COVID-19 impact on distributed energy resources

prepared for the Ontario Energy Board by London Economics International LLC

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The COVID-19 pandemic has had widespread economic impacts on households and businesses across Ontario, which has implications on the outlook for future distributed energy resource ("DER") adoption. This report examines how COVID-19 has impacted the major drivers of DER adoption, including a desire for cost savings, the ability to reap environmental benefits, achieving better supply reliability and greater independence, and taking advantage of government incentives. Based on an assessment of each of these factors, it is anticipated that DER investment in Ontario may slow as a result of the pandemic.

Table of contents

Table of figures

List of acronyms

BOS	Business Outlook Survey	NPV	Net Present Value
C&I	Commercial and Industrial	NREL	National Renewable Energy Laboratory
CHP	Combined Heat and Power	OEB	Ontario Energy Board
DER	Distributed Energy Resource	OPA	Ontario Power Authority
EIA	Energy Information Administration	PDF	Peak Demand Factor
EV	Electric Vehicle	PV	Photovoltaic
FIT	Feed-in Tariff	RESOP	Renewable Energy Standard Offer Program
GA	Global Adjustment	RPP	Regulated Price Plan
GDP	Gross Domestic Product	SEIA	Solar Energy Industries Association
ICI	Industrial Conservation Initiative	TOU	Time-of-use
IEA	International Energy Agency	UK	United Kingdom
IESO	Independent Electricity System Operator	UR	Utility Remuneration
ITC	Investment Tax Credit	US	United States
LBNL	Lawrence Berkeley National Laboratory	WTP	Willingness to Pay
LEI	London Economics International LLC	YoY	Year-over-Year
MW	Megawatt		

1 Executive summary

1.1 Scope of work

London Economics International LLC ("LEI") was engaged by the Ontario Energy Board ("OEB") to assist in its 'Utility Remuneration' and 'Responding to Distributed Energy Resources' consultations (EB-2018-0287 and EB-2018-0288, respectively). As part of this process, LEI has prepared the following three separate reports:

1) a jurisdictional report on regulatory responses to COVID-19 to date across North America, which is jointly used in the OEB's separate Deferral Account consultation (EB-2020-0133);[1]

2) a report covering the impacts of COVID-19 on utility financial health, short- and longer-term electricity and natural gas consumption, and an examination of the roles of stimulus programs;[2] and

3) a report focused on COVID-19's impact on distributed energy resource ("DER") adoption.[3]

This report covers numbered item (3) above, and examines the following topics:

- the **drivers of DER adoption** and how COVID-19 has impacted them (covered in Section 2 and Section 3);
- the impact changes in income patterns will have on perceptions of the **payback period required to invest in DERs** (covered in Section 3.1);
- the impact of the pandemic and associated governmental actions on **Industrial Conservation Initiative** participants (covered in Section 4); and
- the impact on and considerations for **prioritizing, pacing, and sequencing OEB policy development initiatives** related to utility remuneration ("UR"), innovation, and DERs arising from COVID-19 and institutional responses to it (covered in Section 5.1).

1.2 Overview of findings

According to the Independent Electricity System Operator ("IESO"), "a distributed energy resource is a resource that: (1) is directly connected to the distribution system, or indirectly connected to the distribution system behind a customer's meter; and (2) generates energy, stores

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[1] Report titled "A report on regulatory principles, policies, and accounting treatments applied in other jurisdictions in response to COVID-19."

[2] Report titled "COVID-19 Impact Study."

[3] Note this report is different from the 'DER Impact Study' that the OEB has commissioned from ICF.

energy, or controls load."[4] DER adoption in Ontario leads the rest of Canada, with distribution-embedded resources totaling over 3,500 MW of contracted capacity as of Q2 2020 (or 8% of current installed capacity).[5, 6]

However, as a result of the COVID-19 pandemic, as well as the associated lockdowns, continued physical distancing measures, and the resulting economic consequences, DER sales in Ontario are expected to have declined by 33% on average in 2020 (with the largest reported decline of 60%) according to survey responses from a sample of local DER suppliers.[7] The outlook for DER adoption in the province will ultimately depend on numerous factors, which can be assessed based on the impact the pandemic could have on the major drivers of DER investments cited by both households and businesses, including:

- a desire for **cost savings** or a reduction in electricity bills;
- the ability to reap **environmental benefits** from installing renewables, or to meet environmental or sustainability goals (for businesses);
- to achieve better supply **reliability** or resiliency and avoid supply interruptions;
- a desire for greater **independence** through self-supply; and
- to take advantage of **government incentives** (such as tax incentives or rebates to encourage DER adoption).

Figure 1 summarizes the results of this assessment. First, the impact of COVID-19 on **cost savings** and project economics for DERs is likely to be felt most in the short-term, as regulators and policymakers seek tools to reduce rates, and economic uncertainty tightens credit for investment. In the longer-term, as business confidence returns to normal, pent up savings may allow for additional investment, particularly if interest rate levels remain low.

Next, a correlation between income and willingness to pay for **environmental benefits** suggests that households and businesses that have experienced financial strain as a result of the pandemic may demonstrate a decrease in interest for renewable DER investments in the short-term. The impact on DER deployment in the longer-term will ultimately depend on the pace of economic recovery, which will dictate how long households and businesses experience a decline in their income and hence a reduced willingness to pay for environmental benefits.

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[4] IESO. *Innovation and Sector Evolution White Paper Series – Exploring Expanded Distributed Energy Resource Participation in the IESO Administered Markets.* October 24, 2019.

[5] IESO. *A Progress Report on Contracted Electricity Supply.* Q2 2020.

[6] IESO. *Ontario's Energy Capacity.*

[7] Percentages represent sales declines relative to expectations for 2020 prior to the pandemic. Survey is further discussed in Section 3.5.

In terms of **reliability** and a **desire for independence**, surveys suggest these drivers have led to a rise in interest in DERs following the onset of the pandemic, as customers "seek the security and control of having their own backup power supply, especially during uncertain times."[8] This represents an attitude shift brought on by the pandemic, which LEI expects may persist in the longer-term for both residential and commercial and industrial ("C&I") customers.

Finally, recent changes to Ontario **government incentives** (including a temporary freeze in Global Adjustment ("GA") charges for Industrial Conservation Initiative ("ICI") participants, and the announced shift in a portion of the GA charge to the tax base), may impact business decisions on whether to invest in technologies aimed at actively curtailing load during periods of system peak, such as through investments in DERs. As a result of the GA shift, and under instances where a large consumer sees a reduction in its total consumption, the business case for deploying DERs may be negatively impacted into the longer-term.

Figure 1. Summary of COVID-19 impact on future DER deployment

DER adoption drivers	Short-term COVID-19 impact (2021-2022)		Longer-term COVID-19 impact (2022-2025)	
	Residential	C&I	Residential	C&I
Cost savings	↓	↓	=	=
Environmental attributes	↓	↓	=	=
Reliability	↑	↑	↑	↑
Desire for independence	↑	↑	↑	↑
Government incentives	=	↓	=	↓

↑ Upward pressure on DER deployment ↓ Downward pressure on DER deployment = No change to DER deployment

Note: See Sections 3.1 through 3.4 for further details.

Taken together, LEI anticipates that DER adoption may slow in Ontario as a result of the COVID-19 pandemic, at least in the short-term. This aligns with outlooks developed for other markets; for example, the International Energy Agency ("IEA") in its 2020-2021 outlook stated that "households and small businesses facing financial shocks and economic uncertainty may postpone or abandon their plans to install [various renewable energy applications]."[9]

[8] Energy Sage. *Consumer and installer mindset in the age of COVID-19.* May 2020.

[9] IEA. *Renewable Energy Market Update: Outlook for 2020 and 2021.* May 2020.

2 COVID-19 impact on DER adoption to date

The COVID-19 pandemic has impacted all sectors of the economy, including the DER market. This section begins with an overview of the state of DER adoption across the United States ("US") and Canada prior to the onset of the pandemic, then explores the extent of the decline in residential and non-residential installations in 2020 due primarily to shutdown measures. Also presented are the major drivers of DER adoption cited by both households and businesses in the region, namely a desire for:

- **cost savings** or a reduction in electricity bills;
- the ability to reap **environmental benefits**;
- better supply **reliability** or resiliency;
- greater **independence** through self-supply; and
- the ability to take advantage of **government incentives**.

2.1 Current state of DER adoption

While there is no universal definition for the term DER, the IESO uses the following as a working definition: "a distributed energy resource is a resource that: (1) is directly connected to the distribution system, or indirectly connected to the distribution system behind a customer's meter; and (2) generates energy, stores energy, or controls load."[10] As such, "DERs can include solar panels, combined heat and power plants, electricity storage, small natural gas-fueled generators, electric vehicles and controllable loads" and "are typically smaller in scale than the traditional generation facilities."[11]

The state of DER installation to date varies widely across the US and Canada but has been primarily driven by state- and provincial-level policies, as well as cost declines for certain technologies.

In the US, DER capacity reached nearly 28,000 MW in 2019 across all customer classes (or 2% of 2019 existing nameplate capacity),[12] 87% of which was attributable to solar photovoltaic ("PV") installations. Notably, while the data used for this analysis reports capacity for distribution-connected generation and electricity storage, it does not capture other aspects included in the DER definition (namely electric vehicle ("EV") charging load, demand response, or energy efficiency). Nonetheless, this deployment effort has been led for the most part by states such as California and New York, which have implemented enabling state-level policies:

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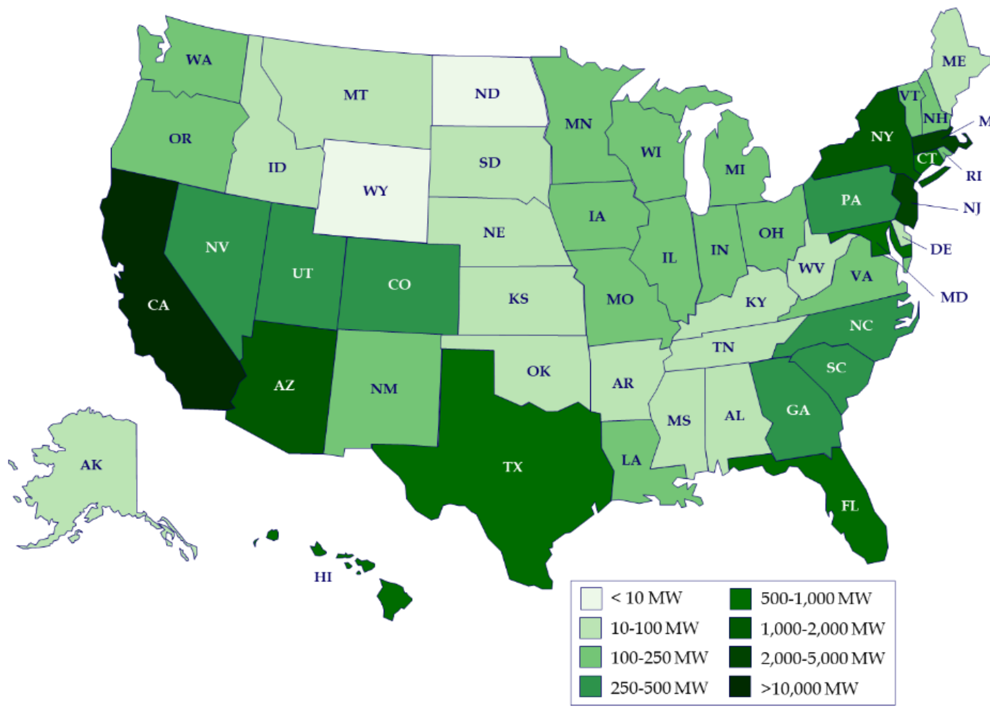
[10] IESO. *Innovation and Sector Evolution White Paper Series – Exploring Expanded Distributed Energy Resource Participation in the IESO Administered Markets.* October 24, 2019.

[11] IESO. *Distributed Energy Resources.*

[12] US EIA. *Existing Nameplate and Net Summer Capacity by Energy Source, Producer Type and State (EIA-860).* 2019.

- **California** leads the US in terms of DER capacity, with over 10,000 MW installed as of 2019 (see the heat map in Figure 2) – representing 13% of 2019 existing nameplate capacity in California.[13] This growth is expected to continue amid policies such as the requirement for solar panels to be installed on all new homes in the state;[14] and
- **New York** reached nearly 2,000 MW of installed DER capacity by 2019 (or 4% of 2019 existing nameplate capacity in New York),[15] with future growth likely to be driven by its target of installing 6,000 MW of distributed solar energy capacity by 2025[16] (or nearly 20% of the state's peak demand).[17]

Figure 2. Heat map of DER installation levels in the US (2019)



Note: The US Energy Information Administration's ("EIA") 'net metering' dataset includes solar PV, storage, wind, and other. The 'non net metering' dataset consists of distributed generators with less than 1 MW of capacity, including solar PV, storage, wind, hydro, fuel cells, internal combustion, combustion turbine, steam, and other. Neither dataset includes data for EV charging load, demand response, or energy efficiency. While the 'net metering' dataset includes customer-owned resources, the 'non net metering' dataset includes resources that may be either customer-owned or utility-owned.

Source: US EIA. *Annual Electric Power Industry Report, Form EIA-861 detailed data files.* October 6, 2020.

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[13] Ibid.

[14] Greentech Media. *5 States Blazing the Trail for Integrating Distributed Energy Resources.* September 9, 2019.

[15] US EIA. *Existing Nameplate and Net Summer Capacity by Energy Source, Producer Type and State (EIA-860).* 2019.

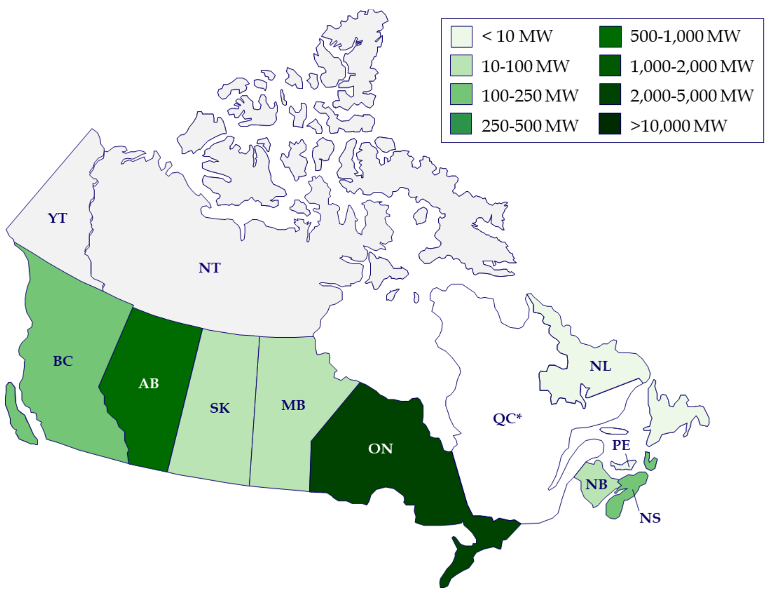
[16] NY State Senate. *Senate Bill S6599.* June 18, 2019.

[17] NYISO estimates that baseline summer peak demand will reach 31,711 MW by 2025. (Source: NYISO. *2020 Load & Capacity Data Report.* April 10, 2020)

In Canada, data on DER installation levels across provinces is most consistently reported for customer-owned, distribution-connected generation resources only. Figure 3 presents a heat map of this capacity, which notably excludes storage systems, EVs, and controllable loads (i.e., demand response) from the IESO's definition of DERs. Thus, while this data does not capture all types of DERs, it does provide an indication of general trends in DER adoption rates, which are highest in Ontario and Alberta.

In Ontario, distribution-embedded resources totaled over 3,500 MW of contracted capacity as of Q2 2020 (or 8% of current installed capacity).[18, 19] Figure 4 breaks down this capacity by fuel type and shows that 61% of generation resources were attributable to solar installations. In comparison, distribution-connected generation resources in Alberta reached approximately 625 MW as of April 2020 (or 4% of total net installed capacity as of 2019).[20, 21]

Figure 3. Heat map of DER installation levels in Canada



* Data for Quebec is unavailable. As noted by the Canadian Energy Research Institute, "[t]o the best of our knowledge, the total installed generating capacity that has resulted from the Net-Metering program is not reported publicly."

Note: Due to limited data availability, the map includes capacity from customer-owned, distribution-connected generation resources only. It does not capture storage, EV charging load, demand response, or energy efficiency.

Sources: CERI. *Opportunities and Challenges for Distributed Electricity Generation in Canada.* July 2020; Alberta Electric System Operator. *AESO DER Roadmap.* June 2020; IESO. *A Progress Report on Contracted Electricity Supply.* Q2 2020; NB Power. *Embedded Generation*; Maritime Electric. *2020 Integrated System Plan.* September 30, 2020; Newfoundland and Labrador Hydro. *Net Metering Program Annual Report.* March 27, 2020.

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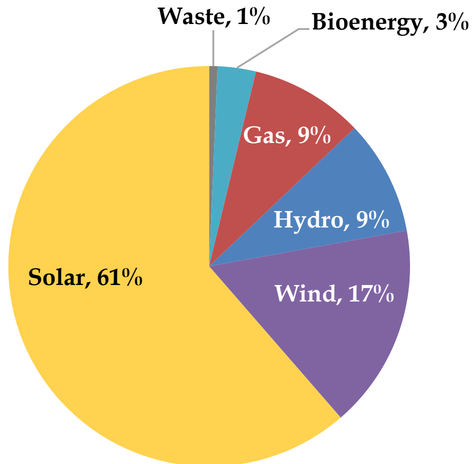
18 IESO. *A Progress Report on Contracted Electricity Supply.* Q2 2020.

19 IESO. *Ontario's Energy Capacity.*

20 Alberta Electric System Operator. *AESO DER Roadmap.* June 2020.

21 Alberta Utilities Commission. *Alberta Electric Energy Net Installed Capacity (MCR MW) by Resource.*

Figure 4. Distribution-connected contracted capacity in Ontario by fuel type (Q2 2020)



Source: IESO. *A Progress Report on Contracted Electricity Supply.* Q2 2020.

2.2 Drivers of DER adoption

Households and businesses tend to share commonalities in their reasons or motivations for investing in DERs, although the ranking or relative importance of each driver typically differs among the two groups. To get a sense of the most common drivers of DER adoption, LEI reviewed surveys relying directly on customer feedback, prioritizing studies conducted among North American households and businesses.[22] The findings of these surveys are aggregated in the subsections below, differentiated by customer class, along with summaries of the details of each study included in the analyses. Generally, the most common drivers of DER adoption fall into the following categories:

- a desire for **cost savings** or a reduction in electricity bills;
- the ability to reap **environmental benefits** from installing renewables, or to meet environmental or sustainability goals (for businesses);
- to achieve better supply **reliability** or resiliency and avoid supply interruptions;
- a desire for greater **independence** through self-supply; and
- to take advantage of **government incentives** (such as tax incentives or rebates to encourage DER adoption).

[22] Notably, surveys on DER investment drivers among the Canadian population were very limited in the literature reviewed (1 of 9 surveys included in the analysis). The textboxes in Section 2.2.1 (household surveys) and Section 2.2.2 (business surveys) detail the geographies covered in each of the surveys included in the analysis, which consisted primarily of the US (7 of 9 surveys) and European countries (3 of 9 surveys). Generally, investment motivations and attitudes are expected to be consistent between these geographies and Canada, given economic and cultural similarities. However, LEI discusses any exceptions or differences worth noting specific to the Ontario context in Section 3.

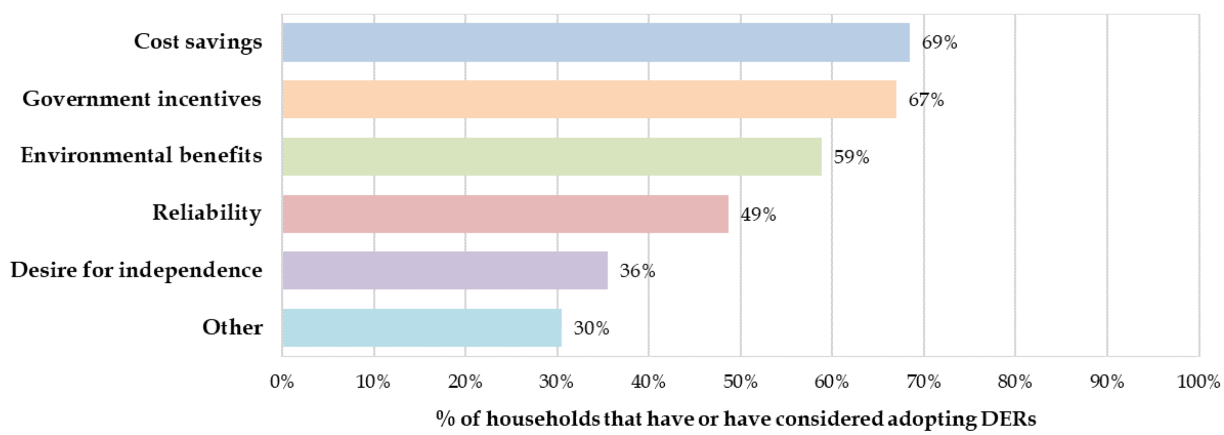
2.2.1 Residential customers

Among households that have installed or have considered adopting DERs, 69% on average (across the five household surveys reviewed) cited **cost savings** as a major driving force. Respondents agreed with statements such as *"to save money on utility bills"* or *"protection from rising electricity prices in the future"* as reasons motivating their investments. 67% of households cited **government incentives** as a major driving force, although this was found in only one of the surveys reviewed (and was specifically related to the US' solar investment tax credit ("ITC")). 59% of households cited **environmental benefits**, agreeing with statements such as *"to help the environment"* or *"reducing environmental impact."* 49% of households cited **reliability**, agreeing with statements such as *"solar power may help ensure I have electricity in the event of a power outage."* Finally, 36% of households cited a **desire for independence** as a major driving force.

Figure 5 illustrates the ranking of reasons for DER adoption among the five household surveys reviewed. Notably, the 'Other' category relates to reasons that were cited less often by respondents, including *"being able to use a promising new technology," "setting a positive example for others in my community,"* and *"adding to my home's market value."*

The textbox provides details of each of the household surveys included in the analysis. Generally, surveys tended to focus on rooftop solar PV adoption, as this is the most common type of DER installed among residential customers, although opinions on storage were also covered in one of the surveys reviewed.

Figure 5. Top reasons for DER adoption among households



Sources: See textbox for details.

Summary of household surveys

The analysis incorporates the findings from the following household surveys:

1. **Pew Research Center:** a self-administered web survey conducted in October 2019 of 3,627 adults in the US (sample was nationally representative and randomly selected). Presented the reasons for considering solar at home based only on responses from a subset of homeowners who have already installed or have given serious thought to installing solar panels;
2. **National Renewable Energy Laboratory ("NREL"):** a survey conducted between June 2014 and April 2015 of 3,600 single-family, owner-occupied households across four US states (Arizona, California, New Jersey, and New York). Presented the "extremely important" motivations for considering solar PV cited by a subset of households that have adopted solar;
3. **IBM Institute for Business Value:** a 2016 survey of more than 41,000 consumers across six countries (the US, United Kingdom ("UK"), Germany, Italy, Spain, and Japan). Reported the most-sought benefits from solar energy sources;
4. **Deloitte Insights:** an online survey conducted in February 2019 of 1,500 US households (sample was demographically balanced), with responses taken from the decision-maker of each household in terms of utility services. Reported the drivers of interest in solar panels among those considering the installation of solar panels on their primary residence; and
5. **EnergySage:** an analysis of 20 million transaction-level data points collected from July 2019 through June 2020. Presented the reasons for interest in storage based on responses from a subset of homeowners that requested an energy storage solution quote through the EnergySage website.

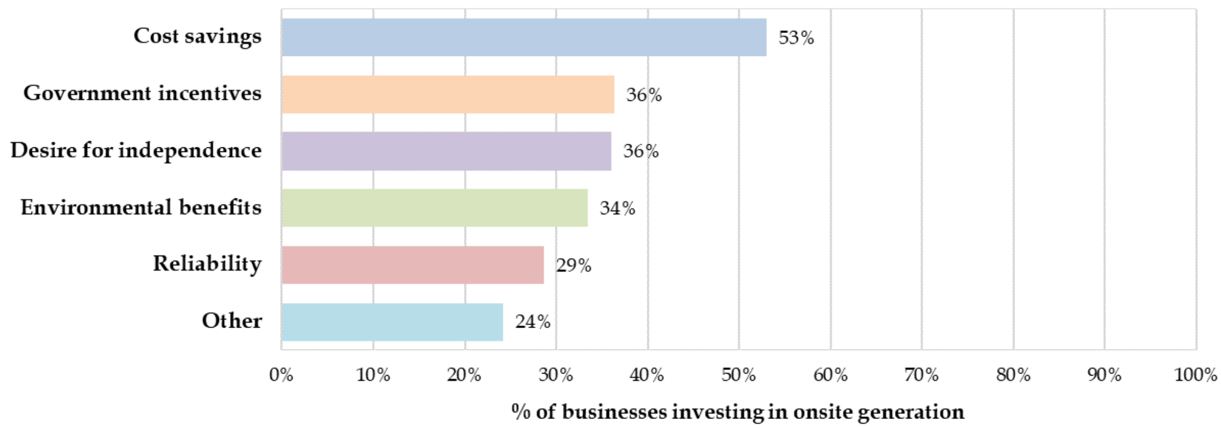
Sources: Pew Research Center. *More U.S. homeowners say they are considering home solar panels.* December 2019; NREL. *A Non-Modeling Exploration of Residential Solar PV Adoption and Non-Adoption.* September 2017; IBM. *The Sun Shines on Solar.* February 2017; Deloitte Insights. *Deloitte Resources 2019 Study.* 2019; EnergySage. *Intel Report.* October 2020.

2.2.2 Commercial and industrial customers

Among businesses that have invested in onsite generation, 53% on average (across the four surveys reviewed) cited **cost savings** as a major driving force. Respondents agreed with statements such as *"price certainty"* or *"significantly reduced energy costs"* as reasons motivating their investments. A desire to achieve cost savings was by far the most common determinant reported, with the next drivers being cited by only 36% of businesses: **government incentives** (*"tax or other incentives for renewable fuels"*) and a **desire for independence** (*"to reduce my reliance on electricity providers"*). Finally, 29% of businesses cited **reliability** as a driver for the decision to invest in onsite generation, agreeing with statements such as *"improved resilience against supply interruption."*

Figure 6 illustrates this ranking of reasons for investments in onsite generation among the four business surveys reviewed (see the textbox for further details of the surveys included in the analysis). Notably, the 'Other' category relates to reasons that were cited less often by respondents, including *"diversification of energy supply," "improved company reputation,"* and *"opportunity to sell excess power into the grid."*

Figure 6. Top reasons for DER adoption among businesses



Sources: See textbox for details.

Summary of business surveys

The analysis incorporates the findings from the following business surveys:

1. **Deloitte Insights:** an online survey conducted in February 2020 of 600 US companies, each with more than 250 employees. Respondents were the decision-makers at each business responsible for energy management practices, reporting on their reasons for investing in onsite generation. Companies included in the survey covered the following sectors: consumer products, industrial products, financial services, health care, and technology, media, and telecommunications;
2. **Centrica Business Solutions:** a 2017 survey of over 1,000 companies, each with 100 or more employees. 35% of respondents were from the US and Canada, with the remaining companies based in the UK (20%), Germany (20%), Italy (20%), and Ireland (5%). Reported the benefits of investing in advanced energy solutions (including energy efficient devices, onsite production, storage). Companies covered the following industries: manufacturing (30%), healthcare (18%), retail (18%), education (16%), property (12%), and travel (6%);
3. **The Economist Intelligence Unit:** a survey conducted over April-May 2018 of 450 UK businesses. Respondents were senior executives with familiarity of their companies' energy strategies, reporting on their reasons for investing in onsite generation. The survey focused exclusively on companies from energy-intensive industries, namely manufacturing, transport and logistics, hospitality, and retail; and

continued…

4. **Ausgrid:** an online survey conducted over August-November 2017 of 617 Australian businesses. Respondents were the decision-makers at each business for energy investments, reporting on the most important motivating factor for purchasing solar. Businesses spanned across the following industries: manufacturing (16%), other services (12%), retail trade (11%), wholesale trade (7%), accommodation and food services (7%), health care and social assistance (7%), education and training (6%), arts and recreational services (6%), construction (5%), and agriculture, forestry and fishing (3%).

Sources: Deloitte Insights. *Deloitte Resources 2020 Study*. May 2020; Centrica Business Solutions. *The Energy Advantage Report*. June 2018; The Economist Intelligence Unit. *Distributed Generation: A Brighter Future?* 2018; Ausgrid. *Business Customer Survey Results.* February 2018.

2.3 COVID-19 impact on DER installation levels in 2020

The COVID-19 pandemic has had an unprecedented impact on all sectors of the economy, including on the level of DER installations completed this year. Due to limited data availability, LEI begins this analysis by presenting data on solar and DER installations in the US, which provides a general sense of the extent of COVID-19's impact on the DER market in the region. LEI then covers data that is available for Ontario specifically.

While focusing on solar installations does not capture COVID-19's impact on all types of DERs, it is nonetheless a useful indicator as solar is the primary form of DER adoption in both the US and Canada (as discussed in Section 2.1). According to the US Solar Energy Industries Association ("SEIA"), residential solar installations in the US declined 23% in Q2 2020 from Q1 (down 7% year-over-year ("YoY")), "due largely to shelter-in-place orders during the initial stages of the COVID-19 pandemic that imposed restrictions on selling and installing residential solar."[23] Notably, on a state-by-state level, residential solar installations declined by between 25% to 75% in Q2 2020 relative to Q1, with the most pronounced declines in "markets that imposed stricter shelter-in place guidelines."[24] As for non-residential[25] solar installations, these declined 12% in Q2 2020 relative to the previous quarter (down 19% YoY) due to project delays caused by the pandemic. SEIA projects that by the end of 2020, US residential solar installations will be flat on 2019 levels,[26] while non-residential installations will decline by 23% from 2019 volumes because of significant project delays.[27]

In terms of the pandemic's impact on DER installation levels more generally (including energy storage, EV infrastructure, fuel-based generation, load management, as well as solar

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[23] SEIA and Wood Mackenzie. *U.S. Solar Market Insight: Executive Summary Q3 2020.* September 2020.

[24] Ibid.

[25] Includes commercial, government, nonprofit, and community solar.

[26] SEIA expects an uptick in residential solar installations in the latter half of 2020 to be driven by the move of residential installers to online sales/permitting practices (reducing the need for in-person contact) and rollbacks of COVID-related restrictions in various states.

[27] SEIA and Wood Mackenzie. *U.S. Solar Market Insight: Executive Summary Q3 2020.* September 2020.

deployments), a slightly older forecast (July 2020, versus September 2020 for the SEIA solar report) projects that 2020 DER installations in the US will decline by 61% YoY.[28]

A similar decline in DER installations was experienced in Ontario this year, according to estimates provided by a sample of Ontario DER suppliers (see the textbox below).

DER supplier survey: Implication of COVID-19 on Ontario's DER market in 2020

In November 2020, LEI conducted a voluntary phone survey of Ontario DER suppliers to get a sense of the impact COVID-19 has had on sales in 2020. LEI reached out to 35 companies and received 11 responses, for a response rate of around 31%. Of the responses received, suppliers estimated that DER sales in Ontario declined by 33% on average in 2020, relative to expectations prior to the pandemic (with the largest reported decline of 60%).

Among respondents that offered additional commentary, the most severe contraction in sales was said to have occurred over the March-June 2020 period. This contraction was a result of numerous factors, including a hesitance among customers to commit to projects due primarily to financial constraints, significant project delays (e.g., one supplier stated that projects that were set to be constructed in Spring 2020 have not yet been completed), and a limit on door-to-door sales efforts due to physical distancing requirements.

Section 3.5 provides further details on the survey conducted, including a review of responses received for all questions asked.

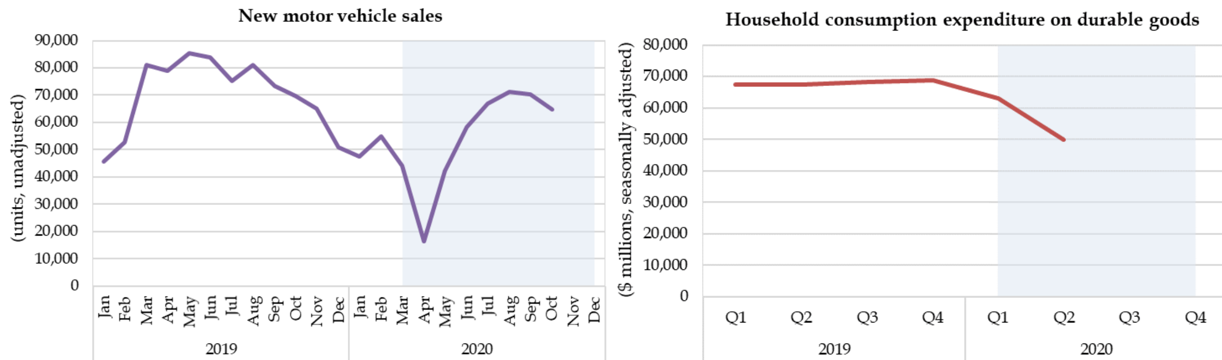
DERs for small customers can be considered consumer durables. As another measure of the pandemic's impact in Ontario specifically, LEI includes an analysis of consumer purchases to indicate how customer spending behavior has changed since the onset of COVID-19. Figure 7 tracks purchases of consumer durables, such as new motor vehicle sales and durable goods in Ontario since 2019, with the period since the onset of the pandemic shaded in blue. As demonstrated in the chart to the left, new motor vehicle sales contracted sharply in April 2020, declining by 79% YoY. By October 2020 (i.e., the most recent month for which data is available), new motor vehicle sales improved markedly, but were still 7% below levels reached in the same month in 2019.

As for consumer durables (see the chart to the right), purchases declined since the beginning of the year, with sales in Q2 2020 (i.e., the most recent quarter for which data is available) down 26% YoY. Although more recent data for consumer durables is not currently available, media reports suggest an improvement in sales in the latter half of the year, similar to the uptick seen in the level of new motor vehicles sales. A news article from October 2020 noted: "[r]etailers say a

[28] Wood Mackenzie. *United States Distributed Energy Resources Outlook.* July 2020.

combination of home renovations, new construction, discounts for energy-efficient appliances and pent-up demand following store closures last spring have led to record sales."[29]

Figure 7. Consumer purchases of vehicles and durable goods in Ontario (2019-2020)



Note: Q3 2020 data (for chart to the right) is scheduled to be released by January 15, 2021.

Sources: Statistics Canada. *New motor vehicle sales (Table 20-10-0001-01)*; Ontario Ministry of Finance. *Ontario Economic Accounts*. Q2 2020.

[29] CTV News. *'Whoever has stock right now is king:' Surging appliance sales cause shortages.* October 6, 2020.

3 Outlook for future DER adoption

Although the impact of COVID-19 on future DER adoption is uncertain, and is ultimately dependent on numerous factors, the following section presents an outlook for deployment based on the five DER drivers introduced in Section 2.2, namely:

- cost savings;
- environmental benefits;
- reliability;
- desire for independence; and
- government incentives.

LEI covers each of these drivers in the subsections that follow, discussing how COVID-19 may have impacted each of them, and in turn how changes in those drivers may impact the pace of DER installation going forward. The discussion focuses primarily on cost savings (Section 3.1) and government incentives (Section 3.4), as these are the most relevant drivers of DER adoption in the Ontario context. Figure 8 summarizes the findings of this analysis, breaking down the directional impact each driver is expected to have on future DER deployment, both by **customer type** (residential versus commercial and industrial), and **duration** (short-term impacts (2021-2022) versus longer-term impacts (2022-2025)).

However, it is important to note that each driver is weighted differently,[30] with cost savings carrying the most weight among both residential and C&I customers (as observed by the household and business surveys discussed in Section 2.2). Thus, while the table indicates that some drivers may place sustained upward pressure on customer interest in DERs (as is the case for reliability and a desire for independence), it does not suggest that actual DER adoption rates will increase, as these drivers may be further down on the customer's priority list.

Overall, observers generally agree that DER deployment levels may be muted in the short-term forward period. In its renewables outlook for 2020-2021, the IEA stated that "households and small businesses facing financial shocks and economic uncertainty may postpone or abandon their plans to install [various renewable energy applications]."[31] Furthermore, according to a DER outlook focused on the US market, "[l]ower economic activity and higher unemployment will decrease both consumers' disposable income and business investment in the early 2020s, reducing investment in non-critical purchases such as customer-owned or -leased energy infrastructure."[32] This is expected to mean that "the DER market will not exceed its 2019 pre-Coronavirus high until 2024."[33]

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30 In addition, different customers will weigh each driver differently – see Section 2.2.

31 IEA. *Renewable Energy Market Update: Outlook for 2020 and 2021.* May 2020.

32 Wood Mackenzie. *United States Distributed Energy Resources Outlook.* July 2020.

33 Ibid.

Figure 8. Summary of COVID-19 impact on future DER deployment

		Short-term COVID-19 impact (2021-2022)		Longer-term COVID-19 impact (2022-2025)	
		Residential	C&I	Residential	C&I
DER adoption drivers	Cost savings	↓	↓	=	=
	Environmental attributes	↓	↓	=	=
	Reliability	↑	↑	↑	↑
	Desire for independence	↑	↑	↑	↑
	Government incentives	=	↓	=	↓

↑ Upward pressure on DER deployment ↓ Downward pressure on DER deployment = No change to DER deployment

Note: See Section 3.1 through 3.4 for further details.

3.1 Driver 1: cost savings and project economics

Among both residential and commercial consumers, cost savings are the most cited reason for investing in DERs – as shown previously in Figure 5 and Figure 6. LEI considers how the economic crisis resulting from COVID-19, referred to as the Great Lockdown, may impact the perception of the cost savings offered by DERs, and the outlook for investment among these customer groups going forward. As discussed below, LEI believes that the decline in business and consumer confidence, and the uptick in precautionary savings introduces financing risk for DER projects. In the short-term, stimulus programs in the US may drive up demand, and subsequently prices of DERs, while policy interventions to cap electricity prices may diminish the project economics and lengthen the payback period. In the longer-term, permanent changes in demand patterns and policy responses due to the pandemic may be mitigated through increased adoption of technological solutions.

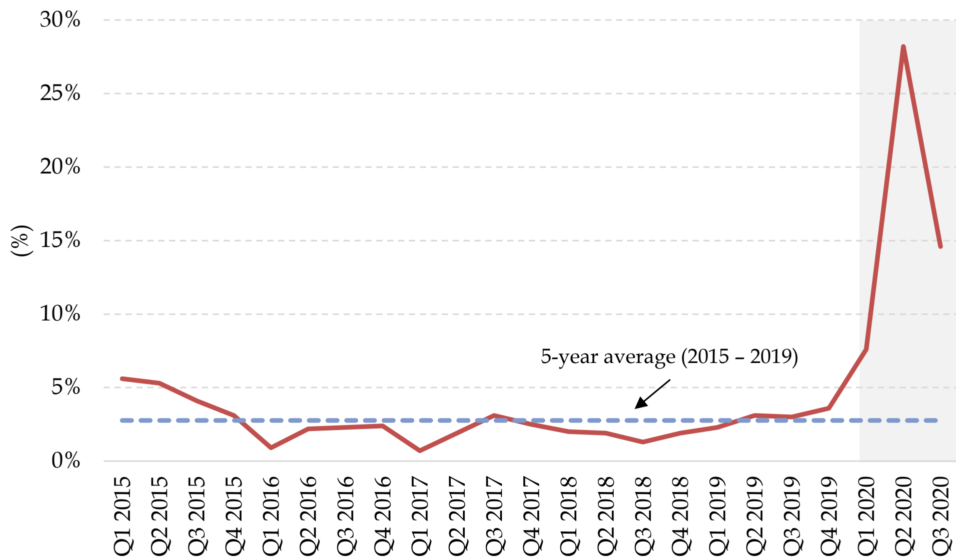
The pandemic has resulted in all customer groups re-evaluating spending and savings patterns – for instance, through an observed sharp decline in business and consumer confidence, and an increase in the savings rate. The most recent quarterly Business Outlook Survey ("BOS") by the Bank of Canada (Q3 2020) indicates that although business sentiment has recovered slightly in the Fall, it remains below historic levels.[34] When asked about plans to invest in machinery and

[34] The BOS is a quarterly survey summarizing the interviews conducted by the Bank's regional offices with the senior management of about 100 firms selected in accordance with the composition of the gross domestic product of Canada's business sector. The BOS indicator is a summary measure that captures common movements from the main BOS questions and is above zero when business confidence is above its historical average. (Source: Bank of Canada. *Business Outlook Survey – Autumn 2020.* October 19, 2020)

equipment over the next 12 months, 34% of firms indicated that they anticipate lower levels relative to the previous 12 months. This is an improvement from the responses received in Q2 2020, where 55% of respondents anticipated lower investments. When asked about credit conditions relative to the previous three months, 16% reported a tightening of terms and conditions in Q3 2020, also down from 42% in the Q2 2020 BOS.[35]

The literature shows that during periods of heightened uncertainty and recessions, households tend to increase their level of savings, referred to as precautionary savings.[36] This was observed starting in Q1 2020, and based on data from Statistics Canada peaked in Q2 2020, with household savings rates rising from 7.6% in the first quarter to 28.2% in the second quarter. Although household savings rates fell in the third quarter to 14.6%, they were still much higher than the five-year average over the 2015 to 2019 timeframe (2.7%). This is shown in Figure 9.[37]

Figure 9. Household savings rate (Q1 2015 – Q3 2020)



Source: Statistics Canada. Table 36-10-0112-01 Current and capital accounts - Households, Canada, quarterly.

Corroborating this data, recent research suggests that Canadian households have accumulated $90 billion in excess cash – i.e., cash beyond the level of deposits that would be expected – as of Q3 2020.[38] Among businesses, excess cash is estimated at $80 billion, but the researchers note that

[35] Ibid.

[36] Mody, Ashoka, et al. "Precautionary Savings in the Great Recession." *IMF Economic Review*, vol. 60, no. 1, 2012, p. 114–138.

[37] Statistics Canada. *Table 36-10-0112-01 Current and capital accounts - Households, Canada, quarterly*.

[38] Tal, Benjamin & Judge Katherine. *Excess Cash.* CIBC Economics. November 17, 2020.

they anticipate little change in the cash levels among businesses as uncertainty over a subsequent wave of the pandemic persists.[39]

It is likely that household consumers will remain uncertain about the future in the short-term, particularly as it pertains to labour income – 39% of business leaders anticipate their firms' level of employment to be higher in the next 12 months, compared to 53% of respondents in Q4 2019.[40] This suggests that savings rates may remain elevated in the short-term, and lead to pent up savings coming into the medium-term as concerns about the pandemic and economic uncertainty subside.

This decline in business and consumer confidence, and the uptick in precautionary savings, has implications for the anticipated pace of DER adoption. The literature provides a framework for understanding the business case for DERs, and an associated payback period.[41] For utilities and system operators, DERs provide an alternative to serve new load growth, and may be cost competitive to additional generation and transmission system upgrades.[42] For consumers, DERs provide an opportunity to avoid peak pricing and, in markets with locational pricing, relative price stability during price spikes.[43] Across all use cases and sets of customers, the desired payback period varies – for example, a survey of 41,000 residential customers in six countries including the US and UK conducted by IBM's Institute for Business Value showed that 65% of respondents expect a payback within five years for their solar installations.[44] For commercial and industrial customers, analysis by researchers at Lawrence Berkeley National Laboratory ("LBNL") estimated that a significant amount of the technical potential for combined heat and power ("CHP") systems in the US has a payback time of less than ten years.[45]

We consider the underlying factors that drive the payback period for DERs and evaluate the potential impact of COVID-19. In the US, NREL estimates a payback period for rooftop solar of 3.5 to 4 years.[46] This estimate is dependent on factors such as existing retail electricity costs and rate design as well as resource availability (solar irradiation), which can widen the range to 7 years.[47] Regions with relatively high average retail prices and good resource will see a shorter

[39] Ibid. p. 4.

[40] Bank of Canada. *Business Outlook Survey – Autumn 2020.* October 19, 2020.

[41] For the purposes of this report, "payback period" refers to the amount of time (in months or years) between initial capital investment and a return of the initial investment.

[42] IESO. *Innovation and Sector Evolution White Paper Series: Non-Wires Alternatives Using Energy and Capacity Markets*. May 2020.

[43] Burger, Scott P., et al. "Why Distributed?: A Critical Review of the Tradeoffs Between Centralized and Decentralized Resources." *IEEE Power and Energy Magazine* 17.2 (2019): 16-24.

[44] IBM Institute for Business Value. *The sun shines on solar: Consciousness, efficiency and the surge in the solar economy.* 2016.

[45] Schwartz, Lisa, et al. "Electricity end uses, energy efficiency, and distributed energy resources baseline: Distributed Energy Resources Chapter." (2017). Lawrence Berkeley National Laboratory.

[46] NREL. *PV FAQs: What is the energy payback for PV?*

[47] Centrica website. *What is the average payback period of a solar PV installation?*

payback. In addition, government incentives and cost will factor into the duration of the payback period. Using solar PV as a reference technology, LEI considers each element of a simple payback period formula and assesses how COVID-19 will impact the outlook going forward for each element specific to Ontario. This is illustrated in Figure 10.

Figure 10. Illustrative payback period formula for DERs

$$T_{payback} = \frac{C_{DER}}{Q_{year} \times P_{AC} \times C_{elec}}$$

Where,

$T_{payback}$ = Payback period (years)

C_{DER} = Capital cost of DER system ($/kW)

Q_{year} = Total output of solar installation (kWh/year)

P_{AC} = System capacity in AC (kW)

C_{elec} = Retail electricity price ($/kWh)

Source: NREL; Kessler, Will. "Comparing energy payback and simple payback period for solar photovoltaic systems." *E3S web of conferences*. Vol. 22. EDP Sciences, 2017.

The potential impact of COVID-19 on each element, differentiated in terms of how it pertains to a potential residential or commercial customer, is as follows:

- **Capital cost of DER system (C_{DER})**: this refers to the unsubsidized cost of the DER system, including the solar array, as well as the balance of system costs. As observed in LEI's COVID-19 Impact Study, there is a potential for targeted stimulus programs in the US to drive up the cost of DERs. Under a scenario where increased US demand for DER technologies drives up the price, this component may increase, and potentially increase the payback period. Under the status quo, current cost declines could be sustained.

  LEI also considers affordability of DER systems under this component, and anticipates that the income effect will be observed in this element. Specifically, in a lower interest rate environment following actions by the Bank of Canada and other central banks in response to COVID-19, customers with greater access to credit and savings may be better placed to invest in DERs. However, as noted prior, Canadian businesses continue to see tightening of credit terms, and consumers are anticipated to maintain their cash positions due to labor uncertainty.[48]

[48] Tal, Benjamin & Judge Katherine. *Excess Cash.* CIBC Economics. November 17, 2020.

- **Total output of installation (Q_{year})**: this element is not expected to be impacted by COVID-19, as it is dependent on the technology. However, it is anticipated that in the long-term, DER configurations that feature storage and/or load following technologies may change the output profile and improve the economics of the project, and ultimately shorten the payback period. Recent research is described in the textbox on the following page.
- **System capacity (P_{AC}):** consistent with existing customer preferences and use cases, the system capacity will be impacted by COVID-19 insofar as behaviour changes force long-term changes in DER size. For instance, a permanent shift to work-from-home arrangements that increases the residential load profile may make a larger solar PV configuration more economic, as the customer's usage increasingly coincides with the load profile of solar PV. Conversely, for small commercial customers anticipating long-term shifts in energy usage patterns, smaller DER configurations may now be more economic. IESO analysis of the first wave of economic restrictions in the Spring,[49] and LEI's assessment of the potential for long-term demand pattern shifts,[50] suggests that there is evidence for potential changes in usage behaviours.
- **Retail electricity price (C_{elec}):** in general, a higher retail price, and therefore avoided cost of the DER, will mean shorter payback periods. This means a higher all-in price, comprising both volumetric and demand charges, will improve the economics of a DER installation. However, in Ontario, in response to COVID-19, the government has mandated temporary changes to rate design, most notably between March and November for residential and commercial customers[51] and beginning January 1, 2021 for larger customers.[52]

  Between March and November, the Government of Ontario established a fixed electricity price for customers on time-of-use ("TOU") prices – corresponding to approximately 5 million customers. The fixed price was set at 10.1¢/kWh between March and May 31, 2020 and at 12.8¢/kWh between June 1 and October 31, 2020. These prices – set below the previous peak price of 20.8¢/kWh and mid-peak of 14.4¢/kWh – may have diminished the economics of DER systems for customers seeking to avoid the peak period, particularly the morning peak of 7 a.m. to 11 a.m. This measure was temporary, however, and a long-term impact to DER deployment is not anticipated as a result. For customers in service territories with significant demand charges, these measures may have had a limited impact as DERs allow avoidance of these costs, even with lower volumetric costs resulting from these changes.

  More recently, the Government of Ontario announced a measure in its 2020 Budget to shifts a portion of non-hydro renewable contract costs that were previously funded through the Global Adjustment charge to taxpayers. Under this measure, the government

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[49] IESO. *An overview of COVID-19 impacts on electricity system operations.* Webinar. April 23, 2020.

[50] See Section 5 of LEI's separate report titled "COVID-19 Impact Study."

[51] Ontario Government. *O. Reg. 80/20: Electricity Price for RPP Consumers.* March 24, 2020 (Revoked November 1, 2020).

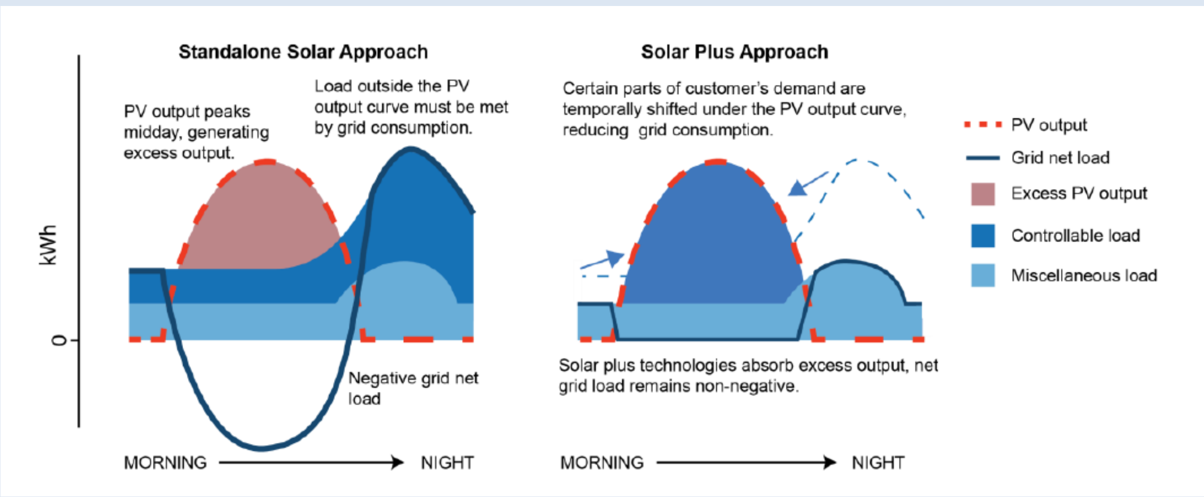
[52] Ontario Ministry of Finance. *Ontario's Action Plan: 2020 Ontario Budget.* Queen's Printer for Ontario, 2020.

seeks to reduce all-in costs among large customers (Class A and non-Regulated Price Plan Class B customers). This measure, anticipated to begin in January 2021, is discussed in greater detail in Section 4.4.

Going forward, we anticipate that the long-term impact of COVID-19, including any associated changes in demand patterns and policy responses, may be mitigated through increased adoption of technological solutions. These include advanced metering infrastructure, and load control technologies implemented by DER owners that seek to optimize their consumption to their installations.

Optimizing DERs through load control solutions

For DER customers, utility actions to minimize the impact of DERs on the system, or other rate reforms, can have a meaningful impact on project economics. Researchers at NREL demonstrated that solar PV coupled with load control technologies for "deferrable" appliances and devices can improve the economics of a solar installation. The objective of this approach, referred to as "solar plus," allows the customer to increase PV self-use, perform grid arbitrage in the case of time-of-use customers, as well as reduce demand charges. The figure below demonstrates their analysis and shows the potential impact of the "solar plus" approach.



The researchers model a representative single family detached home, with controllable loads for electric water heating, laundry, and includes a smart air conditioner. The model demonstrates that the solar plus system under a time-of-use rate design framework results in a 28% greater net present value ("NPV") than a standalone solar PV system (assuming a 6.2% discount rate and 9 a.m. to 2 p.m. peak). Overall, the solar plus system mitigates the impact of declining net metering rates, time-of-use changes and increases self-use.

Source: O'Shaughnessy, Eric, et al. "Solar plus: Optimization of distributed solar PV through battery storage and dispatchable load in residential buildings." *Applied Energy* 213 (2018): 11-21.

In conclusion, the impact of COVID-19 on cost savings and project economics for DERs is likely to be felt most in the short-term, as regulators and policymakers seek tools to reduce rates, and economic uncertainty tightens credit for investment. In the longer-term, as business confidence returns to normal, pent up savings may allow for additional investment, particularly if interest rate levels remain low. Actions by policymakers to reduce prices and reduction in demand may not be meaningful for DER investments as improvements in technology and load controllable technologies improve project economics, irrespective of long-term demand patterns.

3.2 Driver 2: environmental attributes

Willingness to pay ("WTP") is defined as "the maximum amount that an individual indicates that he or she is willing to pay for a good or service."[53] In the energy space, this has often been assessed in terms of the WTP for the environmental benefits offered by clean or renewable energy. In many cases, studies have found that income has a positive effect on these WTP valuations, with this finding having been replicated in the US, as well as Europe and Asia.[54] However, it should be noted that some studies have found the correlation between income and WTP to be insignificant.[55]

Although findings from WTP studies are not unanimous, looking at actual DER installation levels suggests a link between WTP and income does exist. For example, in a study focused on US residential solar installations, it was found that "in 2018, households earning more than USD$200,000 per year were about [four] times more likely to adopt solar than households earning less than USD$50,000 per year."[56] This suggests that as incomes decrease, willingness as well as ability to pay for renewable energy decreases too.

In the context of the COVID-19 pandemic, these findings indicate that households and businesses that have experienced financial strain as a result of the pandemic (i.e., declining

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[53] USAID. *How does willingness to pay influence mini-grid economics?*

[54] *See for example:*

1. Energy Economics. *Consumers' willingness to pay for renewable and nuclear energy: A comparative analysis between the US and Japan.* June 2015: found among households in four US states (California, Michigan, New York, and Texas), "the higher the income level, the higher the WTP [for renewable and nuclear energy] they exhibit." In Japan, "according to the previous papers, the WTP for renewable energy correlates with consumer income."
2. European Bank for Reconstruction and Development. *Mandatory versus voluntary payment for green electricity.* October 2013: found among UK households that "income has a significant effect, lower income groups are less willing to pay [for supporting renewables] compared to the highest income category."
3. Renewable and Sustainable Energy Reviews. *Assessment of public acceptance and willingness to pay for renewable energy sources in Crete.* November 2009: found among households in Crete that "[r]espondents with high family incomes are willing to pay on average more [for renewable energy sources] than those of low incomes. This is an expected finding in [contingent valuation] studies and is also reported by energy related studies."

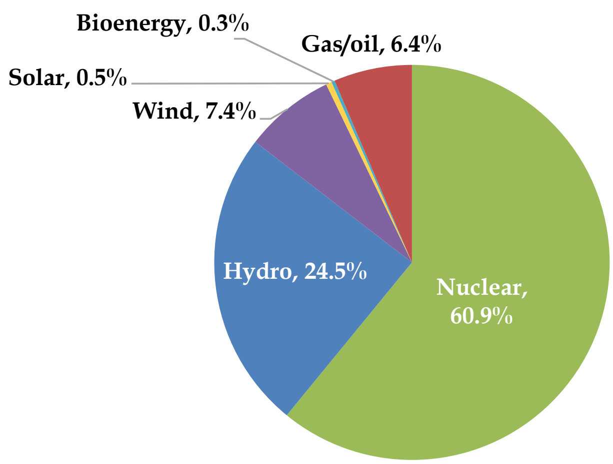
[55] *See for example* Yale Program on Climate Change Communication. *Who is willing to pay more for renewable energy?* July 16, 2019: found that among US respondents, "[p]eople who earn more money are *not* more likely to be willing to pay more for renewable energy, indicating that willingness to pay more is not primarily a question of the ability to afford it."

[56] Nature Energy. *The impact of policies and business models on income equity in rooftop solar adoption.* November 9, 2020.

income/revenues) may demonstrate a decline in their WTP for environmental benefits. This could translate to downward pressure on renewable DER investments for the time being. The impact on DER deployment in the longer-term will ultimately depend on the pace of economic recovery, which will dictate how long households and businesses experience a decline in their income and hence a reduced WTP for environmental benefits.

However, it should be noted that in the Ontario context, electricity supply already comprises of mostly non-emitting generation resources (for example, gas/oil generation resources made up only around 6.4% of 2019 supply, as shown in Figure 11). Given the low-emitting nature of Ontario's supply mix, the pursuit of incremental environmental attributes in Ontario has a very high cost, and as such the WTP for these additional benefits may be muted as compared to other jurisdictions where the electricity fuel mix produces higher emissions. For this reason, it can be argued that environmental attributes are factored into the DER investment decision far less in Ontario than in these other jurisdictions.

Figure 11. Ontario's 2019 electricity generation mix by fuel type (transmission-connected)



Source: IESO. *2019 Year in Review*.

3.3 Drivers 3 and 4: reliability and a desire for independence

The desire for reliability and independence are discussed in tandem, as much of the research on COVID-19's impact on customer preferences for reliability also discusses the pandemic's impact on the desire for independence. For example, in a survey conducted over the March-April 2020 period, 64% of respondents agreed with the statement *"the COVID-19 situation is accelerating my plans to become more energy-resilient."*[57] Respondents comprised of 509 US homeowners that reported actively looking into installing solar prior to the onset of the pandemic. Many homeowners pointed out that they "seek the security and control of having their own backup power supply, especially during uncertain times."[58] This uptick in interest was corroborated by

[57] Energy Sage. *Consumer and installer mindset in the age of COVID-19*. May 2020.

[58] Ibid.

a survey of 118 US solar installers conducted in April 2020. 58% of these installers reported "an increase in consumer interest for batteries as a result of COVID-19."[59]

The rise in interest for DERs driven by a desire for greater reliability and independence seems to be apparent among businesses as well. In an analysis of the outlook for the US DER market amid the uncertainty from the pandemic, it was noted that "confronted with continued threats to operational continuity from major storms, commercial and industrial customers are investigating traditional resilience solutions in addition to natural gas generators and more advanced hybrid DER architecture microgrids."[60]

LEI expects the pandemic's impact on intentions for greater reliability and independence to persist among both residential and C&I customers, as they seem to represent an attitude shift brought on by the pandemic.

3.4 Driver 5: government incentives

As observed in Section 2.1, there is just over 3,500 MW of contracted capacity in Ontario classified as distribution-embedded generation. IESO data shows that these contracts can also be distinguished by their procurement program, revealing that 1,806 MW are Feed-in Tariff ("FIT") contracts, and 825 MW are under the Renewable Energy Standard Offer Program ("RESOP"). The micro Feed-in Tariff ("microFIT") program comprises of over 30,000 contracts, but accounts for only 260 MW of embedded capacity.[61] A summary of these three programs is provided in the textbox below.

Programs contributing to DER contracts

The three largest contract types for DERs in Ontario by capacity are the FIT, RESOP and microFIT, and account for nearly 83% of all capacity, and 99% of all contracts. A brief summary of these programs is provided below:

- **Feed-In Tariff program**: the FIT program was launched in 2009 as one of the programs following the Green Energy Act. All FIT projects had a capacity of more than 10 kW, and were exclusively for renewable energy – wind and solar comprised 60% and 36%, respectively. Under the "Small FIT" size division, for facilities larger than 10 kW but smaller than 0.5 MW, solar comprised 573 MW, or 97% of all contracts in this size;
- **Renewable Energy Standard Offer Program**: the RESOP was launched by the former Ontario Power Authority ("OPA") in 2006, with a target of 1,000 MW in 10 years. Under a Standard Offer contract, small-scale renewables between 1 kW and 10 MW received a 20-year contract through the local distribution companies. The RESOP was replaced by the FIT program by a Ministerial directive in 2009; and *continued…*

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[59] Ibid.

[60] Wood Mackenzie. *United States Distributed Energy Resources Outlook.* July 2020.

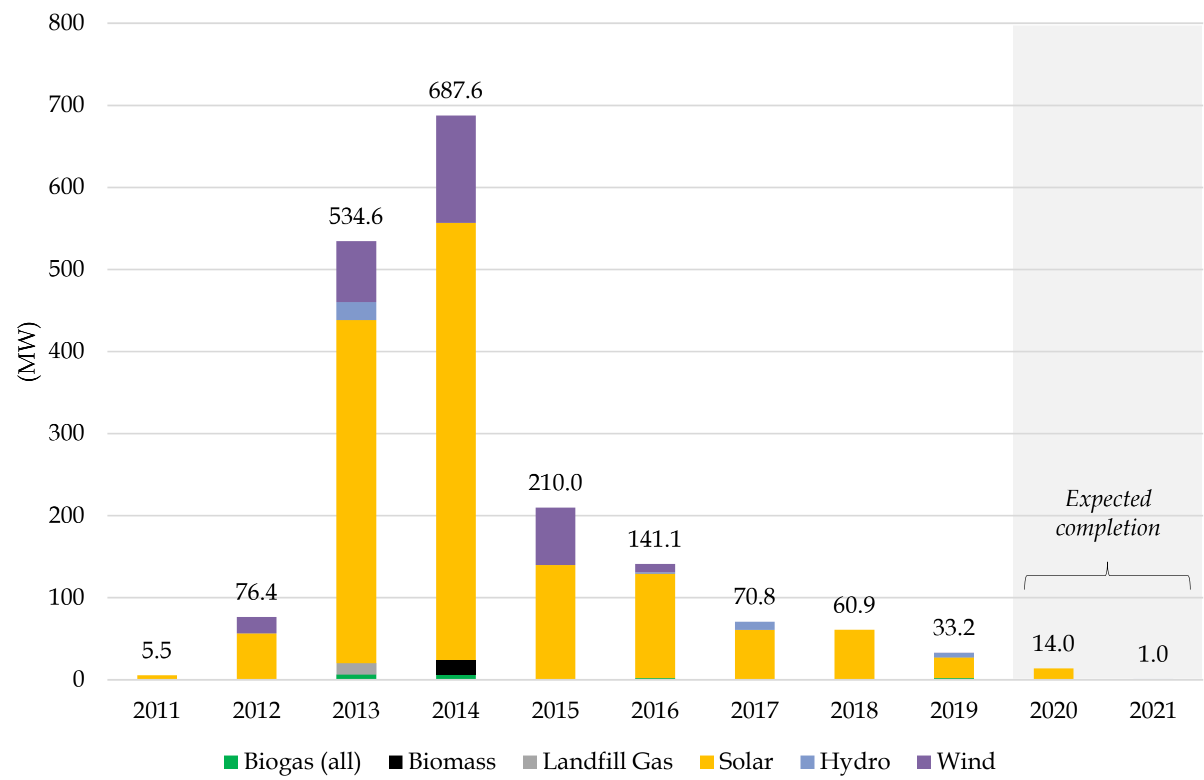
[61] IESO. *A Progress Report on Contracted Electricity Supply.* Q2 2020.

- **microFIT program**: the microFIT program launched in 2009, with the final application window closing in December 2017. Qualifying projects under the program have contracted capacities of 10 kW or less, and have all been categorized as renewable energy sources. IESO data indicates that all but five of the 30,189 contracts awarded under the program were ground-mounted or rooftop solar PV.

Sources: IESO. *A Progress Report on Contracted Electricity Supply*. Q2 2020; IESO website.

The IESO provides data on the active contracts under the FIT program, showing that by 2014, more than 70% of the distribution-connected projects had already reached commercial operation (see Figure 12). The IESO ceased accepting applications under the FIT program in 2016.[62] While similar data was not readily available for the microFIT program, the IESO shows the contracts by price in its quarterly progress report (see Figure 13). This chart suggests a relatively quick growth in the number of projects at the start of the program, followed by some flatlining in growth.

Figure 12. Distribution-connected FIT contracts (2011-2021)



Note: Bars for 2020 and 2021 represent projects with anticipated completion dates in 2020 and 2021, respectively.

Source: IESO. *Active Contracted Generation List*. Data current as of November 12, 2020.

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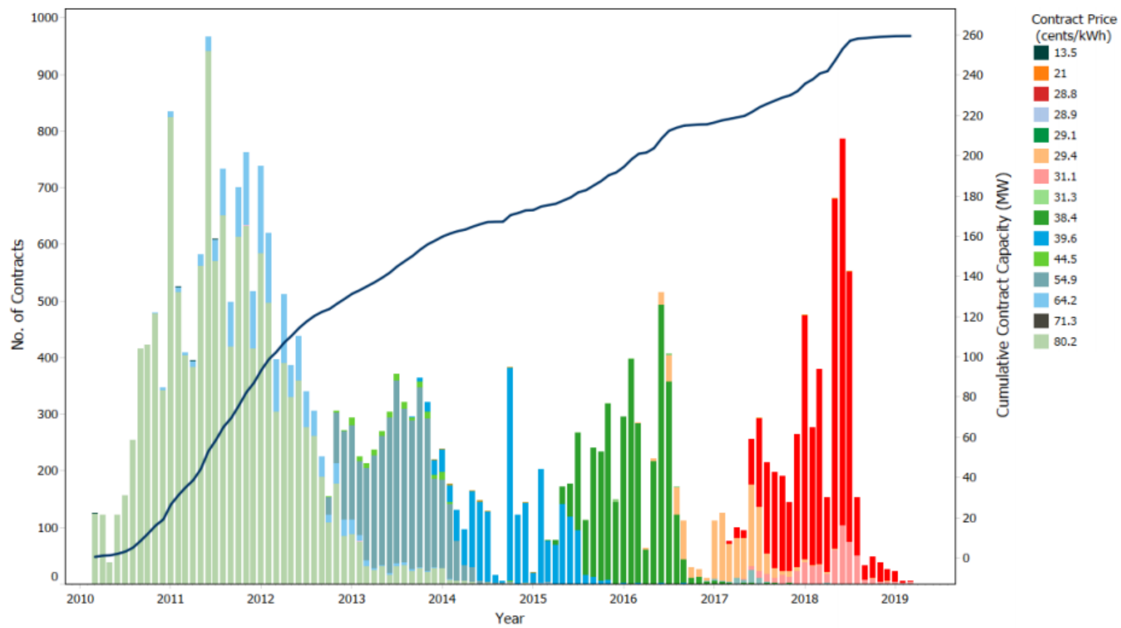
[62] IESO. *Feed-in Tariff Program.*

Figure 13. microFIT contracts by price and capacity growth (2010-2019)



Taken directly from: IESO. *A Progress Report on Contracted Electricity Supply*. Q2 2020.

To further understand the specific customer groups investing in DERs, LEI reviewed publications, comments, and data from industry groups and stakeholders as well as submissions to the OEB under the DER consultation.[63] To date, it is the consensus among stakeholders that economics for DER adoption in Ontario has been largely driven by the FIT and microFIT program, although the ICI also plays a role for certain large consumers.[64] However, given that both the FIT and microFIT programs have ended,[65] these avenues for DER growth are closed.

In contrast, the ICI program is still active, and as such will continue to impact the pace of DER adoption going forward. As discussed in Section 4, the impact of the ICI peak hiatus has led to an effective pause in curtailment activity for many large consumers, although the impact is expected to only last for one year. As also discussed in Section 4, recently announced measures to shift a portion of GA costs to the tax base could have longer-term implications, and may slow DER adoption among ICI participants, as in certain instances it may weaken the business case for investing in active curtailment to avoid high GA charges.

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[63] OEB. *EB-2018-0288. Responding to Distributed Energy Resources (DERs).* Launched March 15, 2019.

[64] *See for example* Canadian Manufacturers & Exporters. *Canadian Manufacturers & Exporters Submission. Consultation on the Utility Remuneration and Responding to Distributed Energy Resources (EB-2018-0287 & EB-2018-0288).* October 2019.

[65] The final FIT application period was held in 2016, and the final microFIT application period was held in 2017. In December 2018, Ontario's Green Energy Act (which established the FIT and microFIT programs) was repealed.

3.5 Survey of Ontario DER suppliers

To understand the impact the COVID-19 pandemic has had on Ontario's DER market in 2020 and going forward, LEI canvassed Ontario DER suppliers to garner their perceptions. Through a voluntary phone survey conducted in November 2020, LEI reached out to 35 Ontario-based DER retailers, installers, equipment manufacturers and suppliers across the solar, storage, EV, CHP, and microgrid markets. LEI received responses from 11 companies, representing a response rate of around 31%. Of the 11 responses received, 64% of companies reported serving primarily commercial or industrial customers (i.e., these customers account for more than 50% of their customer base), while 18% reported serving mostly residential customers. The remaining 18% of respondents did not provide a customer breakdown.

The survey consisted of five questions designed to gain a better understanding of the implications of the pandemic on DER sales in 2020, as well as supplier expectations for the future (broken down by short-term (2021) and medium- to longer-term (2022-2025) projections). It is important to note that given the high degree of uncertainty related to forward periods as a result of the pandemic, responses were meant to provide a preliminary indication of current thinking rather than a reflection of formal or official analysis conducted with any forecasting precision. In addition, given the limited number of respondents, the survey should not be taken as a comprehensive overview of what is being observed by *all* DER suppliers across the province. Nonetheless, the survey responses are useful for illustrative purposes.

The five survey questions were as follows:

1. How has COVID-19 impacted sales of your product(s)/solution(s) relative to expectations for 2020?
2. Do you expect sales growth for 2021 relative to expectations to change due to COVID-19? If yes, is it an increase or decrease, and by what magnitude?
3. What are your expectations for sales growth for the period 2022-2025?
4. Do you believe that recent Ontario government measures to moderate electricity bills will reduce demand for your product?
5. Aside from COVID-19, what do you believe is the biggest barrier to increasing use of your product?

Figure 14 summarizes the results of the survey, aggregating responses on a simple average basis for each of the five questions and illustrating the key trends and takeaways that can be drawn from the respondents. For questions 1-3, answers were generally provided on a numerical basis; for questions 4-5, qualitative answers were provided instead. For these latter questions, LEI grouped answers into general categories and included the number of responses recorded for each.

Figure 14. Ontario DER survey responses

Question	Average	Median	n
1. COVID-19 impact on 2020 sales	-33%	-50%	9
2. Expected COVID-19 impact on 2021 sales	-11%	0%	7
3. Expectations for 2022-2025 sales	66%	40%	3
4. Government measures will reduce demand for DERs	Yes		5
	No		4
5. Biggest barrier to adoption, other than COVID-19	Political risk		5
	Lack of customer knowledge		4
	Lack of financial support		2

Source: LEI November 2020 phone survey.

Based on survey responses (**question 1**), COVID-19 has caused DER sales in the province to decline by an estimated 33% in 2020 relative to expectations prior to the pandemic. As mentioned in Section 2.3, the most severe contraction in sales was said to have occurred over the March-June 2020 period due to numerous factors, including: a hesitance among customers to commit to projects, significant project delays, and a limit on door-to-door sales efforts.

For the short-term forward period (**question 2**), DER suppliers expect a slight improvement in 2021 sales relative to 2020 levels, with sales anticipated to be 11% lower than expectations prior to the pandemic. Many respondents emphasized that anticipated sales growth is difficult to predict given the substantial uncertainty surrounding the potential duration of the pandemic. Among respondents that assumed COVID-19 would still be prevalent in 2021, most said sales growth would be flat or lower relative to 2020 levels. One respondent observed that among its customer base, a decline in sales could persist into 2021 if residential customers remain hesitant to invest in solar due to financial constraints. This respondent noted that this is because customers typically deem such investments to be a "luxury."

For the medium- to longer-term forward period (**question 3**), DER suppliers expect sales to rebound by the 2022-2025 period. Although most respondents did not provide numerical estimates, among those that did, sales were projected to grow by 66% on average. Many cited renewables being a growth industry as a reason for the expected rebound in sales.

With regards to the impact of provincial measures on demand for DERs (**question 4**), respondents provided mixed feedback. Some stated that recent government actions (such as shifting a portion of the GA charge to the tax base, as well as the temporary freeze in GA charges for ICI participants – see Section 4 for more details) undermines the economics of DER projects and hence is expected to decrease demand. For the respondents that disagreed, most were referring to recent increases in TOU rates,[66] which suppliers stated has led to growing interest in DERs among residential customers.

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[66] TOU rates effective November 1, 2020 consist of an off-peak price of 10.5 ¢/kWh, a mid-peak price of 15.0 ¢/kWh, and an on-peak price of 21.7 ¢/kWh. (Source: OEB. *Electricity rates*)

Finally, the biggest barriers to DER adoption cited by respondents aside from the pandemic (**question 5**) can be grouped into the following categories: political risk (mentioned by 45% of respondents), lack of customer knowledge (36%), and lack of financial support (18%). In terms of political risk, respondents mentioned factors such as a lack of government support (both provincially and federally) as an obstacle to DER adoption. Concerning customer knowledge, respondents cited a general lack of understanding in terms of both the technologies available, as well as project economics as a hindrance to DER adoption. Relating to financial support, respondents stated an inability for residential and commercial customers to easily secure financing at appropriate terms and reasonable rates as another barrier to DER adoption.

4 COVID-19 impact on the ICI

The ICI program allows participating large industrial and commercial customers the opportunity to reduce their Global Adjustment costs. Passive participation in the ICI can lead to GA cost savings when compared to the alternative of paying volumetric GA rates, but active participation through curtailing grid demand during periods of coincident peak would lead to more benefits. DERs are one method to achieve this curtailment, and the potential to reduce GA costs are one of the primary reasons why large industrial and commercial customers would consider investing in DERs.

This section first provides a brief introduction to the ICI program, followed by an assessment of the impact the COVID-19 pandemic has had on ICI participant loads (which was down visibly commencing around April followed by a steady partial recovery). Following this, recent changes to the ICI are covered in Section 4.3. Notably, the ICI peak hiatus (hereby referred to as "ICI hiatus" or "hiatus") has effectively paused the program for existing participants, meaning that larger commercial and industrial customers no longer need to curtail their load in order to reduce their GA costs for next year. The impact of this hiatus from a behavioural perspective was significant, but it is expected to end in April 2021, and further structural changes to the program are not currently being discussed.

Another important change that is expected to commence in January 2021 relates to the government's recent announcement to shift a portion of contract costs that were previously funded by the GA to the Province. This is covered in Section 4.4, and the implication of this change would be lower GA costs for ICI and non-ICI commercial and industrial loads.

Finally, Section 4.5 considers the implications of these factors on ICI participation. In whole, LEI does not believe these changes will have an impact on decisions on whether or not to participate in the ICI, but rather on whether investments will be made to more actively curtail load during periods of system peak for ICI participants. As a result of the GA cost shift, and under instances where a large consumer sees a reduction in its total consumption, the business case for investing in active curtailment (e.g. deploying DERs) can be impacted.

4.1 ICI introduction

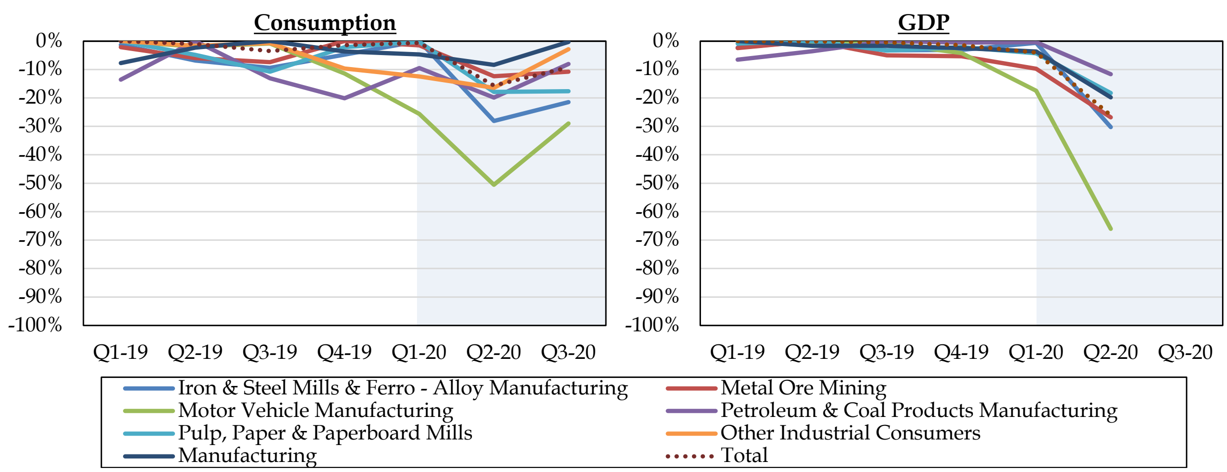
The ICI allows participating customers (called Class A customers) to reduce the GA portion of their electricity bills by reducing their demand during peak periods. The GA portion of a Class A customer's bill is based on its percentage share of demand at the top five daily system peak demand hours over a one-year period. The Class A customer's load during the top-five system peak demand hours is divided by the sum of the system peak over that same period, to arrive at the customer's peak demand factor ("PDF"). The customer's PDF is multiplied by the total monthly system-wide GA costs (in dollar terms) to determine the GA charges seen on the customer's bill. As the alternative for Class A treatment would be paying for the GA on a volumetric basis (i.e. not participating in the ICI, referred to as Class B customers), and the GA portion of a customer's bill is typically the largest individual component, the ability to reduce the GA provides a strong incentive for Class A customers to reduce their electricity consumption at anticipated peak periods.

The around 1,300 ICI participants made up close to 29% of total system consumption in 2018 and 2019, and helped lower system peak demand by 1,550 MW in 2019 (around 7% of system peak).[67]

4.2 COVID-19's impact on ICI participant load and income

The COVID-19 pandemic, as well as the associated lockdowns, continued physical distancing measures, and economic consequences, have impacted commercial and industrial loads and incomes. Although not all ICI participants are industrial customers, and some industrial customers are not ICI participants, using IESO data on industrial load by sector and Ontario data on gross domestic product ("GDP") by industry can still provide a good sense of the impact that the pandemic has had on ICI participant loads and incomes. This is shown in Figure 15, which depicts on a quarterly basis the indexed industrial load by sector, and associated indexed industrial GDP.[68] As can be seen in the figure, industrial loads and GDP fell significantly in Q2 2020, with certain sectors hit harder than others (for example, this was most visible for Motor Vehicle Manufacturing). Load in Q3 2020 recovered from these lows, but was still below levels seen prior to the pandemic (Q3 GDP data was not yet available).[69]

Figure 15. Quarterly indexed industrial electricity consumption and GDP by sector (2019-2020)



Note: industrial groupings shown in the legend are based on IESO data by sector. For GDP data, LEI lined up the sectors shown in the legend to the following industries/sectors shown in the OEA accounts: (i) Primary Metal & Fabricated Metal Products, (ii) Mining, (iii) Auto Industry (Vehicles & Parts), (iv) Chemical and Petroleum Products, (v) Paper Products and Printing, (vi) no data, (vii) all remaining manufacturing not listed previously, (viii) sum of all industries/sectors listed previously.

Sources: LEI analysis using IESO data on Industry Load by Sector, and Ontario Ministry of Finance's Ontario Economic Accounts Table 15.

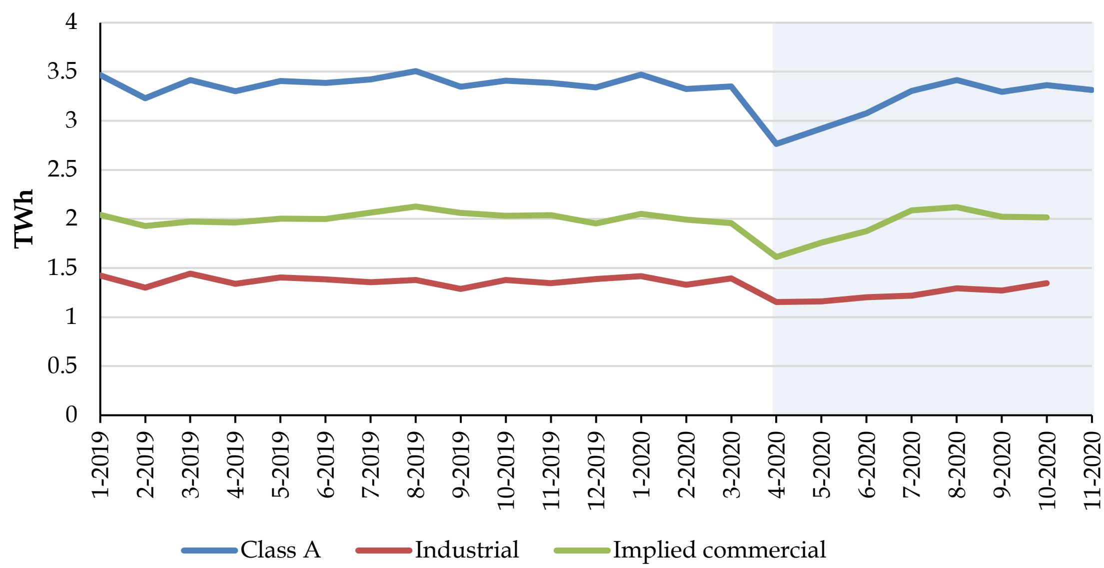
[67] IESO 2019 year-end data; IESO data on GA components by customer class; Ontario government news release from June 26, 2020 titled "Ontario Provides Stable Electricity Pricing for Industrial and Commercial Companies."

[68] The index takes the quarterly data for each sector's datapoint and divides it by its highest value. This indexed approach was used in order to show all sectors on the same scale.

[69] The deadline for release of Q3 Ontario Economic Accounts is January 15, 2021.

Although Class A commercial load data was not available, subtracting the total industrial consumption data from IESO data on total Class A load provides a remainder which can serve as a proxy for implied Class A commercial load. These three values are shown in Figure 16 on a monthly basis from January 2019 until the most recent period data was available. As can be seen in the figure, total Class A load dropped significantly in April, followed by a steady recovery. For the remainder load ("implied commercial"), consumption in August 2020 was close to the amounts seen in August 2019 (although slightly lower), partially attributable to the recovery but also due to weather conditions and the ICI hiatus (discussed in Section 4.3).

Figure 16. Monthly Class A load from January 2019 to November 2020 (TWh)



LEI analysis using IESO data on Class A consumption and Industry Load by Sector. Note November data for industrial load was not yet available.

4.3 Recent changes to the ICI due to COVID-19

On May 1, 2020, the Ontario Ministry of Energy, Northern Development and Mines ("the Ministry") implemented an emergency order to temporarily defer a portion of GA charges for commercial and industrial customers. Through the emergency order, the volumetric rate for non-Regulated Price Plan ("RPP") Class B customers would not exceed $115/MWh, while Class A customers would receive "the same percentage reduction in GA charges as non-RPP Class B customers."[70] This ran from April to June 2020.

Subsequently, on June 26, 2020, the provincial government announced the ICI hiatus in order to allow for ICI participants to "focus on getting their operations up and running and employees

[70] IESO. *Deferral of Global Adjustment Charges - Questions and Answers*. June 3, 2020.

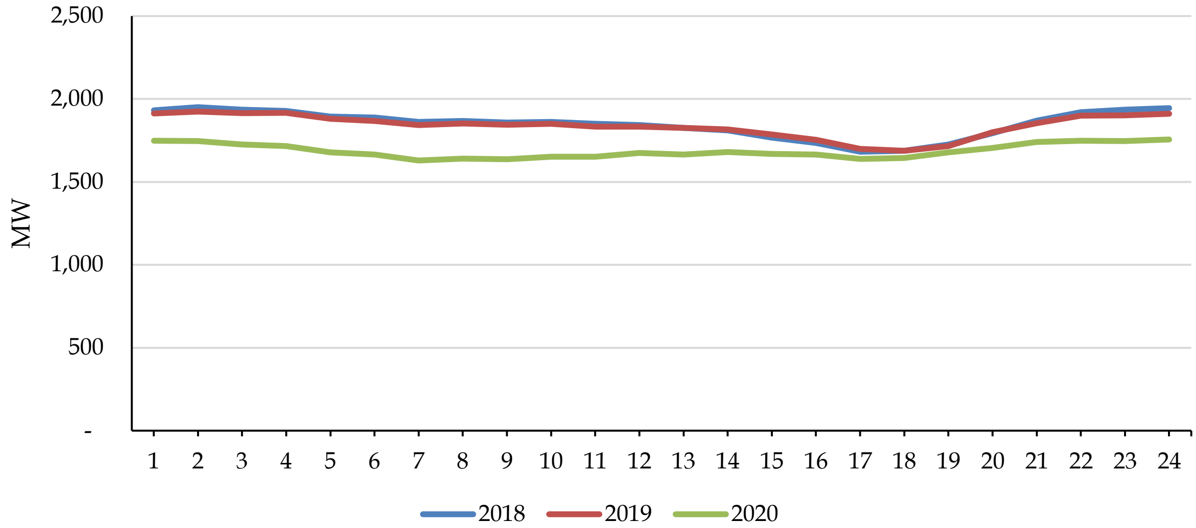
back to work, instead of adjusting operations in response to peak electricity demand hours."[71] The hiatus effectively paused the demand response nature of the ICI program for existing participants for a one-year period, as participants would not have to anticipate system peak hours and reduce their demand to reduce their GA costs. The impact of the ICI hiatus from a timing perspective is shown in Figure 17, with two relevant periods shown: the **base period**, which is the period whereby ICI-eligible customers have their PDFs determined (runs over a one-year period from May to April); and the **billing period**, which is the period whereby those PDFs determined in the base period are used to determine their GA charges for each month (runs over a one-year period from July to June subsequent to the end of the base period). Through the hiatus, existing ICI participants would no longer need to be concerned with the base period from May 2020 to April 2021, and would instead have their base period from last year apply to the following two billing periods.

Figure 17. Timelines of relevant ICI periods before and after hiatus

Using the same data on industrial load by sector discussed previously, some of the implied impacts of the hiatus on curtailable load can be extrapolated. First, Figure 18 presents the average hourly aggregate industrial load between the months of July and August for 2018, 2019, and 2020. As can be seen in the figure, while average hourly load profiles over these months for 2020 were lower for all hours when compared to 2018 and 2019, the drops during periods of anticipated system peak hours were not seen. The impact of the hiatus becomes much more visible when focusing on the average hourly demand during only the top-five demand days over these same years. This is done in Figure 19, which shows large declines in industrial load due to curtailment in anticipation of system peaks in 2018 and 2019 but not in 2020 due to the hiatus.

[71] Ontario government news release. *Ontario Provides Stable Electricity Pricing for Industrial and Commercial Companies*. June 26, 2020.

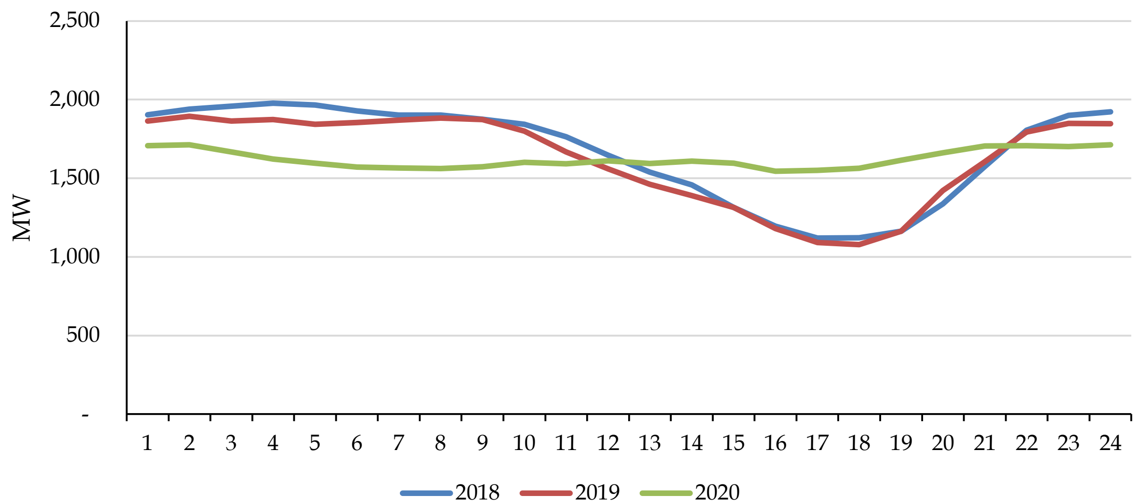
Figure 18. Average hourly industrial load between July and August for 2018, 2019, and 2020



Note: only July and August shown as these are the months where peaks typically occur.

Source: LEI analysis using IESO data on Industry Load by Sector.

Figure 19. Hourly industrial load for top-5 demand days in 2018, 2019, and 2020



Source: LEI analysis using IESO data on 'Industry Load by Sector' and 'Ontario and Market Demand'

Although average consumption levels for ICI participants were lower in 2020 as a result of the pandemic, the effective pause in curtailment activity as a direct result of the hiatus was one of the drivers of Ontario's above-average peak in 2020 (along with weather).[72] The overall impact of a longer-term pause to the ICI program would be material, however the hiatus is only expected to

[72] IESO. *Reliability Outlook: An adequacy assessment of Ontario's electricity system From October 2020 to March 2022*. September 2020.

last until April 2021, and there has been no indication that it will lead to wider structural changes to the ICI. Additionally, given Ontario's system typically peaks in the summer months, the implications of the hiatus from the perspective of curtailment activity is likely to have already passed.

4.4 GA cost shift

As part of the Ontario government's response to the health and economic impacts of COVID-19, the 2020 Budget ("the Budget") announced a measure to shift a portion of non-hydro renewable contract costs that were previously funded through the GA to the Province, commencing in January 2021.[73] According to the Budget, this shift will result in an average reduction in **all-in electricity bills** for Class A and non-RPP Class B customers of around 14% and 16% respectively. Aside from providing rate relief to existing customers, another purpose of this move is to make Ontario's rates more competitive compared to other North American jurisdictions, which if successful could mean new and expanded business operations in the province (i.e. potential for more ICI-eligible participants/load).[74]

While details on what specific contracts will be shifted to the tax base in the Budget were sparse, the wording seems to suggest that the entirety of the GA portion of wind, solar, and bioenergy contracts could be shifted to the tax base. According to information contained in the Budget, costs associated with these contracts in 2019 were around $3.9 billion (18% of $21.9 billion), and a portion estimated at approximately 85% of these costs will be funded by the Province.[75] For reference, costs associated with wind, solar, and bioenergy contracts made up around 28% of total GA costs over the past year.[76] As a direct result of this announced shift, both ICI participants and customers who pay volumetric GA rates will see a reduction in the GA portion of their bills.

4.5 Potential implications for ICI participants

In the longer-term, the above considerations are unlikely to have an impact on existing ICI participants, as despite the reduction in the GA due to the cost shift and potential reduction in consumption levels, the Class A payment structure still provides overall savings as compared to paying volumetric Class B rates. However, for new potential ICI participants or existing ICI participants considering investments in curtailment (including for example DERs), the ICI incentive structure may have been impacted as a direct result of the GA cost shift. An additional

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[73] This decision may have occurred in whole or in part without the pandemic, however as noted in the Budget, "the pandemic has made fixing this [rising cost of electricity] problem an urgent priority that must be addressed if Ontario is going to compete successfully to attract new investments, as governments around the world plan for a recovery from the global recession."

[74] Ontario Ministry of Finance. *Ontario's Action Plan: Protect, Support, Recover.* November 2020. Queen's Printer for Ontario.

[75] LEI assumes the remaining 15% that will not be funded by the Province is the estimate for wholesale market revenues that the contracted generation assets will earn.

[76] According to IESO data on GA by components, Total GA costs between October 2019 and September 2020 were around $13.8 billion, of which around $3.9 billion was associated with these non-hydro renewable contracts.

impact may occur if these large consumers see drops in consumption levels without commensurate reductions in their coincident peaks (i.e. overall consumption level drops, but PDF remains the same).[77]

An example of these potential issues is presented in Figure 20, which provides for illustrative purposes the annual GA costs for a hypothetical customer under Class A and Class B structures under the following cases: (i) the status quo prior to the pandemic; (ii) whereby a portion of costs associated with wind, solar, and bioenergy contracts (totaling $3.3 billion) previously collected through the GA are funded by the Province; and (iii) whereby the customer benefits from the GA cost shift in (ii) but also sees a 10% reduction in consumption without any change to its PDF. Although the annual savings that occur as a result of switching from Class B to Class A payment structures is positive in all three cases, the net effect of each successive change is a reduction in savings.

Figure 20. Illustrative example of the impact of a GA cost shift and consumption reduction

Case	Portion of GA funded by province?	Consumption lower by:	Annual GA costs under:		Annual savings
			Class B	Class A	
(i)	**N**	**0%**	$ 1,518,201	$ 1,000,866	$ 517,335
(ii)	**Y**	**0%**	$ 1,129,992	$ 744,941	$ 385,051
(iii)	**Y**	**-10%**	$ 1,016,993	$ 744,941	$ 272,052

Note: based on the 2018-2019 'Other Industrial Consumers' PDF and consumption, using IESO data. GA costs based on 2019 GA amounts. Portion of GA funded by province assumed to be $3.3 billion.

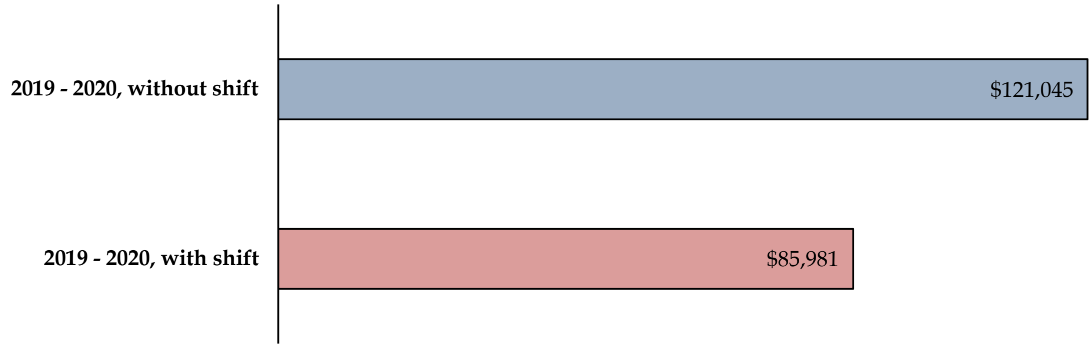
Sources: LEI analysis using IESO data on 'Industry Load by Sector', 'Ontario and Market Demand', and 'GA components plus costs and consumption by customer class.'

An alternative and more direct way of looking at the GA cost shift issue for Class A customers specifically is by assessing the implied cost of consumption at only the top-five peak hours that are used to determine PDFs. Using the total top-five system peak demand data from May 2018 to April 2019, and the GA costs from July 2019 to June 2020, Figure 21 presents the average cost of consuming during peak demand hours under a case where the full GA costs pass through to Class A consumers (blue bar), and an alternative case where costs for solar, wind, and bioenergy are reduced from the GA (red bar). As can be seen in the figure, the average implied cost of

[77] Other ways COVID-19 could theoretically impact the overall incentive structure include: lower wholesale energy prices, leading to a higher GA; and changes to system peak demands, which could impact ICI participant PDFs (e.g. lower system peaks would mean higher PDF for the same amount of curtailment). These changes are likely immaterial from an incentive point of view in the longer-term. COVID-19 may also impact participants more directly if either an ICI participant shuts down its operations as a direct result of the pandemic and its longer-lasting consequences, or if its average monthly peak falls below the threshold required to be eligible for participation.

consumption during these top-five hours is noticeably lower as a result of the cost shift, declining from $121,045/MWh to $85,981/MWh.[78]

Figure 21. Implied cost of consumption at top-five hours for 2019-2020 billing period ($/MWh)



Notes: GA costs used in this example are July 2019 to June 2020 actuals. GA costs being shifted are actual GA costs associated with all wind, solar, and bioenergy contracts over the same timeframe. Peak hour data is based on May 2018 to April 2019 actuals. These values will change by year.

Sources: IESO data for [Top 5 Peaks: Hours & System-Wide Consumption] and [GA by components].

As participation in the ICI still provides for lower GA costs when compared to paying volumetric Class B rates for most load types, including passively participating in the ICI, the policy changes and potential consumption changes are not likely to impact decisions around whether or not to participate in the ICI; rather, the implications are more related to decisions ICI participants or potential participants make around possible investments targeted at more actively curtailing load to minimize GA costs, and whether the savings that occur as a result of minimizing GA can still make up for the costs associated with curtailing grid consumption (both from a business operations perspective, and potentially the costs associated with deploying DERs). All else equal, this could also increase the minimum size of DERs for ICI participants.

[78] This decline represents the amount being shifted, which here is assumed to be the full GA costs associated with these non-hydro renewables. Values will change based on the actual GA amount, the amount of contract costs being shifted out of the GA, and the system peaks for each year.

5 Concluding remarks

Generally, households and businesses are motivated to invest in DERs for the following reasons: cost savings, government incentives, environmental benefits, reliability, and a desire for independence. Although households and businesses rank the relative importance of these drivers differently (as shown in Figure 22), both groups agree that cost savings carries the most weight.

Figure 22. Ranking of drivers for DER adoption – households versus businesses

Rank	Households	Businesses
1	Cost savings	Cost savings
2	Government incentives	Government incentives
3	Environmental benefits	Desire for independence
4	Reliability	Environmental benefits
5	Desire for independence	Reliability

Note: See Section 2.2 for details of the analysis conducted to determine these rankings.

However, due to the COVID-19 pandemic, DER adoption in Ontario may slow, caused in part by the following factors:

- pandemic-related lockdowns, physical distancing measures, and the resulting economic consequences may continue to delay DER project timelines, and could lead to sustained hesitancy among households and businesses to commit to DER investments;
- economic uncertainty, tighter lending requirements, and reduced willingness to invest due to the pandemic introduces financing risk for DER projects;
- financial constraints and reduced incomes arising from the pandemic may decrease customer willingness to pay for the environmental benefits offered by renewable DERs; and
- the shift of a portion of non-hydro renewable contract costs previously funded through the GA to the Province, and declines in consumption, may harm the business case for ICI participants investing in DERs as a means of actively curtailing load during peak periods.

5.1 Considerations for prioritizing, pacing, and sequencing OEB policy

The anticipated slowdown in the pace of DER adoption as a result of the pandemic has implications on how quickly the OEB should move on DER integration and innovative ratemaking approaches. Ultimately, the appropriate timing for further examination of DER remuneration and integration (from the perspective of the regulator, utilities, and other stakeholders) will be determined by numerous factors.

The onset of the COVID-19 pandemic and its implications have drawn the attention of utilities, stakeholders, and the OEB. For example, utilities have had to devote attention to navigating the operational uncertainty introduced by the pandemic. From a regulatory perspective, a number of new initiatives/consultations directly related to the pandemic and its effects have been launched, as well as new temporary reporting requirements that the OEB has introduced to monitor the financial situation of individual utilities during the pandemic. Perhaps most importantly, the pandemic and its wide-reaching effects have also created high degrees of uncertainty with regards to the outlook for the industry and the economy more generally.

In light of the anticipated slowdown in DER adoption due to the pandemic, the uncertainty that the pandemic has created, and the emergence of regulatory initiatives directly related to the pandemic, a more meaningful consultation might be achieved as more clarity emerges on the industry outlook, and as participating stakeholders are able to re-prioritize. At such a time, consideration can also be given to the OEB's new objective of facilitating innovation,[79] and the implications that may have on DER adoption.

LEI believes that instead of issuing a certain date for the UR and DER policy considerations, the OEB should consider a series of triggers which would indicate appropriate timing around the UR and DER consultation calendars. These triggers could be differentiated according to the following categories: (i) COVID-19-related measures which are outside of the OEB's control; and (ii) other measures which are within the OEB's control.

On the former (i), these triggers could include:

- cessation of the provincial emergency declaration, which was issued on March 17, 2020;[80]
- a lifting of all restrictions on business activity in the province; or
- widespread availability of a COVID-19 vaccine in Ontario.

On the latter (ii), these triggers could include:

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[79] Specifically, under Bill 229 (which received royal assent on December 8, 2020), the provincial government amended the *Ontario Energy Board Act, 1998* to remove objectives relating to a smart grid and to renewable energy resources, and to add an objective relating to "innovation" to guide the OEB. *See* Legislative Assembly of Ontario. *Bill 229: An Act to implement Budget measures and to enact, amend and repeal various statutes*. Royal Assent December 8, 2020.

[80] Ontario Office of the Premier. *Ontario Enacts Declaration of Emergency to Protect the Public.* March 17, 2020.

- a survey of regulated entities and stakeholders that indicates substantial readiness;
- a resolution or decision issued in the Deferral Account consultation; or
- another indication besides an OEB decision that demonstrates the financial impact of the pandemic is no longer an issue for utilities (e.g., utilities no longer recording amounts in the OEB's COVID-19 deferral sub-accounts).

The OEB could then select at least one trigger from (i) *and* one trigger from (ii) to indicate a point at which meaningful engagement on DER-related issues could be achieved.

6 List of works cited

Alberta Electric System Operator. *AESO DER Roadmap.* June 2020.

Ausgrid. *Business Customer Survey Results.* February 2018.

Bank of Canada. *Business Outlook Survey – Autumn 2020.* October 19, 2020.

Burger, Scott P., et al. "Why Distributed?: A Critical Review of the Tradeoffs Between Centralized and Decentralized Resources." *IEEE Power and Energy Magazine* 17.2 (2019): 16-24.

Canadian Manufacturers & Exporters. *Canadian Manufacturers & Exporters Submission. Consultation on the Utility Remuneration and Responding to Distributed Energy Resources (EB-2018-0287 & EB-2018-0288).* October 2019.

Centrica Business Solutions. *The Energy Advantage Report.* June 2018.

Centrica website. *What is the average payback period of a solar PV installation?*

CERI. *Opportunities and Challenges for Distributed Electricity Generation in Canada.* July 2020.

CTV News. *'Whoever has stock right now is king:' Surging appliance sales cause shortages.* October 6, 2020.

Deloitte Insights. *Deloitte Resources 2019 Study.* 2019.

Deloitte Insights. *Deloitte Resources 2020 Study*. May 2020.

Energy Economics. *Consumers' willingness to pay for renewable and nuclear energy: A comparative analysis between the US and Japan*. June 2015.

Energy Sage. *Consumer and installer mindset in the age of COVID-19.* May 2020.

EnergySage. *Intel Report.* October 2020.

European Bank for Reconstruction and Development. *Mandatory versus voluntary payment for green electricity.* October 2013.

Greentech Media. *5 States Blazing the Trail for Integrating Distributed Energy Resources.* September 9, 2019.

IBM. *The Sun Shines on Solar.* February 2017.

IEA. *Renewable Energy Market Update: Outlook for 2020 and 2021.* May 2020.

IESO. *2019 year-end data.* 2019.

IESO. *2019 Year in Review*.

IESO. *A Progress Report on Contracted Electricity Supply.* Q2 2020.

IESO. *Active Contracted Generation List.* Data current as of November 12, 2020.

IESO. *An overview of COVID-19 impacts on electricity system operations.* Webinar. April 23, 2020.

IESO. *Deferral of Global Adjustment Charges - Questions and Answers*. June 3, 2020.

IESO. *Distributed Energy Resources.*

IESO. *GA components plus costs and consumption by customer class.*

IESO. *IESO York Region Non-Wires Alternatives Demonstration Project.* November 2020.

IESO. *Innovation and Sector Evolution White Paper Series – Exploring Expanded Distributed Energy Resource Participation in the IESO Administered Markets.* October 24, 2019.

IESO. *Innovation and Sector Evolution White Paper Series: Non-Wires Alternatives Using Energy and Capacity Markets*. May 2020.

IESO. *Reliability Outlook: An adequacy assessment of Ontario's electricity system From October 2020 to March 2022*. September 2020.

Kessler, Will. "Comparing energy payback and simple payback period for solar photovoltaic systems." *E3S web of conferences*. Vol. 22. EDP Sciences, 2017.

Legislative Assembly of Ontario. *Bill 229: An Act to implement Budget measures and to enact, amend and repeal various statutes*. Royal Assent December 8, 2020.

Maritime Electric. *2020 Integrated System Plan.* September 30, 2020.

Mody, Ashoka, et al. "Precautionary Savings in the Great Recession." *IMF Economic Review*, vol. 60, no. 1, 2012, p. 114–138.

Nature Energy. *The impact of policies and business models on income equity in rooftop solar adoption.* November 9, 2020.

NB Power. *Embedded Generation*.

Newfoundland and Labrador Hydro. *Net Metering Program Annual Report.* March 27, 2020.

NREL. *A Non-Modeling Exploration of Residential Solar PV Adoption and Non-Adoption.* September 2017.

NREL. *PV FAQs: What is the energy payback for PV?*

NY State Senate. *Senate Bill S6599.* June 18, 2019.

NYISO. *2020 Load & Capacity Data Report.* April 10, 2020.

O'Shaughnessy, Eric, et al. "Solar plus: Optimization of distributed solar PV through battery storage and dispatchable load in residential buildings." *Applied Energy* 213 (2018): 11-21.

OEB. *EB-2018-0288. Responding to Distributed Energy Resources (DERs).* Launched March 15, 2019.

OEB. *Electricity rates*.

Ontario Government. *O. Reg. 80/20: Electricity Price for RPP Consumers.* March 24, 2020 (Revoked November 1, 2020).

Ontario Government. *Ontario Provides Stable Electricity Pricing for Industrial and Commercial Companies*. June 26, 2020.

Ontario Ministry of Finance. *Ontario Economic Accounts.* Q2 2020.

Ontario Ministry of Finance. *Ontario's Action Plan: 2020 Ontario Budget.* Queen's Printer for Ontario, 2020.

Ontario Ministry of Finance. *Ontario's Action Plan: Protect, Support, Recover.* November 2020. Queen's Printer for Ontario.

Ontario Office of the Premier. *Ontario Enacts Declaration of Emergency to Protect the Public.* March 17, 2020.

Pew Research Center. *More U.S. homeowners say they are considering home solar panels.* December 2019.

Renewable and Sustainable Energy Reviews. *Assessment of public acceptance and willingness to pay for renewable energy sources in Crete.* November 2009.

SEIA and Wood Mackenzie. *U.S. Solar Market Insight: Executive Summary Q3 2020.* September 2020.

Statistics Canada. *New motor vehicle sales (Table 20-10-0001-01)*.

Statistics Canada. *Table 36-10-0112-01 Current and capital accounts - Households, Canada, quarterly*.

Tal, Benjamin & Judge Katherine. *Excess Cash.* CIBC Economics. November 17, 2020.

The Economist Intelligence Unit. *Distributed Generation: A Brighter Future?* 2018.

US EIA. *Annual Electric Power Industry Report, Form EIA-861 detailed data files.* October 6, 2020.

USAID. *How does willingness to pay influence mini-grid economics?*

Wood Mackenzie. *United States Distributed Energy Resources Outlook.* July 2020.

Yale Program on Climate Change Communication. *Who is willing to pay more for renewable energy?* July 16, 2019.