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Industry Perspective

Understanding Barriers to Smart Grid Adoption

MaRS

Natural Resources Canada
Ressources naturelles Canada

Canada

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1 Introduction

As a neutral, third-party convener, MaRS Discovery District (MaRS) conducts research to help advance industry and ecosystem transitions across sectors. To help the energy industry overcome barriers to the adoption of smart grid technologies across Canada, MaRS has conducted both stakeholder interviews and secondary research in order to highlight the main challenges and barriers facing the smart grid sector.

Canada is at a potentially critical point in its recovery from COVID-19 where investment in smart energy systems are well positioned to add jobs, economic productivity and contribute significantly to GDP. A study by Bloomberg New Energy Finance (BNEF) on the effect of U.S. investments in smart grid technologies after the 2008/09 banking crisis found that $1M of direct spending on smart grid projects generated $2.5 – $2.6 million in GDP and employed over 47,000 people.[1] The unquantifiable nature of the environmental and social impacts of investing into current smart grid technologies – beyond estimated reduction in greenhouse gasses such as nitrous oxide, sulfur dioxide and carbon dioxide associated with reduced fossil fuel use and an increase in efficiencies associated with energy production and consumption[2] – are exacerbated by the barriers outlined below in this report. Smart grid technologies' cross sectoral applications offer benefits to multiple sectors – including the electricity sector – in overcoming barriers to customer quantification, acquisition and retention, as well as cross sectoral collaboration.

1. https://www.bnef.com/insights/23337/view **2.** https://www.sciencedirect.com/science/article/pii/S1364032116002744

2 How to Read this Report

This report comprises seven further sections, outlining the main challenges to the adoption of smart grid technologies across Canada, as follows:

Section 3
An executive summary

Section 4
An outline of the objectives of this report

Section 5
A review of the methodology used to compile the findings

Section 6
An overview of the Canadian energy sector

Section 7
Barriers to Smart Grid Adoption

Section 8
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3 Executive Summary

The Canadian electricity sector is diverse by necessity. It reflects the varied communities and customers it serves across Canada, creating a wide range of technical expertise and capabilities. Canada's unique landscape, regional characteristics, and people have always obliged the electricity sector to recognize the differences between service providers and acknowledge that the variance in their capabilities is a necessity. The same diversity applies to innovation. A one-size-fits-all approach to catalyzing innovation and transforming the electricity sector is an ineffective way to discover new solutions and technologies to benefit the Canadian electricity sector and, more importantly, the stakeholders and customers for energy services. This varied approach to sector transformation, however, has created unique challenges for the nation's electricity sector.

Canada's approach to innovation in the electricity sector is, at its core, motivated by community and customer relationships. Despite impressive efforts from electricity sector leaders in industry, academia and government, the adoption of innovative smart energy systems has been slow in Canada to date – compared to the U.S. While changes to our generation profile is on the horizon, our current production profile is abundant in non-emitting hydroelectric and nuclear facilities, disincentivizing rapid, incremental, change.

Canada's electricity sector faces many challenges in its pursuit of smart grid innovation, which are outlined in this report. According to stakeholders interviewed, the primary sources of these challenges include:

1. Canada's Federal and Provincial/Territorial Policy Environments

Interviewees noted that Federal and provincial/territorial policy environments are cyclical and beholden to shifting agendas, which can inhibit long-term, intentional investments into new technologies.

2. Regulatory Leadership

Paired with the difficulty stakeholders have understanding the future policy environment, interviewees highlighted the need for the development of a more nuanced and strategic approach to the adoption of smart grid technologies. Interviewees noted that across Canada, outdated regulations and approval structures, which no longer match market need, needlessly amplify the risk of bringing new technologies into the marketplace, by obliging them to wait for full regulatory approval or reporting structures to be put in place for each new type of technology or investment and not fully accounting for the value a new solution might bring to the market.

3. Barriers to New Business Model Development

The increased risk created by the regulatory environment in Canada can often lead to difficulties with identifying and developing unique, value-driven business models for new technologies. Technology providers find it hard to communicate the value of a new solution when the technology is perceived by their customers to have high associated capital costs as well as risk. For solutions providers, these customers are often risk-averse organizations such as utilities, building owners, and commercial and industrial (C&I) facilities. Investments in new technologies are made when pilot projects are undertaken, which is often triggered by securing appropriate funding. Unfortunately, the funding of these projects is often limited, and excludes considerations of scaling, thereby reducing the overall number of implemented solutions, even when pilots are technically successful.

4. Market Barriers for Stakeholders of All Sizes

Barriers to innovation exist for large and small stakeholders alike. For small electricity and solution providers, the path to becoming an active electricity market participant at either the local capacity level or at the wholesale level is blocked by hurdles that are over-burdensome and financially not feasible. Interviewees noted that larger market participants, meanwhile, are not properly incentivized to seek out unique solutions to their challenges – further reducing the demand for new technology adoption.

5. Electricity Sector Culture and Customer Awareness

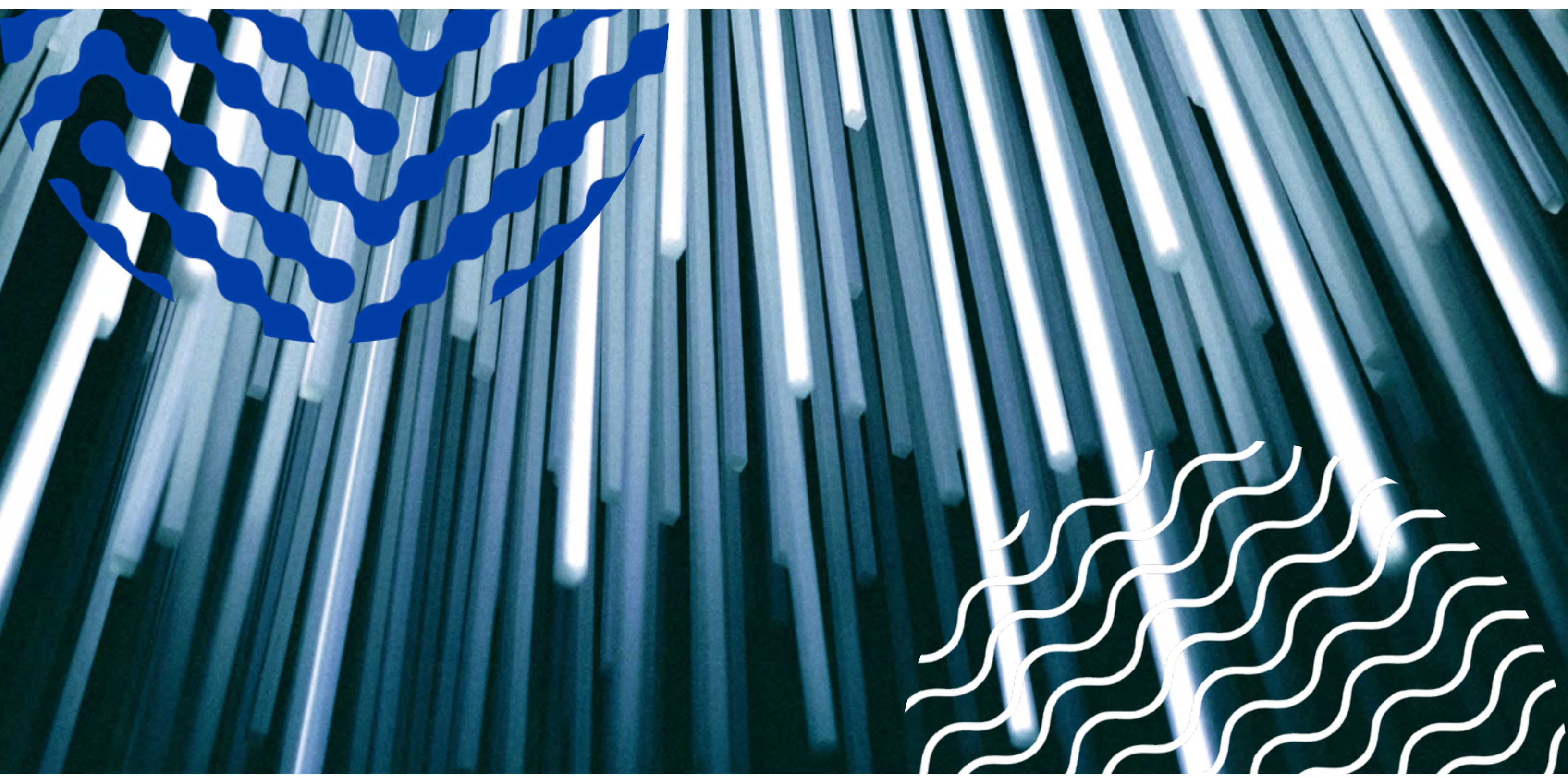
Innovation requires much more than external incentives. Electricity sector culture and customer awareness and understanding play critical roles, and they create many challenges in Canada at present. Solution providers find it extremely difficult to work with utilities on projects due to their risk averse tendency. Customer awareness of new, cost-saving or efficiency-gaining technologies is also generally quite low, and customer relationships with utilities are often at arm's length. This leaves customers with a narrow understanding of electricity services. In addition, new technologies are not marketed to customers directly but rather through their electricity providers, further constricting the ability to communicate the value of innovation to electricity customers.

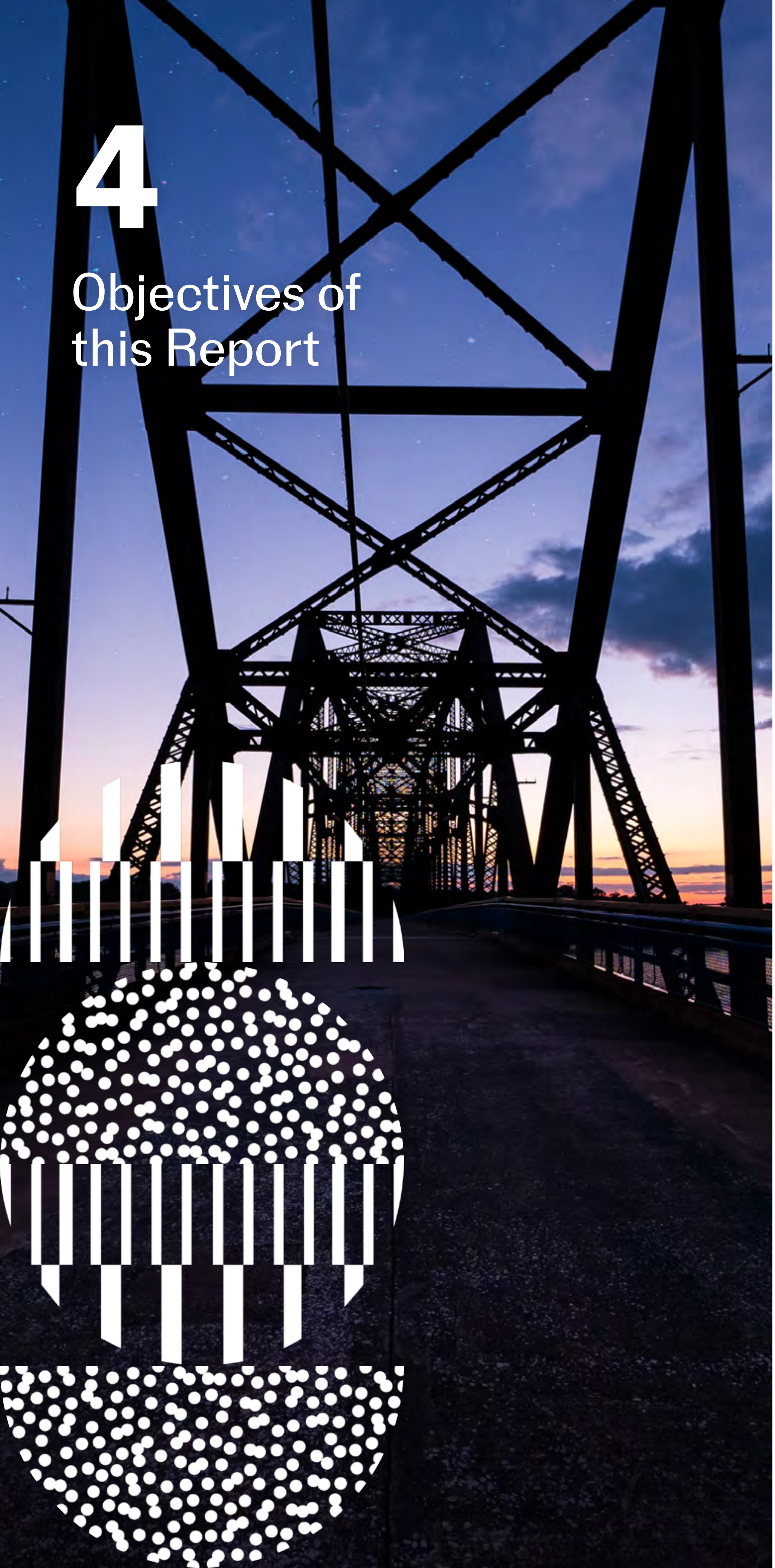
6. The Rapid Rate of Technological Change

One of the major challenges identified by interviewees is the difficulty integrating new technologies, including new processes and requirements, into current systems. Interoperability issues between two systems are exacerbated by the technical requirements of new digital tools and new security protocols, which rely on sector knowledge and skill sets new to the electricity industry.

7. The Impact of COVID-19

The impact of COVID-19 on the electricity sector cannot be ignored. The economic crisis caused by the pandemic caused loads to rapidly decrease and shift away from commercial centres towards residential areas. This has raised questions about the general resiliency of the electricity system, its supply chains and the financial instruments available to new businesses, original equipment manufacturers, and utilities.





4 Objectives of this Report

This report serves to achieve four objectives:

1

To provide an up-to-date, pan-Canadian and multi-stakeholder view into current barriers to the adoption of smart grid technologies;

2

To catalyze the formation of partnerships between traditional and non-traditional energy players required for Canada's transition to smart grid systems;

3

To inform electricity sector stakeholders of the effects of COVID-19 on the energy sector;

4

To inform post-COVID-19 economic stimulus and recovery activity and priority investment areas to drive the energy transition across Canada.

5
Methodology

Between April 27th and June 5th, 2020, MaRS conducted 27 interviews with energy sector stakeholders across Canada. MaRS interviewed representatives from energy associations, customer segments, energy providers, financing entities, government, innovation centres, original equipment manufacturers, research institutes, solution providers, system operators, and utilities.

The interviews were then analysed into eight themes, which were identified by MaRS using a keyword analysis. Each interview surfaced key challenges, barriers and needs/wants of the industry – allowing MaRS to identify key challenge areas to smart grid adoption across Canada.

Table 1

Outreach Location	Number of Interviewees	Business Type	Number of Interviewees
Ontario	10	Association	1
Alberta	2	Commercial and Industrial (C+I)	1
British Columbia	1	Energy Provider	2
Saskatchewan	1	Solution Provider	1
Quebec	3	Finance	1
Newfoundland	1	Government	1
New Brunswick	1	Original Equipment Manufacturer (OEM)	1
Prince Edward Island (PEI)	1	Research Institute	2
Canada	2	Regional Innovation Centre (RIC)	2
World Wide (WW)	3	System Operator	1
		Utility	6
		Venture	7
		Customer	1
Total	**27**		**27**

6

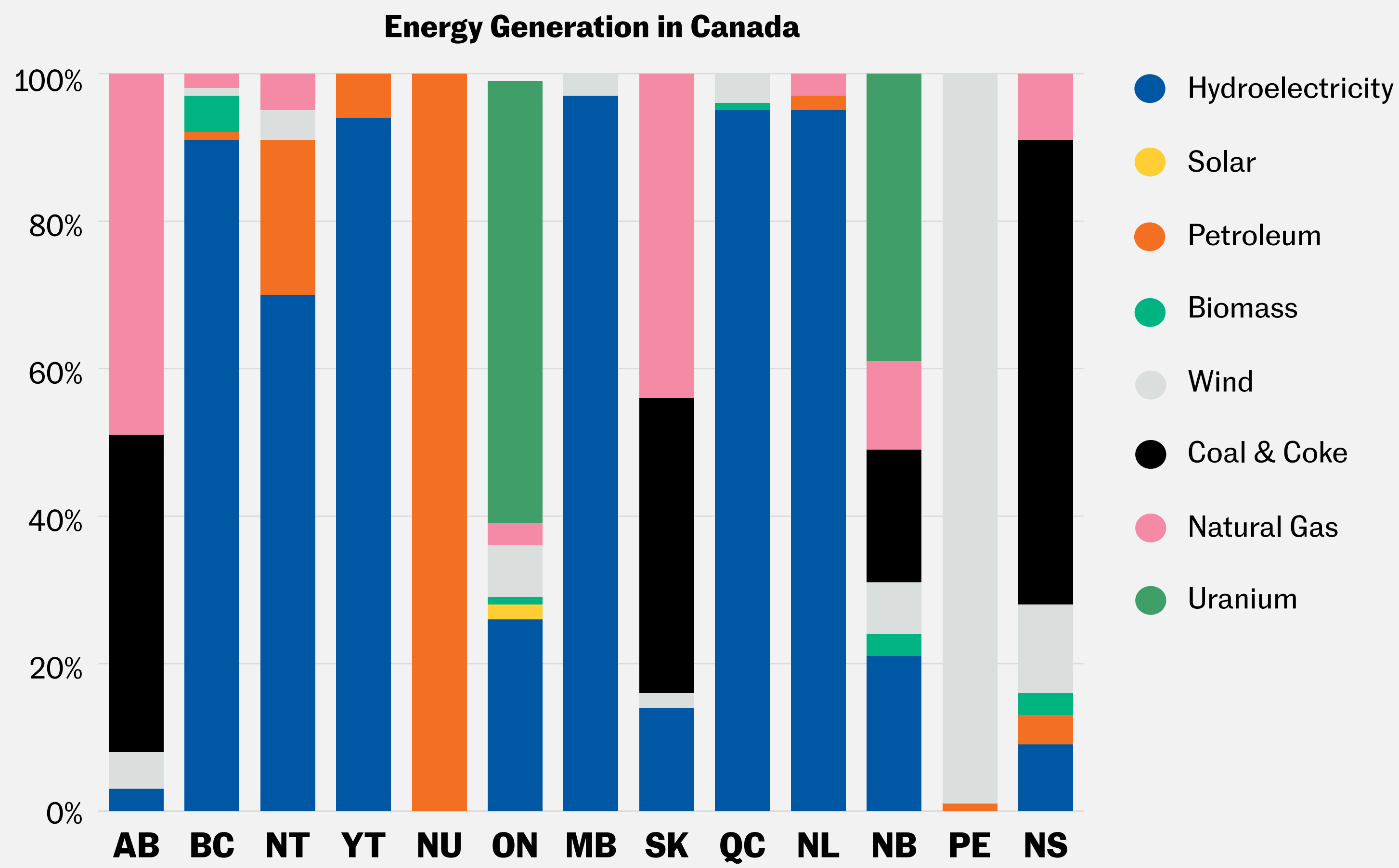
Background and Context

As a neutral third party, MaRS is well positioned to address cross-country, multi-sectoral challenges and barriers to the adoption of smart grid technologies. The adoption of new technologies and business models will improve access to clean, reliable and affordable electricity, while also reducing greenhouse gas (GHG) emissions from numerous sectors. A smart grid, with clean generation and energy storage, has distributed and autonomous monitoring, analysis and control, and is enabled by the following technologies: advanced metering infrastructure (AMI), demand response (DR), distributed energy resources (DERs), monitoring and control, electric vehicle (EV) integration and control, energy storage, microgrids, new rate options, self-healing grid, voltage and voltage ampere reactive (VAR) control. Smart grid technologies enable and support the transition to clean, reliable and affordable energy solutions and services for Canadians.

Canada's electricity sector is highly diverse, and Canada's federated energy structure means approaches to innovation differ across the country. Because provinces and territories have authority over their local generation, transmission and distribution, the electricity sector allows for a wide range of approaches to supply Canadians with electricity. The graphs below (Image 1/2) outline the generation and end-use profiles of each province and territory within Canada.

Some provinces and territories have profiles heavy in fossil fuels (e.g. New Brunswick, Alberta, Saskatchewan). Given the shift towards lower carbon energy systems, there is a huge opportunity for these provinces to adopt smart grid technologies. Provinces can increase their renewable generation through DERs and leverage smart grid technologies, such as storage and microgrids, to help with integrating DERs into the system. Other regions that already have a high percentage of renewable generation, such as hydro or wind, can also benefit from the integration of smart grid technologies by supporting additional renewable integration, optimizing investments in grid infrastructure, increasing customer service, and enabling opportunities for new service offerings. For example, smart grid solutions can help reduce carbon emissions from other sectors, such as reducing automotive sector emissions through EV charging, or optimizing electricity use and reducing the peak load of large residential and commercial buildings in heavily populated urban centres.

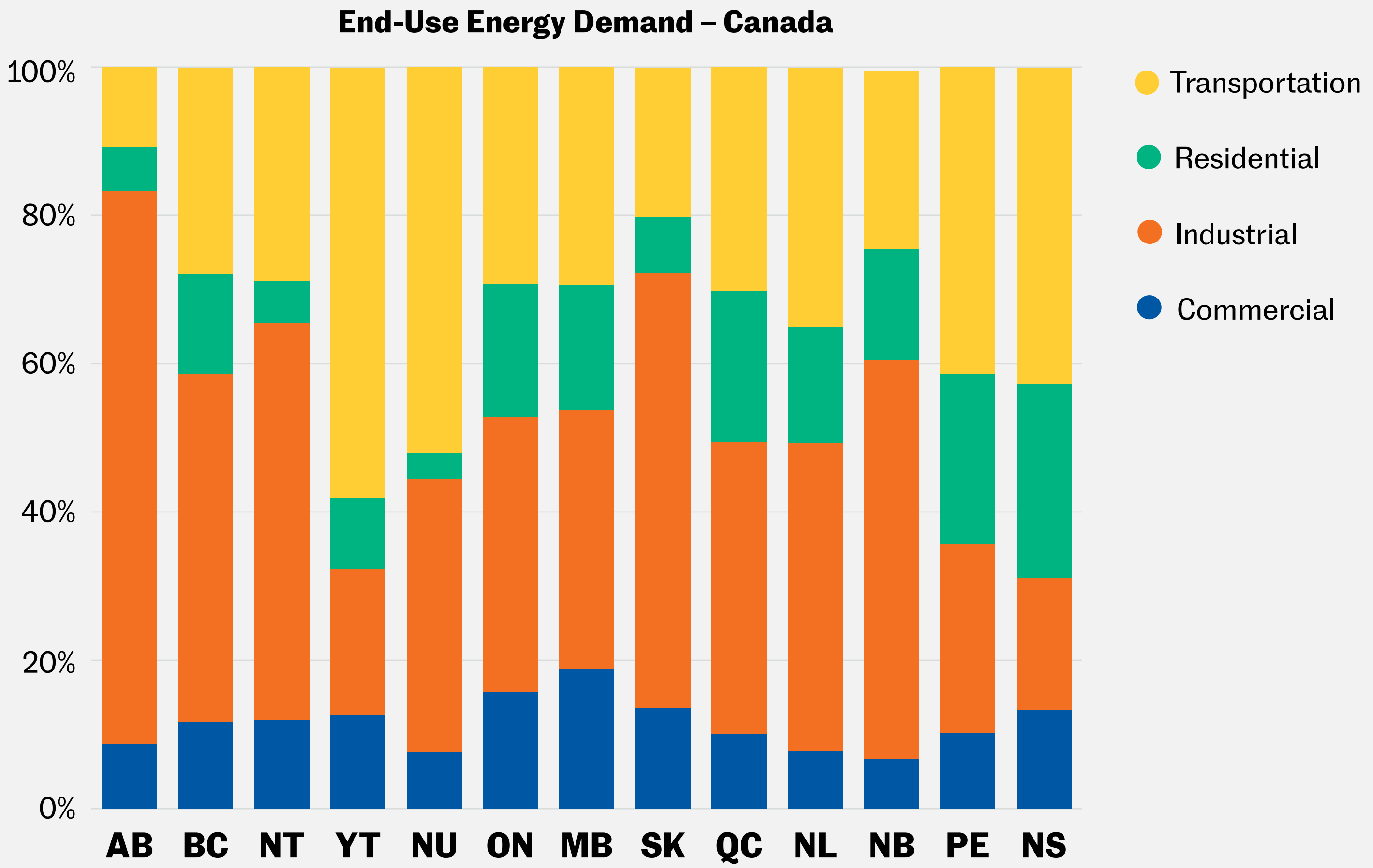
Image 1: Generation Profiles of Canada's Provinces and Territories[3]



Province	AB	BC	NT	YT	NU	ON	MB	SK	QC	NL	NB	PE	NS
Hydroelectricity	3%	91%	70%	94%		26%	97%	14%	95%	95%	21%		9%
Solar	<1%	<1%				2%							
Petroleum	<1%	1%	21%	6%	100%	<1%			<1%	2%	<1%	1%	4%
Biomass	<1%	5%				1%	<1%		1%		3%	<1%	3%
Wind	5%	1%	4%			7%	3%	2%	4%	<1%	7%	99%	12%
Coal & Coke	43%						<1%	40%			18%		63%
Natural Gas	49%	2%	5%			3%	<1%	44%	<1%	3%	12%		9%
Uranium	0%					60%					39%		

3. https://www.cer-rec.gc.ca/nrg/ntgrtd/mrkt/nrgsstmprfls/cda-eng.html

Image 2: End-Use Energy Profiles of Canada's Provinces and Territories[4]



Province	AB	BC	NT	YT	NU	ON	MB	SK	QC	NL	NB	PE	NS
Transportation	10.8%	27.8%	28.9%	58.0%	52.0%	29.2%	29.3%	20.1%	30.2%	34.9%	24.0%	41.5%	42.7%
Residential	5.9%	13.5%	5.6%	9.5%	3.6%	18.0%	17.0%	7.6%	20.4%	15.7%	15.0%	22.8%	26.1%
Industrial	74.6%	46.9%	53.6%	19.8%	36.8%	37.1%	35.0%	58.6%	39.4%	41.6%	53.7%	25.5%	17.8%
Commercial	8.7%	11.7%	11.9%	12.6%	7.6%	15.7%	18.7%	13.6%	10.0%	7.7%	6.7%	10.2%	13.3%

The larger ambitions of the Canadian energy sector include reducing the use of fossil fuels and decommissioning all coal plants by 2040, with an overall reduction of greenhouse gas (GHG) emissions by 30% below 2005 levels by 2030. These goals cannot be addressed separately from the pursuit of broader technological innovation and new technology adoption nationwide, which requires an increased access to communications infrastructure as well as increased reliability and stability within the electricity sector.[5] While there are a number of challenges facing the sector writ large, the recent COVID-19 pandemic has posed additional challenges and opportunities, with specific implications on the adoption of smart grid technologies (see Section 8). COVID-19 has reduced economic activity in almost every sector around the globe, and its effect on the energy sector has been substantial.

4. https://www.cer-rec.gc.ca/nrg/ntgrtd/mrkt/nrgsstmprfls/cda-eng.html **5.** For more on Canada's energy ambitions and challenges experienced in the traditional utility space – please see, *"Industry Perspective - Smart Grid Technology Adoption Across Canada", October, 2019* – https://www.marsdd.com/wp-content/uploads/2019/03/MaRS_Industry-Perspective-Smart-Grid-Technology-Adoption-in-Canada_Oct2019-.pdf

7

Barriers to Smart Grid Adoption

The following section highlights the challenges and barriers to the adoption of smart grid technologies, which were raised during primary research interviews. It's important to continue research in this area in order to provide feasible actions to overcome identified barriers. Based on the interviews, eight key challenges were identified that impede the ability of the sector to adopt innovative technologies. These challenges fall under the following broad themes: Policy, Regulation, Business Models, Market Structure, Energy Sector Culture, Customer Awareness, Technological Integration, and Data/Digitalization.

Similarly, further to objective #4 of this report – *To inform post-COVID-19 economic stimulus and recovery activity and priority investment areas to drive the energy transition across Canada.* – addressing these barriers will help Canadians achieve climate and GHG targets – while adding jobs and contributing to a green recovery from COVID-19.

A. Policy and Regulation – The policy environment, pathways to innovation, regulatory leadership, the regulatory-market gap

Policy

The Policy Environment in Canada

"Because utilities are heavily regulated, the risk and consequence of adopting and implementing new technologies, which may undermine the stability of the grid, is far too high. Solutions that can be tested in a sandbox environment and then scaled are the safest and least risky, but policy then must be friendly to innovation and incentivize the development of long-term solutions by utilities and entrepreneurs." – Utility

Interviewees noted that the policy environment in Canada is not welcoming to smart grid technologies. Some highlighted that in particular, both federal and provincial/territorial policy in Canada is confusing to navigate, and does not foster the strategic foresight necessary for the highly regulated electricity sector to make investments in vital future innovation. Competing interests across levels of government can also be seen to prevent policy mechanisms from properly informing market structures, mandates and objectives. One example referenced by an interviewee was the regional dissent of provincial governments from the federal carbon taxation regime. Interviewees suggested that policy mechanisms should be incentivizing the adoption of smart grid technologies through tariff structures or new business models such as "cost of revenue" (COR)[6] contracts, rather than "cost of service" (COS)[7] contracts – allowing utilities to earn and re-invest revenue into new innovative projects and revenue streams. This would also allow for OEMs, startups and other solution providers to more easily be tendered for a market solution.

"It is the governments' and regulators' job to incentivize and ensure that they are motivating the changes that we want to see in the sector." – Original Equipment Manufacturer

Governments should be setting targets at both the national and regional levels to incentivize the adoption and deployment of new technologies. The absence of aligned federal and provincial policy objectives based on a broader definition of energy (one that includes, for example, cities,

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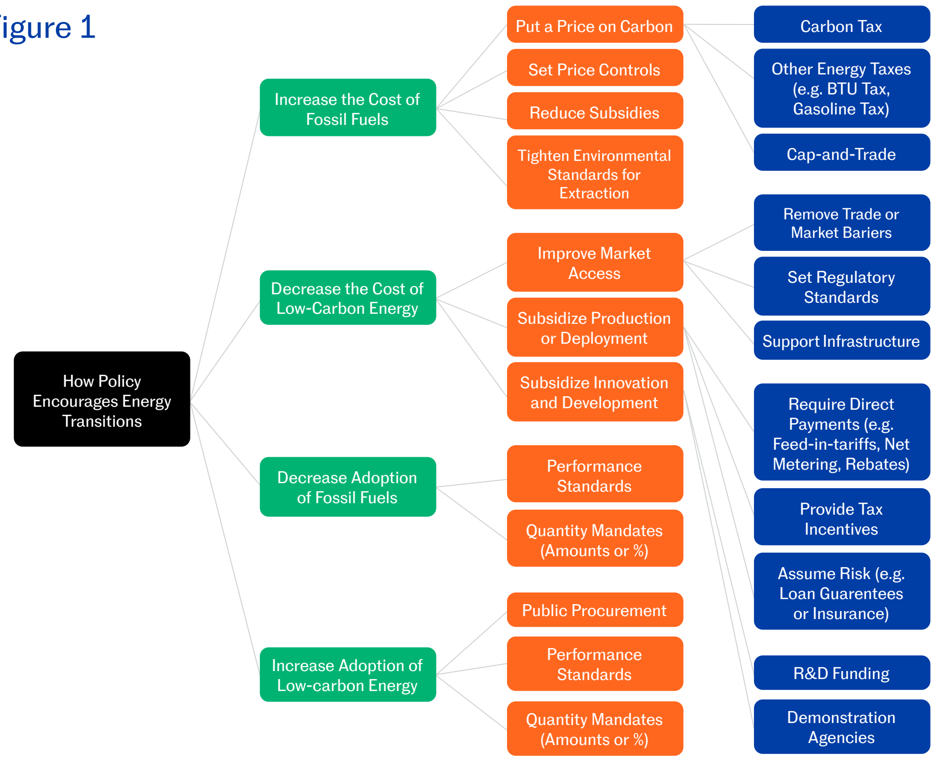
6. Cost of revenue: total cost of manufacturing and delivering a product or service to consumers **7.** Cost of service: reflects the total amount that must be collected in rates for the utility to recover its costs and earn a reasonable return transportation and the Internet of Things) reinforces traditional conceptions of the energy sector. Aligned targets that oblige collaboration between both conventional and unconventional partners will incentivize the adoption of new technologies and motivate technological advancement in the sector generally.

Interviewees noted that the energy sector broadly needs a roadmap – a clearly articulated long-term policy that supports innovative change and enhances the value proposition of engaging in innovative projects. Multiple interviewees noted that the identification of ‘energy’ broadly as an area of national security in the U.S. has allowed for a country wide conversation and approach to solving energy issues. Without such a roadmap, jurisdictions will continue to differ in their approaches, timelines, and plans for sector advancement and innovation. Regional innovation plans also need to be developed to provide clarity on the challenges involved and the locations where infrastructure can and should be built, as well as supplying jurisdictional clarity on how local laws and regulations will be amended to reflect new policy goals.

Pathways to Innovation

Innovation in the energy sector today is synonymous with climate action. Policy choices can provide nearly limitless pathways to the achievement of these goals – pursuing energy sector emissions reductions while also enabling opportunities for new technology adoption. Interviewees noted that one of the most frequently discussed methods is setting higher carbon prices. Unless provinces intervene to increase stringency, interviewees pointed out that the federally enforced price of carbon alone is not enough to make a significant impact in fossil fuel

Figure 1



Source: *School of sustainability, Arizona State University*[8]

use nor act as a sufficient catalyst for change. Other policy mechanisms and pathways to change in the energy sector, highlighted below, will be required, and should be explored.

Moving beyond carbon pricing to a range of additional energy transition pathways, interviewees identified that specific procurement targets for new technologies would enable an easier technological transition. Canadian electric utilities (with the exception of Fortis BC[9] who were recently approved $24 million over four years to fund clean energy innovation[10]), traditionally cannot rate-base new technologies that don’t fall into the current categories of capital costs or infrastructure expenditure. For example, energy storage (with some exceptions in the far north) cannot be rate-based despite the value it adds to the grid through stability and resilience.

Interviewees pointed out that funding is another way that multiple levels of government can signal and encourage the pursuit of their objectives. The type, duration, purpose, and design of government incentives all have different effects on the ability of electricity sector players to leverage funding opportunities. Interviewees raised that short-term, or multiple rounds of incentives serve as negative signals to the market – they disincentivize electricity sector players from making their own investments and from investing in long-term solutions. They also mentioned that short-term funding increases the likelihood that pilot projects remain pilots as the incentives for longer-term projects are removed. It is important to note that governments will typically help commercialize new technology, but it is up to the market to adopt and scale solutions.

8. https://static1.squarespace.com/static/5b6f913085ede1a17e4c2bf7/t/5ba2bb1b21c67c9e611ca509/1537391389069/Breetz+Mildenberger+Stokes+-+2018+-+Political+Logics+Clean+Energy.pdf **9.** FortisBC was not interviewed for this report **10.** https://www.fortisbc.com/about-us/clean-growth-innovation-fund

Regulation

Regulatory Leadership

Interviewees noted that there is an opportunity for much stronger regulatory leadership in Canada's electricity sector. Because regulation of electricity markets is provincial this leads to both higher upfront costs and higher risk-mitigation costs for new investments by OEMs or other solution providers who span multiple markets. The higher upfront costs result from an increasingly stringent and lengthy due-diligence process to ensure developments meet both current and potential future regional regulatory requirements. Risk-mitigation costs, meanwhile, often arise when the lack of regulatory direction stalls projects indefinitely. Potential regulatory changes and the burden of meeting new standards can increase the risk that a project might not meet new regulatory standards even if it met the old ones and increases the risk of potential financial loss on a project.

"Regulation is a top-down way of changing and influencing the market, where local elected officials lead through policy and supporting regulation is developed to meet the new policy. This is how utilities see the route to change – through regulatory and policy-led direction" – Utility

The slow pace of regulatory change has major impacts on the ability of electricity sector players to adopt and adapt to new technologies. Although the market is normally ahead of regulation, it responds well to increased regulatory clarity. For example, the adoption of AMI proceeded quickly across a number of provinces (in Ontario, Quebec and British Columbia) due to robust regulatory supports. However, across many provinces and territories, newer technologies, such as EV charging infrastructure, has not seen the same regulatory support and speed. The slow rollout of EV chargers is due to a number of factors in Canada – Canadians face range anxiety due the expansive nature of the Canadian landscape, and often opt for combustion engines rather than EVs – reducing the demand for EV charging stations. On top of that – level 2 chargers (50kw) – take hours to recharge a dead battery, which take up significant public space and are difficult to build a business model around. On the other hand, fast chargers (350kw), which approach the same refueling time as a standard combustion engine, are expensive and have different usage patterns than level 2 chargers.[11] Overall, confusion around who, how, and when people will be using EV chargers, and where they are best positioned geographically lead to slower regulatory direction or comittment.

In our interviews, utilities noted that there is a disconnect between their perception of risk associated with new technologies and traditional investments or technologies, compared to that of the regulator. Some interviewees felt that regulators are concerned about the destabilizing risks introduced to the grid by new technologies, such as energy storage devices. As such, they have not figured out ways to model them from either a power flow perspective, or financially. Utilities expressed that they are keen to invest in these energy storage technologies, but the perceived risk of investing in them is too high due to regulatory uncertainty. The cleavage between industries' increased interest in energy storage and the slow, and sometimes completely stalled, regulatory efforts to model these new devices on the grid creates concerns about the impact of possible regulatory change on the investment in new technologies and disincentivizes adoption.

Across Canada, regulators often lag behind current markets with outdated regulations and traditional mindsets. This creates significant obstacles for those looking to make bold investments in new technologies. These technologies did not exist when the regulations were written, and so this regulatory lag further perpetuates a conservative and risk-averse mentality to adopting innovation. As a result, many organizations are faced with extended project or deployment timelines and costs that sometimes completely remove the business case for small, yet fundamental, upgrades in areas such as energy efficiency and smart metering.

The Regulatory-Market Gap

Interviewees identified an urgent need across the industry to enhance and refine the development of standards and regulations for smart grid technologies to match the market more closely. Customers are demanding cleaner energy, and market players are falling behind incumbents in their ability to offer solutions to those looking to reduce their demand, or achieve sustainability or GHG targets. Stronger regulatory leadership can unlock value for industry players who are looking to make changes through strategic partnerships, projects, and technologies. Industry is not alone in this struggle with outdated regulations – regulators and government stakeholders have also mentioned that they find it difficult to navigate outdated regulations and streamline or update regulations in a timely manner. The complexity that comes with updating and streamlining – reflects the other side of the coin. The interconnected nature of the electricity sector makes it a difficult and lengthy process to enact change, and track the effect of a regulatory change on electricity sector stakeholders.

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11. https://www.mdpi.com/2032-6653/10/2/45/pdf

B. Business Models and Market Structure – Traditional business models, communicating value, funding, traditional market economics, regional markets, barriers to scaling projects

Business Models

Traditional Business Models

The development of business models within the sector is dependent on a number of factors within local markets. Points of consideration include regulatory models, market structure, and local grid requirements. The traditional cost of service (COS) model is a difficult business model for a utility to innovate within, which leads to an exploration of business models that are more suitable to innovative technology. The COS model is based on the idea of a utility maintaining the lowest cost possible in order to provide non-discriminatory service to all customers. The COS model is used in fully vertically integrated provinces and territories, such as Manitoba, Saskatchewan, and Newfoundland and Labrador. In provinces with open markets, such as Alberta and Ontario, new performance-based models[12] are being explored by electric utilities, and are often used for gas utilities.[13] Performance based regulation (PBR)[14] introduces new challenges for the electricity sector, such as deciding which type of performance-based model works best for a particular region or utility, but they also create opportunities for solution providers and utilities, allowing both to be more competitive and flexible in the delivery of their services while maintaining a high level of reliability and service.

Regardless of differences in market structure, utilities and other electricity solution providers across Canada all struggle to monetize smart grid projects and scale their investments. Solution providers are finding that the financial requirements of utilities for operational and capital costs deter investment in solutions co-owned by third-parties. Assets owned by third-parties become a capital expenditure for utilities, which they are unable to monetize and seek a return on through traditional rate structures. As a result, most utility-scale deployments are done through procurements and contracts, which reduces the appetite for third-party merchant projects or partnerships. In general, utilities and other large industrial firms have difficulties working with smaller, innovation-driven companies for a number of reasons, in which business models are one contributing factor.

"Becoming a successful partner requires a lot of work, and utilities need to be much more flexible with financial tools to be able to support solution providers. Innovative products and models are needed to reduce the cumulative burden on both parties in the investment and development of new products or tools." – Venture

As a result of the confusion wrought by complex market and regulatory structures, utility investors in new technologies are often unable to communicate their value to the marketplace or share the cost of those new investments with

12. Performance based regulations (PBRs) are designed to strengthen incentives for utilities to increase performance metrics, allowing utilities and regulators to focus on desired,measurable outcomes. The most common types of PBR are Award-Penalty Mechanisms (APMs) and Multiyear Rate Plans (MRPs). **13.** https://www.oeb.ca/documents/consultatation_ontariogasmarket_rateregulation_070904.pdf **14.** https://www.nrc.gov/reading-rm/basic-ref/glossary/performance-based-regulation.html other beneficiaries. This results in unnecessary financial burden on those willing to invest into new technologies, even as the value is disproportionately distributed to actors other than the investors.

Communicating Value

Solution providers have crucial roles in encouraging the energy sector to consider the adoption of new technologies. In particular, they must find ways to articulate the value of their solution to both investors and utilities in more nuanced ways. Some interviewees have suggested that solution providers should work to foster a greater general understanding of how their technologies provide value to the market or to a specific customer base. In addition, they should note the differences in priorities when investors and utilities analyze value. Investors tend to be less interested in the technical aspects of a technology and more focused on the value proposition and the commercial relationships enabled by it. Utilities, on the other hand, often focus more on the technical aspects, and are more likely to infer the value proposition based on their technical expertise. Energy storage is a good example of a technology which has multiple value propositions for different stakeholders and is thus difficult to communicate in a business case. Collaboration to commercialize projects is an important piece of the investment puzzle to expedite early on.

"The commercial collaboration agreement sets the expectations for both parties. Then it falls to the utility to provide space or appetite for a use case to be developed and tested. Once the product is ready, a partnership with a utility removes barriers to market access, such as reputational challenges associated with being a new, small player." – Utility

Interviewees, particularly utilities and large electricity providers, noted that educating and communicating value to customers, such as cities and municipalities, on what new and potentially beneficial technologies are available would also help shift the discussion at the regulatory level toward longer-term, commercially viable arrangements. These long-term arrangements can build local capacity in new technologies and community resilience through investment in new technologies, and reduce the reliance of these investments on short-term funding in order to scale projects. Interviewees across stakeholder segments stated that municipalities are often uninformed about the range of solutions and commercial options available.

Funding

In the current regulatory environment, solution providers and utilities prefer to wait for incentives and funding opportunities in order to subsidize and build commercial interest from solution providers and investors. The short-term nature of many government grants (between 5 and 10 years) motivates short-term projects or pilots - but reduces the incentive to scale viable solutions. Interviewee's noted that having more metrics within funding opportunities around developing viable business models for new technologies could enable the scaling of solutions which may not have a long funding horizon.

Access to capital often becomes particularly difficult outside of the pilot phase of a new project. Many firms are unable to access continued funding post-pilot because the funding horizons of many projects end after the first testing phase has been completed, even if the technology is proven to work and adds significant value to an organization or to customers. Interviewees noted that the overemphasis on upfront (short-term, pilot) investment is a challenge to the long-term development of projects. For example, funding for the first commercial deployment requires its own financial support.

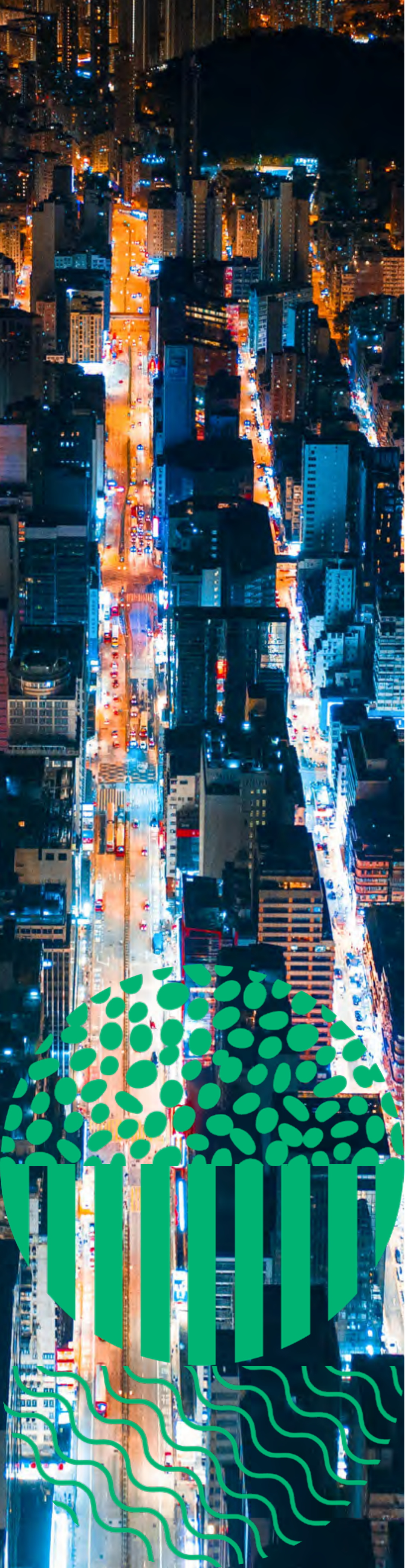
Many utilities and electricity providers in open markets in Canada finance their own projects, which increases their exposure to risk and reduces the number of organizations willing to take on the risk to lead new projects.

"Market structures and uncertainty prevent the monetization of assets, such as energy storage, which operate as both a load centre and an energy provider on the market. There is currently no market standard to model these devices." – OEM

To make meaningful change at any level, the time horizon on the quantification of the return on investment into smart grid technologies needs to be extended beyond the one to five years typical of most funding arrangements – and unique and potentially non-traditional funders also need to be explored. Large customer bases, such as cities that are considering smart grid technologies, can become leaders in the space, but to do so, they must adopt a longer-term horizon (10+ years) on their investments, and work with utilities and solution providers to understand the long-term commercial aspects of the investment.

Best practices in the U.S., such as the New York Green Bank, scale down funding for projects over time to encourage a faster transition to the adoption of sustainable and scalable technologies and business models[15] – an approach that could be applied

15. https://greenbank.ny.gov/Investments/Investment-Strategy



in Canada. Longer-term funding tied to provincial/territorial and federal objectives would also reduce the uncertainty in the market that is preventing the investment community from fully engaging the electricity sector. This funding could be tied to true impact measurement which would allow for funding targets and carbon targets to be interconnected.

According to interviewees, current government funding options are not as effective for certain kinds of businesses, such as ventures and other small-to-medium (SME) organizations. The evaluation of funding requirements often relies on proposed project outcomes rather than the development of sustainable or scalable business models. This is true for both regulated businesses, such as utilities, as well as SME's. While there are mechanisms and organizations like the Climate Action Incentive Fund, which limits its funding to smaller organizations of 500 people or less[16], intending to make the programs more cost-effective, it inadvertently ends up reducing applicability of many organizations. Incentives should be designed so that outside financing can be obtained in order to transition to scale. Subsidies for a portion of the project or system could enable wider deployment and growth and help SME's scale their solutions. While interviewees suggested improvements to these funding structures, they also recognized that each side of the funding relationship is responsible. SME's and businesses generally seeking funding opportunities need to ensure their projects are outcomes based.

Market Structure

Traditional Market Economics

Utilities, solutions providers, and government stakeholders alike noted that traditional market economics do not apply in the regulated electricity sector, representing both a risk and an opportunity. In terms of risks, regulated and/or crown-owned utilities are slow moving and often lag behind most other market players in innovation, such as digitalization, technological integration, remote work, cybersecurity or new business ventures. However, there is also an opportunity for the regulator to enable new solutions and accelerate the transition to cleaner energy solutions.

Provinces/territories that have larger fossil-based economies, such as Saskatchewan and New Brunswick, face a greater challenge in achieving federal carbon targets. As such, these provinces are at risk of leaving some communities devastated by job losses if some of these traditional sectors or employers shut down. There is opportunity in these provinces and territories to pair innovation in the electricity sector with job creation and a general economic transition away from fossil fuels.

"Now is the time to rethink the plans for infrastructure investments in Western Canada" – RIC

Canada's electricity market is not perceived to be welcoming to new solution providers. Small, value-driven providers find it extremely difficult to participate in the electricity market due to significant upfront costs. Barriers to participation for these providers include costs, complexity of market demands, and security standards. Many potential market participants find themselves

16. https://www.canada.ca/en/environment-climate-change/services/climate-change/carbon-pollution-pricing-proceeds-programming/climate-action-incentive-fund.html moving to markets in the U.S. or abroad, where there's more opportunity with investor-owned utilities or there are economic development organizations that enable market participation through business development connections. Solution providers in particular note that they have the most difficulty navigating the long sales and development cycles of utilities and governments in Canada, which prevent small ventures from turning over capital quickly. Approvals in some provincial and territorial markets take two to three years for infrastructure, whereas 12-18 months is preferred by small solution providers depending on project size. Cost recovery mechanisms also change across the market for different organizations. Utilities find it hard to recover the costs of flexible assets – both digital assets and energy storage assets – when the value of the asset is not accurately assessed by the regulator. This also applies to other new smart grid technologies, such as battery energy storage. Energy storage resources, which must pay both distribution and demand charges, have a difficult path forward to recover their costs.

Regional Markets

Interviewees noted that the regional variation in Canada's electricity markets presents a large barrier to electricity sector growth. Lessons learned in one market can be hard to translate to another, and solution providers face particularly significant challenges in transferring the knowledge and value of their new technologies across regions. Solution providers encounter barriers, for example, when attempting to do business in a new province or territory, owing to a lack of knowledge of the nuances of the market's structure. For example, different power purchase agreements may offer simple solutions in jurisdictions where there are fewer barriers to solution identification and implementation, while others require requests for proposals, which increase the time between pitch and actual payment, discouraging investment in these regions.

Solution providers, meanwhile, can be enticed by revenue agreements to provide services and add value to customers, and customers are willing to take on financial costs to ensure they have reliable access to power. One interviewee reported that customers in Newfoundland and Labrador, for example, have purchased expensive generators to ensure they have power during stormy weather. While government incentives act as risk backstops and promote market liquidity, they cannot replace private market participation. Regulation in these markets remains biased toward older and more familiar technologies, often due to significant sunk costs and perceived barriers to the adoption of non-traditional grid technologies.

Barriers to Scaling Projects

The Canadian electricity sector lacks a full system view – from generation to consumption, and this impedes the development of a common vision for the energy sector of the future. Solution providers need a complete system view in order to overcome regional differences and develop strategies to scale their solutions across regions, without forcing the cost of innovation onto one customer base. In order to scale new technologies, their technical risks must be reduced by understanding the integration needs of the existing systems. Installing new technologies that include dynamic controls should take the traditional model of "chasing the customer load"[17] into account to ensure the existing system's requirements are met.

"Up until now, utilities were a safe space, but as you start to get into new smart grid technologies and customers, well, if you don't provide the options, customers are going to find it themselves, and they're buying the product from somebody else. If we don't start adopting quicker, and moving from pilot to implementation in a shorter time frame, well, Google or Amazon is going to come along and do it for you. We need to be a bit nimbler, and quicker at turning these projects around, and proving these technologies." – Utility

Scaling risk can be partially mitigated by a utility through sharing aggregated, non-attributed data with smaller partners who are helping to install these new technologies. Small partners are much more flexible and helpful in meeting the demands of both the utility (as a partner) and the system (as an integrator).

C. Electricity Sector Culture and Customer Awareness – Risk aversion, traditional mindsets and utility culture, partnerships, people capacity

Electricity Sector Culture

Risk Aversion

The electricity sector is risk averse by nature, which poses challenges to the adoption of smart grid technologies. Utilities do not want to be the first ones to build anything new, creating an additional disincentive to develop or adopt new technologies.

17. Chasing customer load refers to increasing, decreasing generation or selling off excess electricity in line with estimated peaks and valleys in electricity consumption of a particular customer base – at a particular time of day (e.g., Residential, Commercial).

Interviewees operating in both the U.S. and Canada noted that this is particularly evident in Canada, where technology adoption is slow and there is an especially strong aversion to embracing new things. The current industry culture and regulatory environment do not encourage innovation, and regulators are not providing signals for change, perpetuating conservative approaches and de-risking mindsets. The differing levels of risk tolerance in Canada and the U.S. are reflected in their respective policies and regulations. In Canada, policies and regulations encourage more secure developments, but they also slow progress and the speed of adoption. In states like New York, Texas and California, regulations are more open to risk, which drives innovation.

Traditional Mindsets and Utility Culture

"The barrier we're running into is not technology or financial - it's human resources. The volume of change that we're running through is a challenge" – Utility

Culture change in the utility sector is particularly important for the adoption of smart grid technologies. The existing culture tends to be guarded, traditional, and difficult to penetrate because it is centred around established, close-knit communities of traditional electricity players. As the electricity system changes, distribution utilities will be particularly impacted, but they can also enjoy significant opportunities if they can position themselves as leaders. Shifting this mindset may require re-evaluating how internal teams work together, as utilities are typically siloed organizations, and teams that are leading new projects may require buy-in from other departments. Utilities that are investor-owned and private are profit-driven and often have a very different culture than crown or municipally-owned utilities, which has helped accelerate technology adoption in investor owned utility jurisdictions. Particularly, the risk profiles of investor owned utilities are often higher due to the fiduciary responsibility investor owned utilities have to their shareholders. While safety, security, resilience and the low cost of power are still front and center of these utilities – shareholders demand growth – forcing more experimentation and riskier investments.

Partnership and Collaboration

There are many barriers to pursuing and activating partnerships throughout the electricity sector. For utilities, which traditionally have monopolies in their jurisdictions, too much time is often required to develop projects and build appropriate political and public support, slowing down the process of transforming energy systems. In some cases, utilities can be resistant to private development in general. There is also increasing complexity in the electricity sector as customers become more willing to work with third-parties or "do it themselves" instead of waiting for the traditional actors, like utilities, to provide solutions. The sector's digital transition, meanwhile, increases security concerns. This raises questions about how electricity stakeholders can work better together to address new technology concerns in a more meaningful and tangible way. In order to achieve organizational goals, external as well as internal collaboration will be necessary. A crucial first step toward better collaboration is integrating innovation initiatives with corporate strategy.

People Capacity

"We find that people matter in transformation as much as anything else. The culture of change and progressiveness are important here."
– Venture

The capabilities and mindsets of the people working in the electricity sector have significant influence on its culture and its ability to activate new ways of doing business. Because the electricity sector is long established and monopolistic in nature, organizational ingenuity has taken a back seat to safety, stability, and reliability – all which have been reinforced by political and regulatory mandates.

The challenge this state of affairs presents is evident in work on community-based projects, such as in remote (often northern) communities, where the capacity to take on an initiative has a direct impact on the project's outcomes. In smaller communities, there are fewer people available with the skills to take on and champion more complex solutions, as they may not have the background to evaluate a technological solution's advantages and disadvantages. As a result, these projects often end up with developers who may have differing interests from community members. Agencies and programs exist to help address this gap and build capacity, but these approaches will still take some time, and organizations active in small communities need to bear this in mind when hiring or nurturing expertise. Successful jurisdictions have the stability and security to pursue innovation, which in turn enables them to attract people with similar mindsets and new talent. These jurisdictions see innovation as an economic development generator, and are able to connect with other similar initiatives.

Customer Awareness & Understanding

Customer Perception

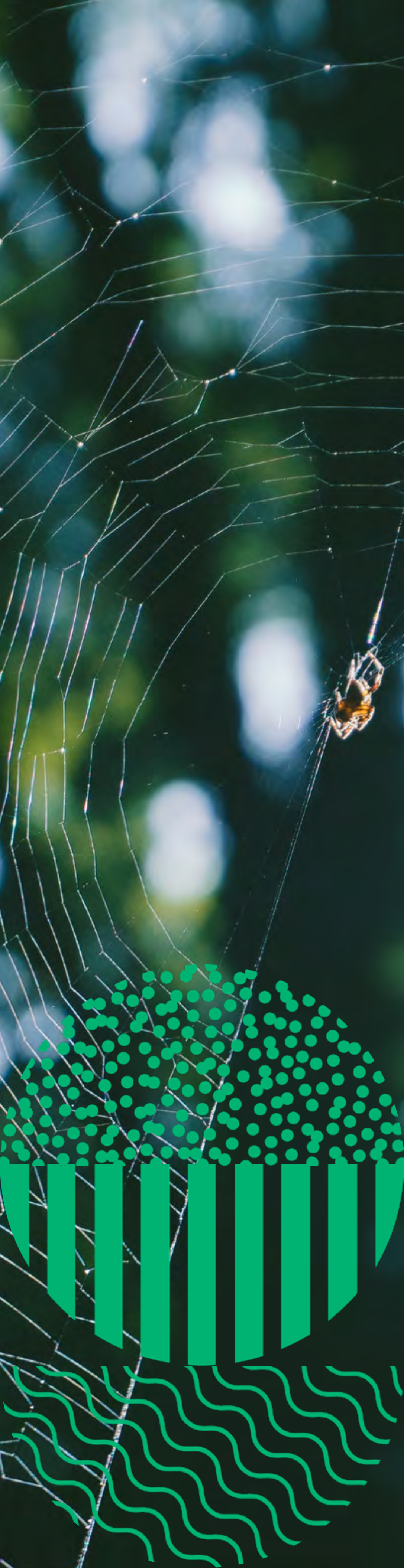
Although customer perception of smart grids varies across jurisdictions, a common barrier to increased adoption of technology is the customer's understanding of what they are buying from electricity providers as well as their perception of utilities as an extension of government. In jurisdictions where utilities have monopolies, there are fewer opportunities for customers to demand alternative approaches to electricity provision. In jurisdictions where large commercial and industrial (C&I) customers have priorities beyond electricity savings, there are challenges regarding how to engage C&I customers and convince them to take on additional risk through pilots or the adoption of new technologies. There is also a general sense of apathy and conservatism with respect to smart grid technologies. These customer perceptions vary substantially between residential and C&I customers. Residential customers often focus their electricity on total cost reduction, reliability and general customer service, rather than new technology integrations. C&I customers however are more likely to work with a third-party solution provider to have their electricity needs met.

Education and Awareness

There are differing levels of knowledge and understanding of smart grid technologies among different utilities and jurisdictions, with interest levels varying significantly based on respective need, desire, and capacity to take on innovative projects. The complexity of smart grid technologies creates an additional technical barrier among new customers. This is particularly challenging for investing in or financing smart grid projects, because the audience is non-expert and may not have a strong technical understanding of the electricity system.

The value and impact of smart grid technologies is complex, and communicating that value requires education by providers and governments, and awareness from customers. Customers and utilities are often unaware of the range of solutions available and their respective benefits, and often lack insight regarding use cases of similar applications from other jurisdictions. Informing customers about use cases and established business models can provide significant value by helping them understand potential revenue models.

C&I customers often view smart grid technologies with distrust, seeing them as expensive with unclear value, especially when similar innovations have been regarded as under-performing. For example, customers in Ontario report that installing smart meters has not led to price reductions. This was a result of miscommunication by utilities, as price reductions were not an intended outcome and the smart meter installations were coupled with a rate increase, creating further misunderstanding. Using layman's terms and highlighting a clear value proposition are effective ways to drive the initial conversation.



D. Technology & Digitalization – Development and implementation, technology integration, rates of adoption, digital transition, privacy and security, standards, interoperability

Development and Implementation

The technological challenges facing smart grid adoption in Canada cover a wide range of issues from development to implementation. Development challenges include insufficient infrastructure and problems with scaling new technologies, while the lack of interoperability between technical aspects and standards of different solutions for system design represents an implementation barrier across the country. These technology-related challenges cannot be addressed without also considering general trends in data and digitalization, and importantly, their impact on a smart grid.

"Let's have infrastructure to decarbonize these power markets and systems and run grids in a modern, efficient way so that ratepayers can get the lowest cost and best service possible. Now is the time to rethink the plans for infrastructure investments out west."
– Solution Provider

To overcome these obstacles, the electricity sector needs a strategy for new grid infrastructure, clarity on where new technologies and solutions can be built out geographically, and more support for infrastructure development. One solution provider noted that gaps in critical infrastructure are preventing Canada from installing new renewable electricity sources – Manitoba and British Columbia, where this solution provider is looking to install facilities, do not have sufficient transmission infrastructure to support and site an additional 100MW facility, making it difficult for this particular provider to make a business case for a new investment. A more systematic, long-term approach to choosing locations for new infrastructure would help expedite the approval and permitting processes of new projects. Smart grid ventures are even more likely to encounter this challenge. For example, many Canadian utilities are lagging behind on electric vehicle (EV) infrastructure (with the exception of Quebec[18] and British Columbia[19] who have surged ahead of other provinces due to provincial targets). This challenge is not limited to physical grid / transmission infrastructure, but extends to digital and communications infrastructure as well.

One smart grid technology with its own unique integration challenges are microgrids. As microgrids employ some technologies that are not mature enough to be deployed on the grid, it is challenging to fully develop those solutions at scale. This is a particular problem for grid integration as the current electrical system was not designed for these types of solutions. Each microgrid system is also unique, depending on its use case and location, which also makes it challenging to scale. This challenge speaks to the foundational nature of certain smart grid technologies.[20] Foundational technologies include AMI, advanced communications infrastructure (ACI), demand response capabilities and even self-healing grids. These

18. https://vehiculeselectriques.gouv.qc.ca/assets/pdf/english/Brochure-running-electric-EN-2020.pdf **19.** https://pluginbc.ca/charging-stations/finding-stations/ **20.** For a more in depth discussion of foundational smart grid technologies – see "Industry Perspective" technologies represent a base layer of communications and information infrastructure which enable additional smart grid technologies and capabilities to be utilized.

Technology Integration

There are fundamental technical barriers impeding the integration of smart grid technologies into the current electricity system. In order to scale, integration into the existing system is extremely important. The traditional model of utilities involves chasing the consumer load and does not include the dynamic controls that smart grid technology requires. These controls must be built with both the local technical requirements and the needs of utilities in mind. Physical connections to the grid can also create challenges across North America as a result of both legacy infrastructure and the management of reliability and stability at the North American level through North American Electric Reliability Corporation (NERC) and the Federal Energy Regulatory Commission (FERC). The need to access the utility grid, partner with utilities, and engineering firms to establish interconnections further complicates the process of technological integration.

Rates of Technology Adoption

"Utilities are generally very conservative, but they are now being forced to adapt and adjust, as the adoption of tech by industries has been sped up ten-fold, and the amount of investing in cleantech is only increasing." – Corporate Venture Capital CVC

Canada has experienced differing rates of smart grid adoption across the country[21], providing many lessons that lagging provinces and territories can use to leapfrog from current technology to state-of-the-art solutions.
For example, regions that are now shifting away from coal can skip the transition to gas, and integrate renewables and storage instead.

The investment community expects to see a continued increase in the adoption of digital technologies by the electricity sector. In particular, this trend will continue with utilities, who are generally conservative, but have accelerated adoption in order to adapt and adjust to the changing landscape. As such, it is likely that cleantech investments will benefit from the result of increased digital tech adoption. It will be important to leverage this trend and opportunity for additional funding to accelerate and increase technology adoption.

In addition, the electricity sector often sees underdeveloped tenders, requests for proposal (RFPs), and specifications for smart grid and storage projects (compared to better understood products such as solar inverters). Technology providers and project developers in particular often encounter projects with specifications which are either bespoke to a particular region or are contradictory to specifications being used elsewhere. A better understanding of these specifications would help enable the development, tender, and deployment of scalable projects.

Digitalization and Data

Transition to Digital

The transition to smart grid technology requires an understanding of how to gather data from the field, clean and store the data, as well as use and analyze that data. Acquiring this technical and digital capability is crucial for the electricity sector as effective use of this data can support planning, demand management, and support new offerings and insights. As such, there's an opportunity for the sector to learn how to use data more effectively and improve operational efficiency. The inability to effectively use data also hinders a utility's ability to utilize the increased amount of data both required and generated by a 'smarter' grid.

Smart grid technologies have generally been advancing rapidly over the last few years, and digitalization and automation will become increasingly valuable tools to accelerate adoption.

"The challenge the sector faces is how to transition a hundred-plus-year-old system that wasn't designed for change to digital." – Venture

There is a current gap in understanding the impact of software on the grid. This needs to change in order to enable greater software adoption by utilities. Rather than only focusing on adding hardware devices to the grid, the digitalization of infrastructure would help pull the right resources in the right location to improve on operational efficiency. Digital tech would also support new capabilities, such as dynamic real-time demand response and monitoring, self-healing grids, as well as artificial intelligence. Investing in digital transformation has a significant rate of return, and it's important to apply that to cleantech. The main barriers to digitalization in the industry include an absence of domain expertise to handle and leverage large volumes of data, lack of data available, difficulties accessing data, and concerns around privacy and security.

Smart grid solutions also require the integration of multiple data sources. This in turn requires diligence in cleaning data from several different sources (e.g., Global Information System (GIS), Advanced Metering Infrastructure (AMI)

21. https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/canmetenergy/pdf/Smart%20Grid%20in%20Canada%20Report%20Web%20FINAL%20EN.pdf

and Supervisory Control and Data Acquisition (SCADA)), and ensuring consistency in the data across the board. Some utilities leverage large-scale enterprise systems to avoid potential integration challenges in the future. From a technology perspective, they would prefer to integrate once rather than 25 times.

There are other opportunities to reduce barriers and de-risk the implementation of smart grid technologies, such as by providing a secure space to test the integration of new technologies. The New York Power Authority's Advanced Grid Innovation Lab for Energy (AGILe)[22] is a great example of a safe space to test technology. AGILe develops models and tests advanced transmission applications, cyber security, sensors, automation and controllers, serving as a sandbox for in-the-loop testing[23] of both software and hardware.

Privacy and Security

In order to leverage insights and make data-driven decisions, the data itself must first and foremost be available and accessible. When important data regarding factors such as consumption and grid operations is unavailable, it creates challenges for the integration and ramping up of smart grid technologies.

"To overcome data sharing barriers, we invest in feasibility studies from universities, academic and other institutions such as CanMET. We share data with them and ask them to determine if a concept is even viable. Once that is proven, we proceed to the next step. We share aggregated utility data freely with academia, and with corporations via an NDA." – Utility

Obtaining permission from households to access residential data that are submitted by aggregators to system operators also presents a challenge. System operators require their own mechanism to access data easily and in a timely manner, without compromising privacy. There are third-party entities, such as smart metering entities operating in homes that have either a substantial amount of meter data or proxies for meter data, and can readily provide data on residential loads. Although residential customers play a critical role in demand response (DR), they lack incentive to participate because they are not direct beneficiaries of gains in efficiency or cost reductions. One successful way to overcome this data-sharing challenge, and more easily integrate smart city technologies, is to conduct a public consultation and participation process assisted by an independent body, which can demonstrate the benefits of sharing data between utilities, customers, and solution providers – the Green Button data sharing standard offers some parallels as a business case here.[24]

Utilities require expertise and software to maintain their digital infrastructure, handle large volumes of data, as well as analytics capabilities to generate insights from the data. Grid operators, however, do not always have the skillsets required to maintain a fully digital system, and can be skeptical of the reliability and security of using Cloud services. These concerns are the operator's commitment to the security of digital systems, which may be threatened by potential breaches of third-party providers.

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22. https://www.nypa.gov/services/digital-energy-services/agile-lab **23.** In the loop testing is the digital or physical replication of a complex system (a power plant or a grid system as a whole) and the testing of a hardware or software on that system to understand its effects. **24.** http://www.greenbuttondata.org/

The switch from utilities owning in-house software to purchasing software-as-a-service (SaaS) from vendors will change the way utilities pay for technology. SaaS is an operating expense, which, with few exceptions, cannot be rate based, and therefore utilities are heavily incentivized to choose an in-house software option (a capitalization expense[25]), which may delay adoption or integration. For example, NERC requires data storage to be done in-house[26], which prevents utilities from using Cloud services for computation or storage, and thus limits data capabilities and the uptake of related technologies and services.

Interoperability and Connectivity

Technology specifications and technological requirements can either hinder or enable smart grid adoption. Some digital tools and processes currently in use can slow the adoption of smart grid technologies because the tools are unable to model or dispatch energy storage or the aggregation of DERs. SCADA systems and network modeling tools have limitations regarding the representation of storage or hybrid facilities – making them difficult to model and understand their effect on the grid. There are other options in the market, but they require fine tuning and customization for each jurisdiction.

In order to make the benefits of smart grid technologies available to different utilities and jurisdictions, Canada's energy sector requires greater interoperability and connectivity across the country. Interoperability problems, including differences in technologies, standards and security protocols, creates connection and data-sharing challenges which hinders national cooperation. This also makes it challenging for utilities to integrate solutions from multiple vendors, and limits insights that can be gleaned from that data.

"To overcome integrating system barriers, we built our own fiber system and communication system and didn't deal with any third-party advisors, which means we don't have to think about security as much – there is no physical interconnection between any third-party external systems." – Utility

Technology providers encounter additional manufacturing issues unless they are providing a turnkey solution. For example, battery providers need to be able to integrate with different battery management systems. Establishing clear standards across the sector would help streamline this process. In addition, building control centres to serve as central connection points would enable utilities to more quickly realize the benefits of new technologies and build out the next generation of smart grid solutions. From a system operator's perspective, this would also allow for greater wholesale market participation and the coordination of resources across different levels of the electricity system.

Interviewees also recognized the need to innovate across the sector to deal with significant exogenous disruptions to supply chains and even the reliability of the sector itself. The impact of COVID-19 on the sector has not fully been understood – and energy sector stakeholders see the implication of COVID-19 as both a potentially major barrier to sector change – as well as a significant opportunity if leveraged successfully into new investments.

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25. BloombergNEF, Utilities, Get Your Head in the Cloud (November 20, 2018) **26.** https://www.nerc.com/pa/Stand/Project%20201602%20Modifications%20to%20CIP%20Standards%20RF/Storage_Virtualization_Webinar_07272017.pdf **27.** https://news.bloomberglaw.com/environment-and-energy/green-energy-seeks-funding-ahead-of-canadas-oil-and-gas-bailout

8

Impacts of COVID-19

The COVID-19 pandemic has had major impacts on the electricity sector, as outlined below. It is however important to note that COVID-19 also presents the sector with a huge opportunity as the world begins to reopen and rebuild economies. A "green economy" has been a major theme in recovery measures across Canada and globally. For example, the European Union's stimulus package has earmarked one-third of its funds towards addressing climate change.[28] Many governments are looking towards the energy sector in particular as part of their economic recovery efforts. COVID-19 has uncovered numerous challenges experienced in the energy sector which are directly linked to challenges highlighted in Section 7. Using the effects of COVID-19 as a frame to understand where investment is needed and barriers need to be overcome will help to ensure that challenges and barriers being addressed are being done in a meaningful way – highlighting both short- and long-term objectives which need to be achieved to ensure an equitable and sustainable economic and sectoral recovery.

Economic Impacts

The economic downturn[29] resulting from the COVID-19 pandemic is creating general concerns for the electricity sector due to the potential decrease in working capital. Many drivers of smart grid technologies – including a thriving economy, capital flexibility, and the high price of oil – have all been diminished. In the absence of these external catalysts to innovation, it is likely that investment in smart grid technologies will slow down unless it is significantly incentivized.

The pandemic is also having significant secondary effects on energy markets. Buyers and solution providers dealing with this crisis noted they are less worried about efficiency and more concerned about automation or the number of people required for new builds. Changes in access to construction sites due to social distancing measures is lengthening the time required to build new assets as well as increasing the overall cost of projects. Some projects have been stalled to date due to the lack of digital processes to process and approve building permits. Notably, in some cities, municipal departments that issue building permits were unable to continue to operate with work from home policies in place.

Energy Demand

Electricity providers noted that COVID-19 has also had a significant impact on electricity demand. The sector has seen a shift in demand from C&I centres to residential centres. This reduction in revenue is affecting the capital budget of utilities – possibly eliminating the incentive or ability to invest beyond core services. In open market scenarios, this lack of revenue may result in either bankruptcy or the consolidation of local distribution companies.

The pandemic has also had an impact on the underlying loads that make up demand response (DR) resources, and projects have been stalled and delayed. However, they have not been cancelled, as the reduced demand is recognized as a temporary event that will pass, with a return to a "new normal."

28. https://www.bloomberg.com/news/articles/2020-07-21/eu-leaders-reach-deal-on-750-billion-euro-virus-recovery-fund
29. https://www.bloomberg.com/news/articles/2020-03-18/no-industry-left-unscathed-in-canadian-economy-gearing-down

Operations and Technology Adoption

“As a company we overcame obstacles we thought were six-to-twelve-months out. We solved them in a week. It’s amazing to see how quickly we’ve been able to implement and adapt. It forced a lot of innovation internally, this has set the precedent that we can get things done quickly.” – Utility

For some utilities, COVID-19 has had a positive impact on operations and technology adoption. It has helped to shift internal mindsets and accelerate the implementation of technology. COVID-19 has forced a lot of unintentional innovation, obliging people to embrace new ideas and opportunities and to find new ways to use technology. The ability to provide concrete examples and use cases during this time has facilitated greater buy-in from employees and regulators. It has also helped provide data on the future of work at utilities, with a better understanding of how many people and other resources are needed to support these types of initiatives, such as data management and cybersecurity.

Policies

As the pandemic persists and impacts continue to be felt, there is significant concern in the electricity sector that the policies and directives that drive the demand in smart grid technologies will slow down as priorities shift to supporting economic recovery and growth. Traditionally, governments have prioritized building new infrastructure, such as roads and bridges, after an economic downturn to create new jobs and growth opportunities. Instead, the Canadian government should focus on infrastructure to decarbonize these power markets and systems, and run grids in modern, efficient ways.

Resiliency

As a result of COVID-19, the energy sector has seen a broad, rapid shift towards resiliency. This shift has not only addressed resiliency challenges of the electricity system but also the operational and financial resiliency of energy sector organizations. This includes new types of considerations, such as environmental sustainability and digitalization. The pandemic has revealed a range of interconnected areas that affect organization and system reliability, including manufacturing, supply chains, and customers. Insufficient resilience in any one area creates knock-on effects in other areas. Strategic investments in future-proofing technologies and offerings for customers can help build resiliency as energy systems ebb and flow with policy and economic changes. For example, if Canada ramps up its decarbonization strategies, organizations that are resilient will have already begun to invest in carbon-free and renewable electricity projects, which will be essential assets as we move toward a net-zero economy.

9 Conclusion

The electricity sector is in the midst of a major upheaval. The research conducted for this report makes it clear that innovation within the electricity sector, encompassing the funding, development and scaling of new technologies, is complex and nuanced across Canada. Electricity sector transformation has significant impacts on many different parts of the economy, and the most affected sectors need to be directly engaged in the discussion of smart grid technology adoption and advancement.

More generally, Canada stands at a strategically challenging nexus of government experimentation and radical shifts in major economic sectors. The energy sector is an engine for both economic growth and transformative change. Investments into technologies, systems and people which work towards the sustainability of our energy sector – are of immense value. These investments are even more valuable during a time defined by mass unemployment, political uncertainty and the need for innovative solutions to problems that will persist beyond the era of COVID-19.

10 Acknowledgements

This report, *Industry Perspective: Understanding Barriers to Smart Grid Adoption* was done in collaboration and with support from Natural Resources Canada. MaRS would like to thank the 27 interviewees and 24 organizations willing to speak to MaRS about the challenges and barriers they experience advancing the sector and adopting smart grid technologies

This report was completed in line with the MaRS vision of promoting the adoption of innovative, new technologies, and supporting collaborative innovation within Canada and internationally.

The information in this report is general in nature and provided as a summary of interviews. This report is meant for informational purposes – to aid in the understanding of challenges to innovation faced by the electricity sector in Canada.

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