2026	43,951	53,159	67,647
2027	46,153	59,303	81,825
2028	48,743	67,578	101,617
2029	50,844	75,158	121,178
2030	53,196	84,313	146,218

Solar PV Projections: By Customer Class, Mid Scenario

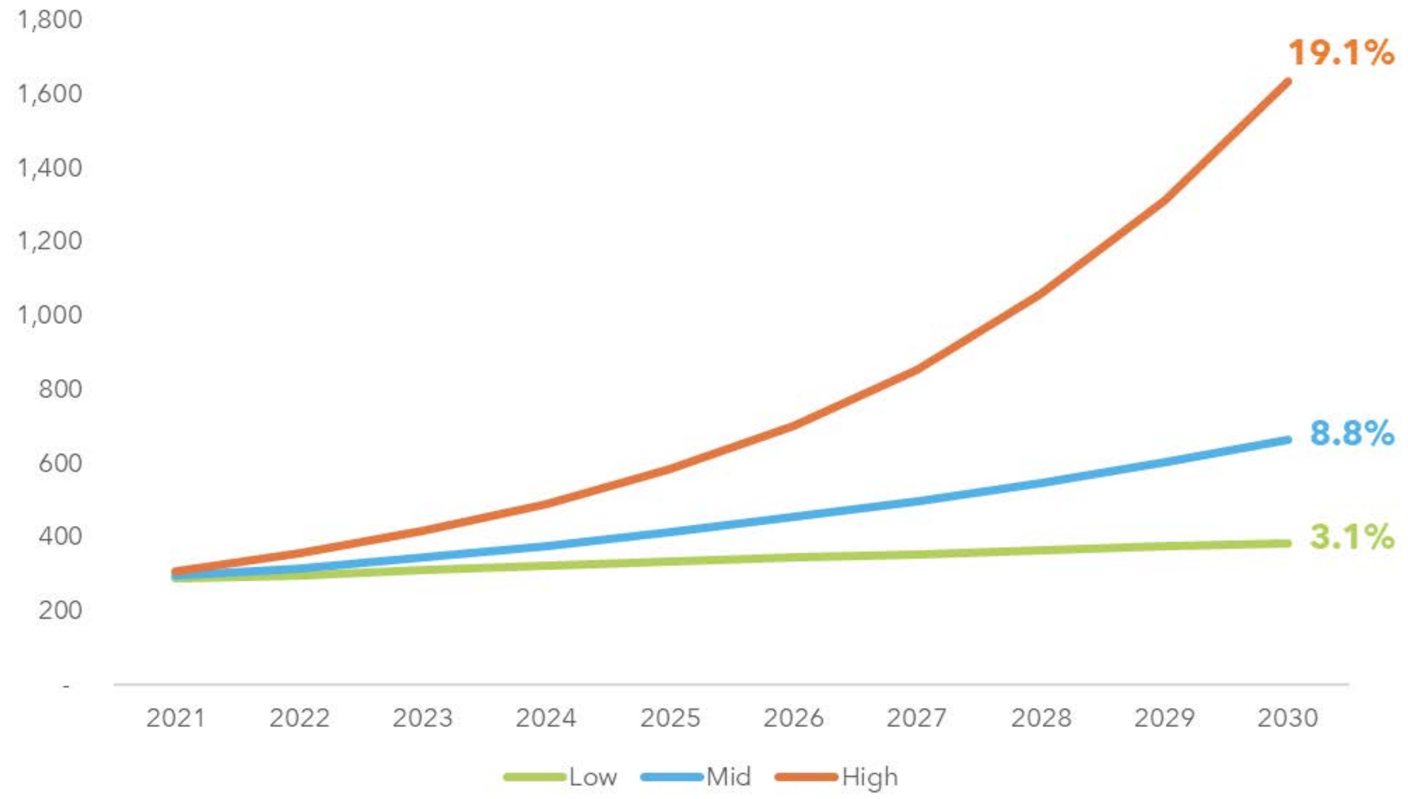
Cumulative Installations



Year	Residential	Small Business	Non-RPP Class B	Class A
2021	28,534	4,655	2,453	133
2022	29,810	4,880	2,535	137
2023	31,730	5,219	2,653	143
2024	34,496	5,707	2,835	150
2025	37,886	6,278	3,046	158
2026	42,555	7,089	3,347	168
2027	47,516	7,945	3,665	178
2028	54,202	9,093	4,092	191
2029	60,333	10,140	4,482	203
2030	67,742	11,399	4,953	218

Storage Projections: By Scenario

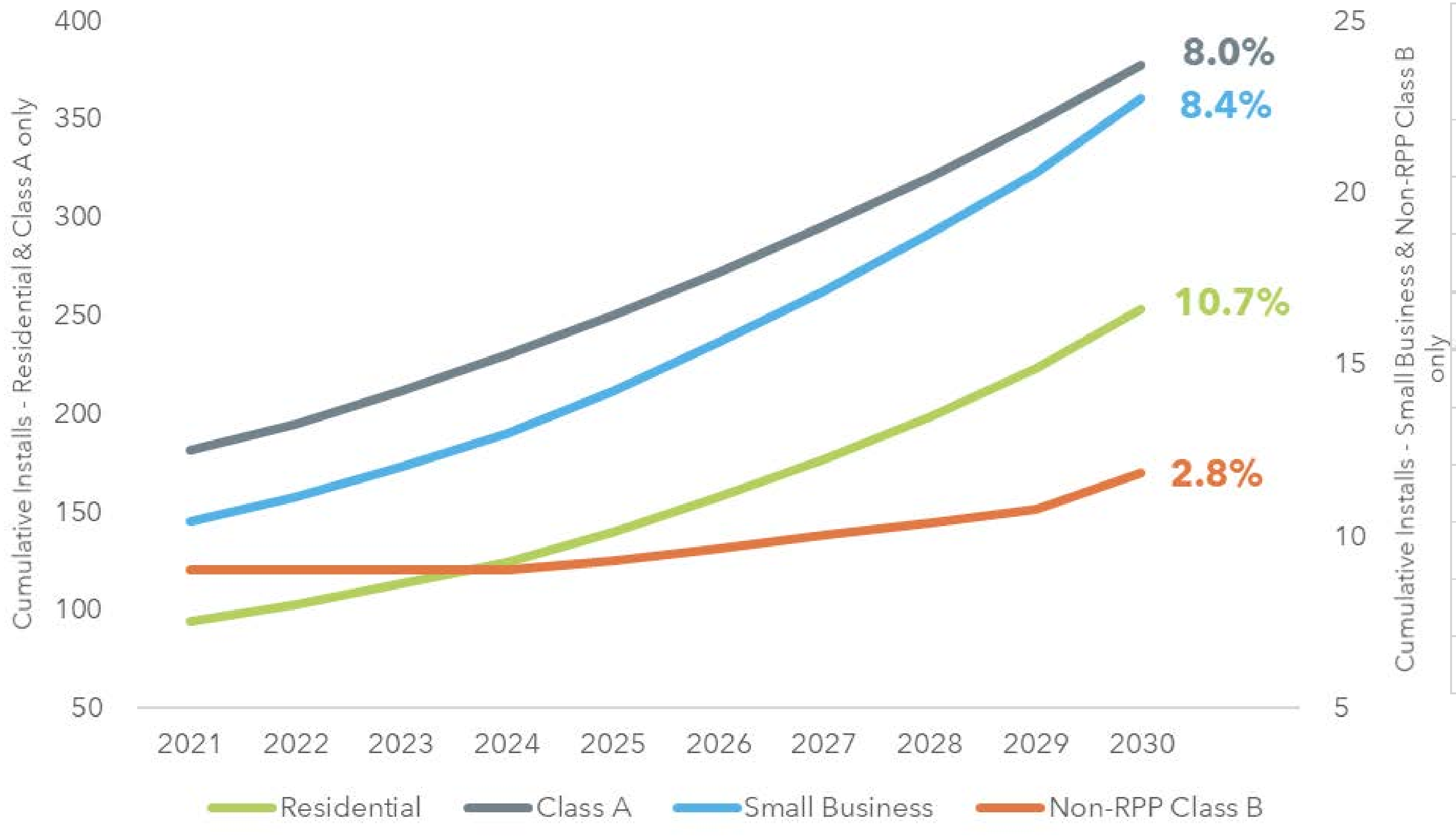
Cumulative Installations



Year	Low	Mid	High
2021	291	295	308
2022	299	317	357
2023	310	346	418
2024	322	377	492
2025	335	414	585
2026	345	455	703
2027	354	500	855
2028	364	549	1,058
2029	375	603	1,313
2030	385	665	1,633

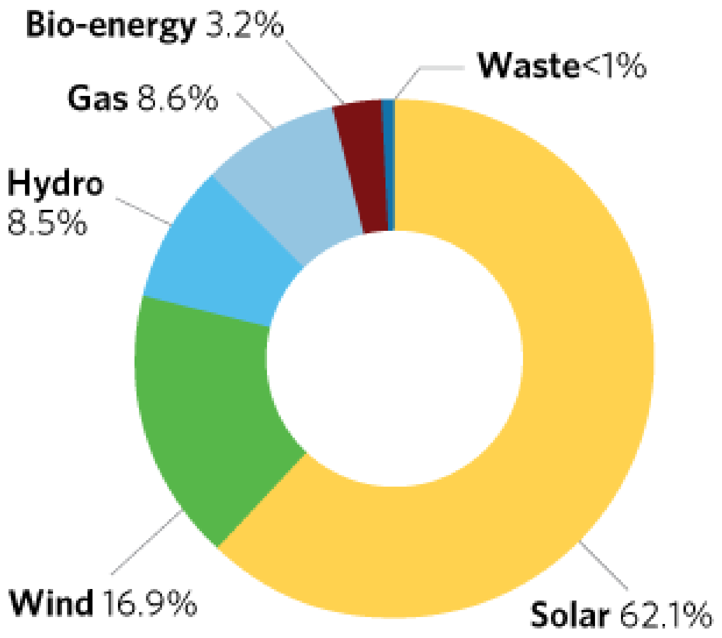
Storage Projections: By Customer Class, Mid Scenario

Cumulative Installations



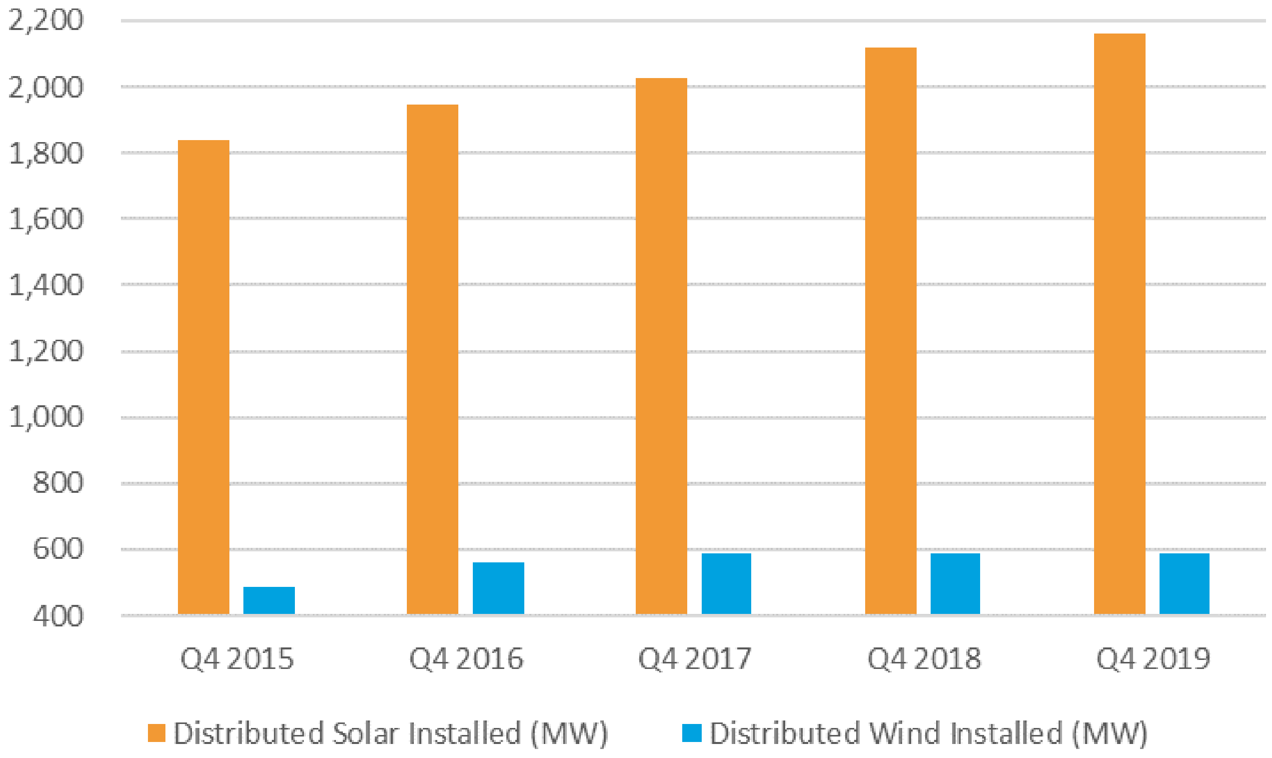
Year	Residential	Small Business	Non-RPP Class B	Class A
2021	94	10	9	181
2022	103	11	9	194
2023	113	12	9	212
2024	125	13	9	230
2025	140	14	9	250
2026	157	16	10	272
2027	177	17	10	295
2028	199	19	10	321
2029	223	21	11	348
2030	253	23	12	378

Distributed Energy Resources in Ontario



Solar	2,166 MW or 62.1%
Wind	590 MW or 16.9%
Hydro	297 MW or 8.5%
Gas	299 MW or 8.6%
Bio-energy	110 MW or 3.2%
Waste	24 MW or <1%

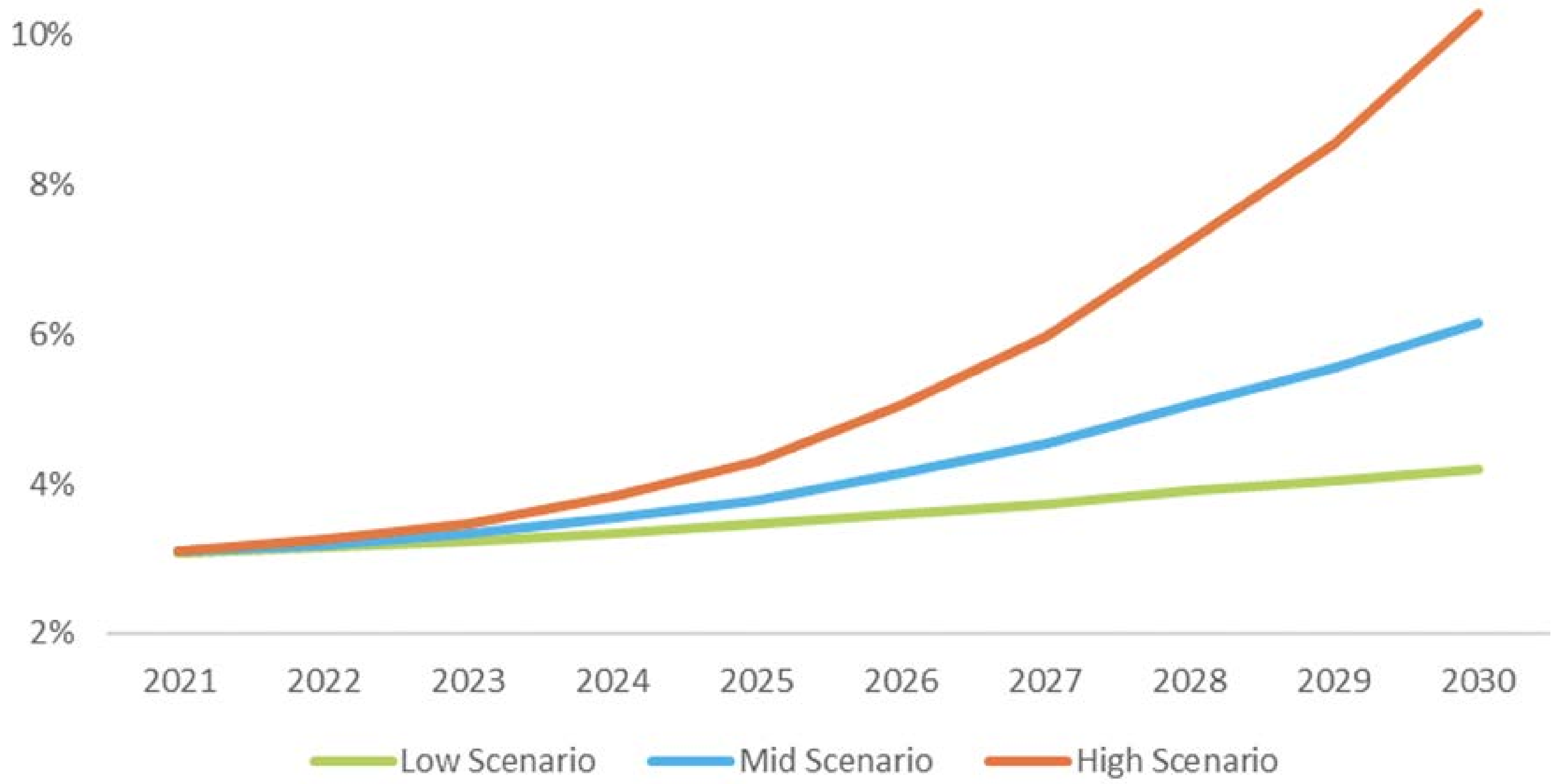
As of September 2020. Source: IESO's Progress Report on Contracted Electricity Supply, Second Quarter 2020



Cumulative MWs of Distributed Solar and Wind (commercial operation) in Ontario
Source: IESO's Active Contracted Generation List.

Solar PV Projections: % of Peak Load

Cumulative Capacity as Share of Peak Load



Storage Projections: % of Peak Load