Ivey Business School
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Energy Policy and Management Centre

Electrification and Investment in Electricity Infrastructure

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EXECUTIVE SUMMARY

Canada's electricity sector has the potential to play a central role in the country's transition to a low emission economy and in meeting Paris Agreement emission reduction commitments, due to its significant utilization of zero emission hydroelectric, nuclear and renewable power generation technologies – which rank Canada as having one of the world's greenest electricity grids. Yet, achieving electrification objectives will require major investments in new electricity infrastructure across the country: recent research estimates that in order to achieve the net zero target by 2050, Canada would need to more than triple its power generation capacity, build over 23,000 kilometres of high voltage transmission lines, and invest in new energy storage technologies, all at a cost of more than $1,100 billion over the next thirty years. The challenge for policymakers and regulators will be to attract sufficient financial capital and to encourage investment in electricity infrastructure in an efficient manner that does not impose undue cost burdens on end-use consumers or disrupt the reliable supply of on-demand energy services.

This Policy Brief provides an in-depth assessment of the investment environment for Canada's electricity sector based on data from an extensive survey of senior industry executives conducted by the Ivey Energy Policy and Management Centre at the Ivey Business School. Analysis of survey responses offers insights into views of the climate for investment, firms' investment plans in electricity infrastructure – power generation, transmission, distribution, energy storage, energy management services and smart grid technologies - and the impact of economic, policy and regulatory factors on investment decisions.

A core finding is that while at an aggregate level investment conditions are perceived as somewhat favourable – primarily due to supportive economic factors – they are patchy across provinces and technologies. Overall conditions for investment are relatively positive for nuclear power generation and for newer technologies such as smart grid and energy consumption management, but less so for renewable and hydrocarbon power generation. The investment environment in Alberta is regarded more favourably on average than in British Columbia and New Brunswick, although within Alberta conditions for renewable power rank better than for distribution and transmission. Similarly, within Ontario, investment conditions for nuclear power and newer technologies are more favourable than for renewable power and distribution and transmission networks. Since electrification requires coordinated investments across multiple parts of the electricity sector value chain, as well as coordination between provinces, there is a risk that the existing patchwork of investment conditions will impede progress in meeting national policy objectives.

A second finding is that public policy factors overall have a neutral impact on investment decisions, but provincial regulatory frameworks for the electricity sector are viewed as having a somewhat negative impact – notably for transmission and distribution, within British Columbia, and for much of Ontario's electricity sector. Weaknesses in the regulatory environment can hinder private sector investment, particularly in new energy technologies that do not easily fit into existing frameworks, and for inter-provincial transmission projects that require jurisdictional cooperation. Survey respondents indicated that a priority for provincial governments should be to improve the stability and transparency of energy policies and regulation, which would foster greater investment certainty.

At a broad level, the results of the survey highlight the need for a strategic and coordinated approach to developing electrification policies, both within and between provinces, as well as strengthening regulatory conditions within all parts of the electricity sector value chain.

INTRODUCTION

As part of Canada's climate change commitments under the Paris Agreement, the federal government is proposing to transition Canada to a net zero emission economy by 2050,[1] a process that could involve increased electrification of the economy. Electrification refers to the substitution of hydrocarbon-based energy sources with technologies that use electricity as a source of energy. When electricity is generated from non carbon-emitting sources such as wind, solar, hydroelectric, or nuclear fuel, increased electrification of a country's more carbon intensive sectors reduces overall carbon emissions.

Canada has a relatively low emission electricity sector compared to many other countries given the preponderance of hydroelectric, nuclear and wind power: it ranks 3rd globally in hydroelectricity, 6th in nuclear and 8th in wind electricity production.[2] The greenhouse gas (GHG) intensity of Canada's electricity sector is 123 gCO_2 / kWh, which is among the world's lowest and well below the world average of 450 gCO_2 / kWh.[3] Increased electrification of Canada's residential and commercial building, heavy industry, and passenger transportation sectors, which together account for approximately half of Canada's emissions, thus represents a potential path forward in the transition to a low carbon economy.

Electrification of the economy would require significant capital investment, however, in new electricity infrastructure. According to one recent estimate, the cost of annual investment needed in new electricity generation, transmission and storage assets would range from $9.8 billion to $47.7 billion during the period 2016 to 2050, with a cumulative total of more than $1,100 billion.[4] Other countries are also pursuing electrification goals, and so global competition for financial capital to fund infrastructure investment is likely to intensify in the coming decades. One core challenge for policymakers and regulators will hence be to establish an investment environment that is sufficiently attractive to globally mobile financial capital and to create the conditions that support long-term investment in electrification projects.

This Policy Brief provides an assessment of the current investment climate in Canada's electricity industry, specifically for generation, transmission, distribution, energy storage, hydrogen/fuel cells, energy consumption management services and smart grid technologies. The analysis is based on data from a survey of Canadian senior electricity sector executives, conducted by the Ivey Energy Policy and Management Centre at the Ivey Business School in the fall of 2020. Analysis of survey responses offers insights into senior executives' views of investment conditions, projections for investment in electricity sector technologies, and how economic, policy and regulatory factors are facilitating or hindering investment.

The next section provides a summary of key findings from recent research on electrification of the Canadian economy. This is followed by a brief description of the survey methodology, presentation of the survey results, and concluding remarks.

ELECTRIFICATION PATHWAYS TO A LOW CARBON ECONOMY

Several recent studies have modeled possible pathways for decarbonization of the Canadian economy by 2050.[5] Each study makes different assumptions regarding emission targets, future availability of technologies, and policies to incentivize consumers and firms to adopt new technologies and behaviours. Nonetheless, all pathways envisage increased electrification of end-use sectors such as transportation, of residential and commercial buildings, and of heavy industry, and new investment in low carbon electricity generation and infrastructure networks. A review of key findings from these studies offers insights into the implications and challenges for Canada's electricity sector in the transition to a low carbon economy.

First, to achieve net-zero emissions by 2050, electricity demand, as a share of total national energy demand, would need to increase from roughly 23% in 2016 to over 57% by 2050, according to one recent study.[6] This represents a 110% increase in demand from 638

terawatt hours (TWh) in 2016 to as much as 1,341 TWh by 2050. Electricity demand growth is projected to come primarily from electrification of the transportation sector through the shift from conventional internal combustion engines to electric-powered vehicles and from electrification of space and water heating in residential and commercial building sectors. The pace and amount of growth in electricity demand will depend on end-use investment in energy efficiency improvements and advances in new technologies such as first and second-generation biofuels. Meeting peak space and water heating energy demand at a reasonable cost may require the continued use of natural gas.[7]

Second, to maintain a reliable supply of on-demand energy services, substantial new investment in zero and low emission generation capacity would be required. One study estimates that generation capacity would need to increase more than three-fold from 147 gigawatts (GW) in 2020 to 488 GW in 2050, at an investment cost of approximately $840 billion to $1.25 trillion over the 30-year period.[8] Wind and solar generation are expected to be important sources of supply in the future. However, the intermittency and uncertain availability of wind and solar power necessitates complementary investment in more flexible and reliable sources of supply, such as natural gas generation. A range of factors, such as the cost and development time of new large-scale hydroelectric projects, social acceptance of new nuclear supply, and the rate of commercialization of energy storage, carbon capture, and carbon sequestration technologies, will influence the optimal investment mix in different generation technologies.

Third, economic modeling of the transmission sector suggests that major investment in new high voltage transmission lines between provinces – which have very heterogeneous generation resource profiles – would promote interprovincial trade and lower the overall cost of achieving a completely decarbonized electricity grid. For example, new transmission lines from Manitoba to Saskatchewan, Saskatchewan to Alberta, and Alberta to British Columbia would enhance provinces' access to hydroelectric and wind power.[9] Annual capital investment costs for new within- and between-province transmission lines are estimated at $28 billion to $36 billion in the full grid decarbonisation scenario. It is important to note, however, that these costs do not account for the additional transmission capacity needed to accommodate increased demand for electricity arising from decarbonisation of other sectors – and the associated increase in power generation from low carbon sources. The scenario also assumes regional coordination of capacity and transmission planning, regional pooling of resources, and integration of markets. In the absence of inter-provincial coordination, the costs of decarbonizing the grid would be significantly higher. Currently, provincial electric grid operators in Canada largely plan and operate electric power systems independently, and do not fully account for the potential benefits of regional integration and resource sharing.[10]

Finally, researchers have examined policies and regulations that can facilitate electrification objectives in an efficient and equitable manner. Technology-neutral policies such as carbon pricing or taxation, zero emission standards and clean energy tax incentives or subsidies are often considered economically efficient methods for driving private sector investment and for risk-sharing between firms, government, and consumers, though many governments have focused instead on stimulating investment in specific new technologies or projects.[11] Electricity retail rate policies will also have a major impact on how electrification unfolds. Consumer rates are expected to rise as a result of new investment in infrastructure, and integration of provincial electricity markets could also put upward pressure on rates in lower cost provinces, which may fuel voter opposition to electrification agendas. Designing rate structures that encourage consumers to use electricity efficiently and that protect vulnerable or low income groups will be an essential component of successful implementation of electrification goals.

SURVEY METHODOLOGY

The quantitative analysis in this Policy Brief draws on data from an extensive survey of senior energy sector executives conducted by the Ivey Energy Policy and Management Centre at Ivey Business School, Western University, which asked questions about the climate for investment in Canada's electricity industry. The survey was sent by email to senior executives in the electricity, oil, gas, pipeline and cleantech industries in the fall of 2020 (see Appendix A for the survey instrument). The results reported here are based on the responses of 215 executives from 140 companies active in the electricity industry.

Table 1: Survey Responses by Technology and Province

Technology	MB	NL	NB	SK	QC	BC	PEI	NS	ON	AB	Territories	Total
Renewable Generation	4	3	2	10	9	22	1	3	45	26	7	**132**
Distribution and/or Transmission	2	4		4	2	11		1	57	11	4	**96**
Energy Storage	1		3		1	4		6	20	3		**38**
Consumption Management		1	2		1	2			21	7		**34**
Nuclear Generation			8	3					16			**27**
Natural Gas/Coal Generation				2					6	6	3	**17**
Smart Grid Technologies				2	1				12	1		**16**
Other Electricity						1			4	4		**9**
Total	**7**	**8**	**15**	**21**	**14**	**40**	**1**	**10**	**181**	**58**	**14**	**369**

Table 2: Survey Responses by Technology and Firm Ownership Type

Technology	Municipally Owned	Provincially Owned	Privately Owned	Total
Renewable Generation	9	15	108	**132**
Distribution and/or Transmission	46	20	30	**96**
Energy Storage	2	1	35	**38**
Consumption Management	5	1	28	**34**
Nuclear Generation		5	22	**27**
Natural Gas/Coal Generation	2	7	8	**17**
Smart Grid Technologies	7	2	7	**16**
Other Electricity		2	7	**9**
Total	**71**	**53**	**245**	**369**

The survey asked respondents to identify up to three 'businesses' (defined by electricity sector and province) that were the most important to their companies. A total of 369 electricity-related businesses were identified (Table 1). Renewable generation was the most frequently identified business (132 or 36% of all respondent businesses), of which 108 were privately-owned (Table 2). Distribution and/or transmission businesses were the second most represented businesses, with 96 responses (26%). Most of the distribution and transmission businesses were owned by municipal or provincial governments. Nuclear power generation (27 responses), energy storage (38), energy consumption management services (34), and smart grid technologies (16) responses were predominantly from privately-owned companies. Finally, 17 natural gas/coal generation businesses and 9 other electricity businesses (e.g., retail service providers, generator service providers) were identified in the survey. Of the 369 businesses, 245 (66%) were privately-owned, 71 (19%) municipally-owned and 53 (14%) provincially-owned.

Most of the identified businesses were located in Ontario (181 or 49%), Alberta (16%) and British Columbia (11%). These provinces have larger numbers of generation, transmission and distribution companies operating within their provincial borders than do other provinces (See Appendix B, Table B-1).[12]

THE INVESTMENT ENVIRONMENT FOR THE ELECTRICITY SECTOR

The survey assessed senior executives' perceptions of the state of the investment environment in the electricity sector, asking questions about (i) future investment plans, (ii) the overall attractiveness of the investment environment, and (iii) the impact of economic and policy factors on investment decisions. Respondents were also asked to identify up to two policy reform priorities.

i. Future Investment Plans in the Electricity Sector

The overall outlook for investment over the next three years in Canada's electricity industry is relatively positive according to survey respondents, although there is important variation across technologies and provinces as well as ownership types.

Respondents projected that investment levels will likely increase in all electricity technologies in the near-term (see Figure 1A). Respondents were most optimistic about increasing investment in energy storage, nuclear generation, smart grid and energy consumption management technologies, where 75% to 95% of respondents reported that investment will increase either slightly or significantly. This is consistent with the recent focus of federal and some provincial government policies on stimulating investment in emerging and clean energy technologies. By contrast, respondents anticipated less dramatic increases in investment in 'traditional' parts of the electricity value chain, such as distribution and transmission, natural gas/coal generation, and renewable power generation.[13]

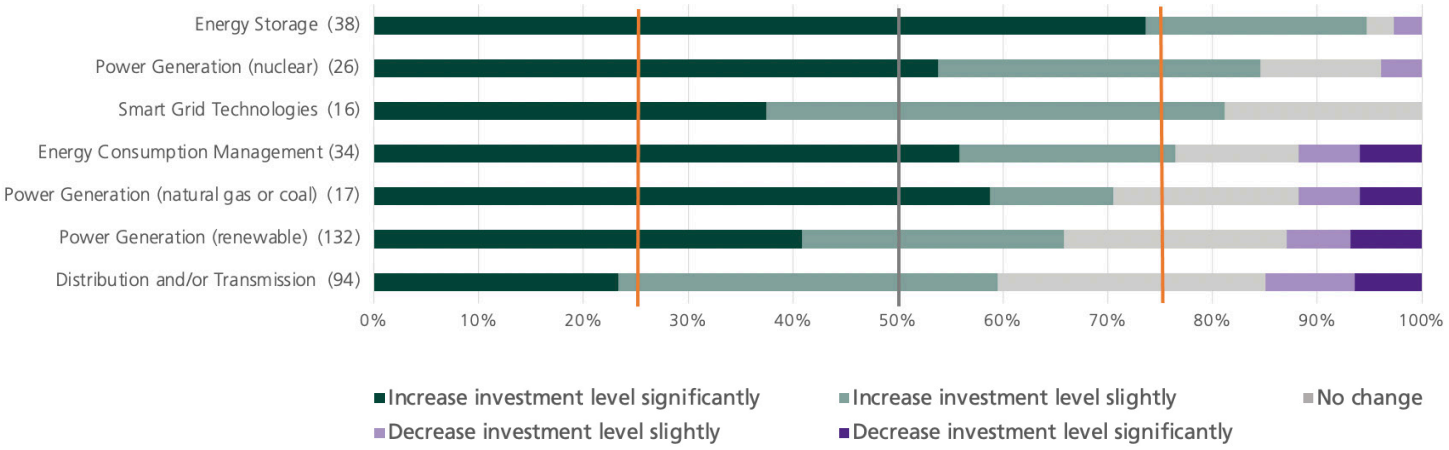
At the provincial level, electricity businesses located in the Territories, Saskatchewan, Nova Scotia, New Brunswick and Alberta were viewed as most likely to increase investment (see Figure 1B). In each of these provinces, the median respondent expected a significant increase in investment over the next three years. British Columbia ranked last in terms of investment intentions, where the median respondent anticipated a slight increase in investment, similar to Ontario and Quebec.

On average, respondents at private sector companies reported greater investment intentions than respondents at provincially or municipally-owned companies (see Figure 1C). More than 50% of private company respondents expected that investment would increase significantly, while the equivalent percentages for provincial and municipal company respondents were 36% and 21%, respectively. These differences are driven partly by the different mix of sectors since most government-owned respondent companies were active in distribution/transmission and in renewable power generation.

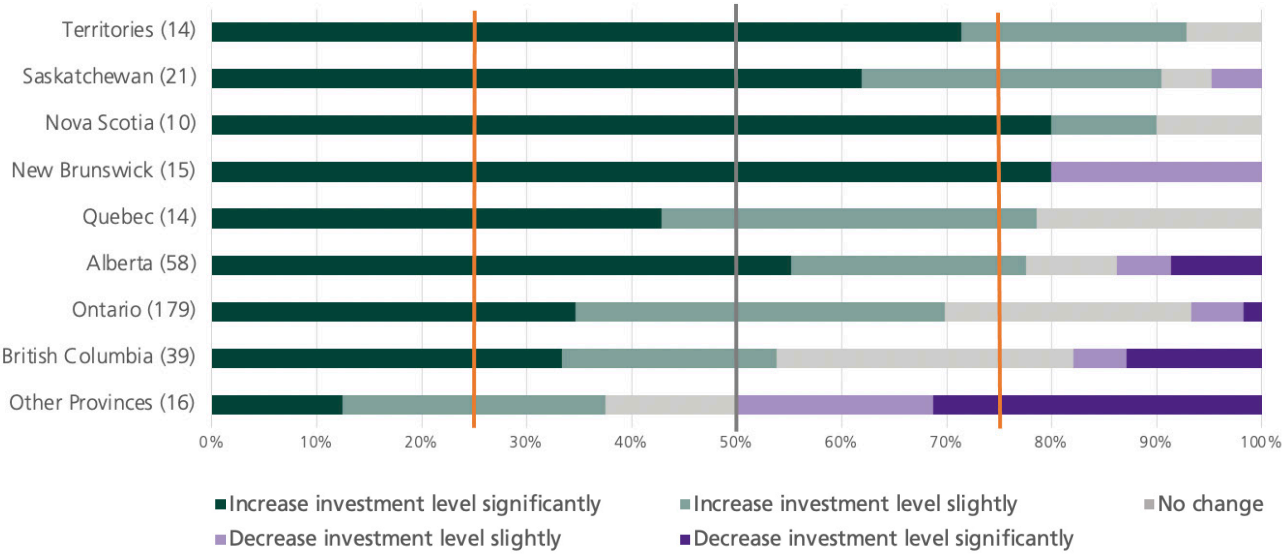
Figure 1: Expected Investment in the Electricity Sector

Q: How is the level of investment by your company likely to change over the next three years in the industries/ jurisdictions that are the most important to your company?

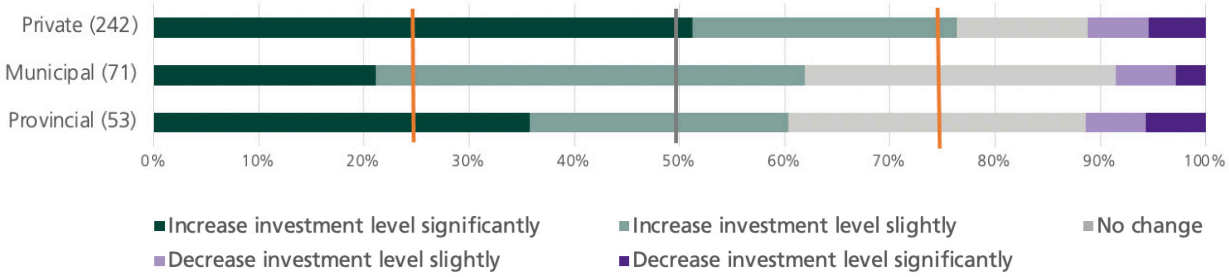
A. Technology



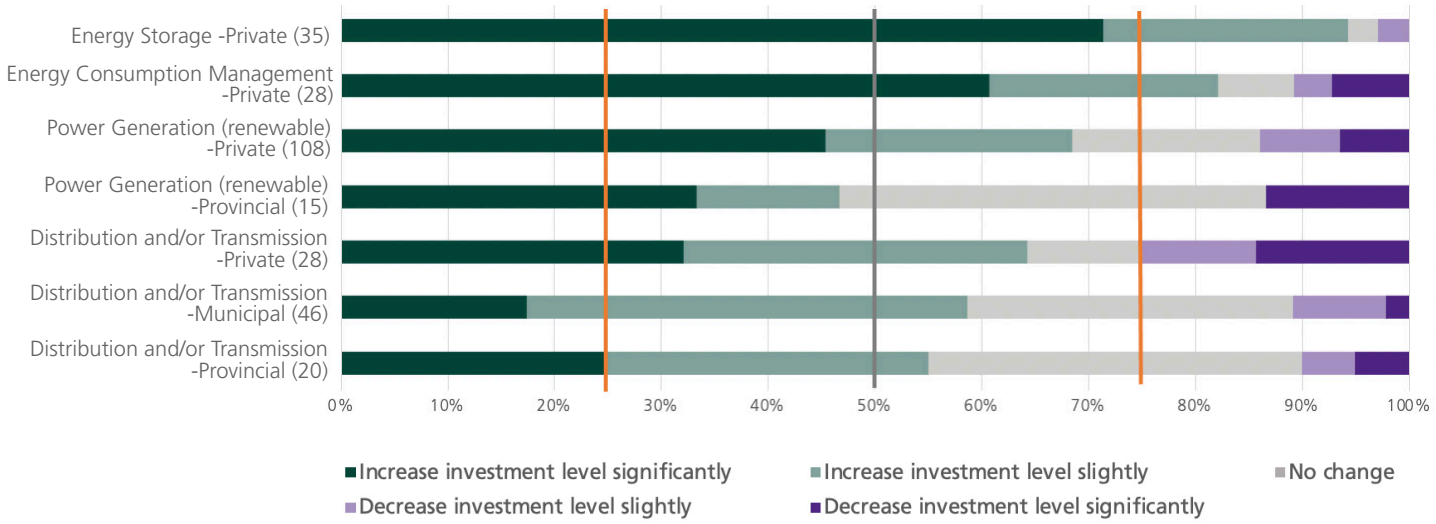
B. Province



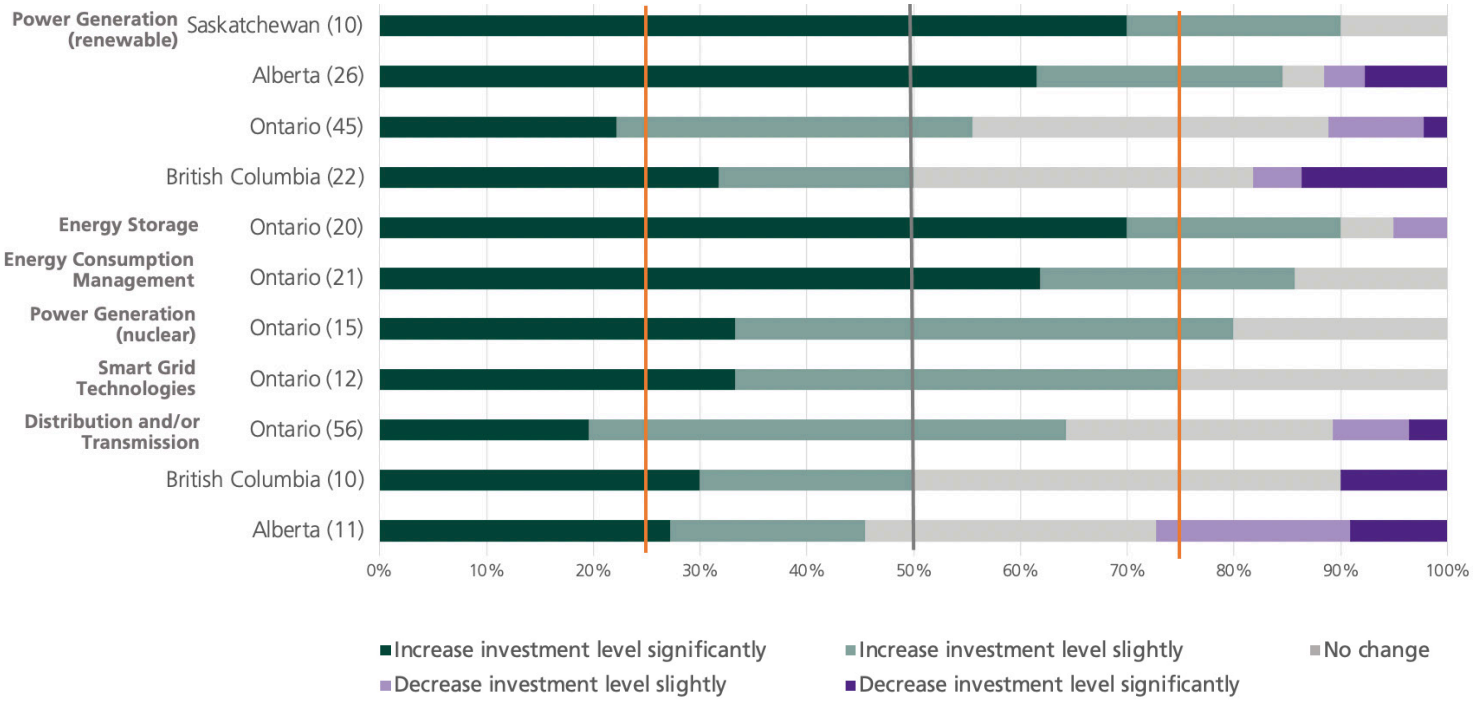
C. Ownership



D. Technology/Ownership



E. Technology/Province



Note: Other Provinces includes Manitoba, Newfoundland and Labrador, and Prince Edward Island

Figures 1D and 1E provide a more detailed look at expected investment levels by technology and ownership, and by technology and province. For both renewable power generation and distribution/transmission, private firms appeared more likely to increase investment than government-owned firms (provincial or municipal) (see Figure 1D). The median respondent for private renewable power reported that investment would increase slightly while that for a provincially-owned company anticipated that investment would not change in the near term. Similarly, a greater fraction of respondents (64%) at privately-owned distribution/transmission companies reported that investment would increase than respondents at municipal and provincial entities.

There are also interesting differences in expected investment levels between different electricity sector technologies within the same province as well as between provinces for the same technology (see Figure 1E). For example, a substantial majority of respondents in renewable power generation in Alberta and Saskatchewan expected their companies would significantly increase investment in the next three years. In contrast, approximately half of respondents in Ontario and British Columbia expected no change or a decrease in renewable energy investment. This pattern of expected investment may reflect recent trends in the four provinces' renewable energy policies. The governments of Ontario and British Columbia have recently suspended renewable feed-in tariff programs and are no longer actively procuring renewable energy capacity.[14] More than ninety percent of electricity produced in Ontario and British Columbia comes from zero GHG emitting sources (See Appendix B, Figure B-1). Alberta and Saskatchewan, on the other hand, are in the process of phasing out coal-fired electricity generation and expanding investment in renewable power generation.[15]

While the investment outlook for renewable power is positive in Alberta, the outlook for investment in distribution/transmission in the province is relatively pessimistic: a majority of respondents expected that investment in network infrastructure would stay the same or decrease over the next three years. Alberta's congestion-free transmission policy, established in the early 2000s, has led to major investment in new power lines over the last two decades, which has been recovered through higher bulk and regional transmission delivery rates for all customer classes. Increasing transmission rates have encouraged some end-use consumers to invest in behind-the-meter generation, including natural gas, wind and solar, which reduces the future need for grid-level investment in network assets.[16] Similarly, in British Columbia, approximately half of respondents expected that investment in distribution and transmission networks would remain the same or decrease.

In Ontario, the relative contrast in investment plans between renewable power and network assets is the reverse of Alberta: expected investment levels are greater for distribution/transmission than for renewable power. 65% of respondents whose companies were active in distribution/transmission in Ontario expected investment would increase in the near-term versus 55% for renewable power.

ii. Overall Investment Conditions in the Electricity Sector

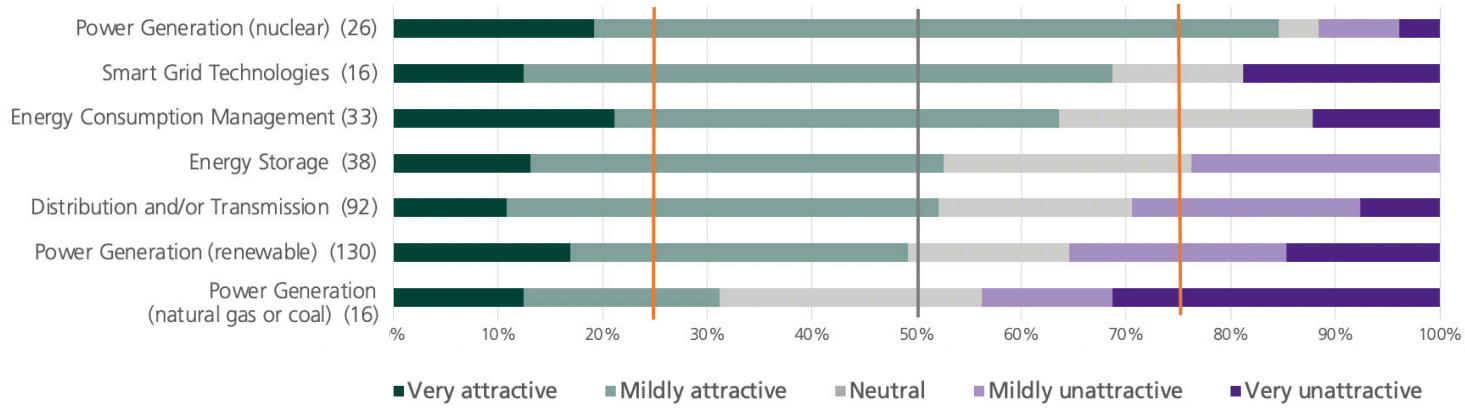
Respondents evaluated overall investment conditions as broadly positive across most elements of the electricity sector, except for renewable power generation and hydrocarbon generation (natural gas and coal), which were rated as approximately neutral (see Figure 2A). Conditions were viewed as especially positive for nuclear power generation and newer technologies such as smart grid and energy consumption management.

While there was no significant difference in evaluations by respondents at private versus government-owned energy firms (Figure 2C), there was considerable variation in assessments of the investment environment among the provinces (Figure 2B). Specifically, investment conditions in Alberta, Saskatchewan, the Territories and Ontario were rated the most favourably on average – more than 55% of respondents rated the investment environment for their businesses in each of these regions as being Very or Mildly Attractive. By contrast, the equivalent percentage was 35% for British Columbia, which was ranked overall as having the least attractive investment environment by respondents whose companies had businesses in the province. More respondents rated investment conditions as unattractive than attractive in British Columbia. Conditions in Quebec, Nova Scotia, New Brunswick and Other Provinces (Manitoba, Newfoundland and Labrador, and Prince Edward Island) rated as closer to neutral overall.

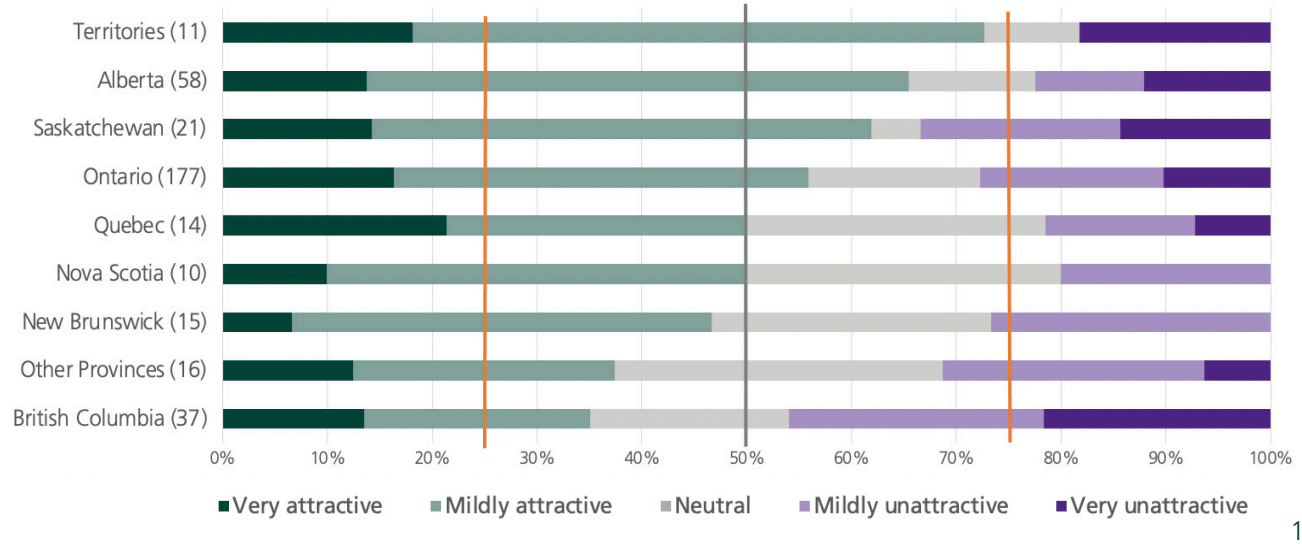
Figure 2: Investment Conditions in the Electricity Sector

Q: How attractive are the current investment conditions in the industries/jurisdictions that are the most important to your company?

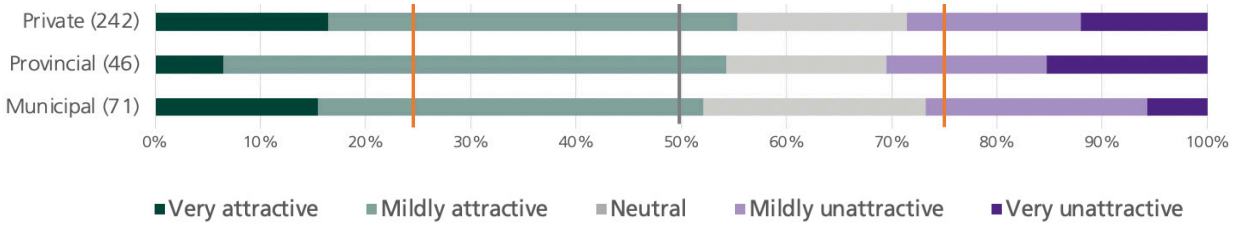
A. Technology



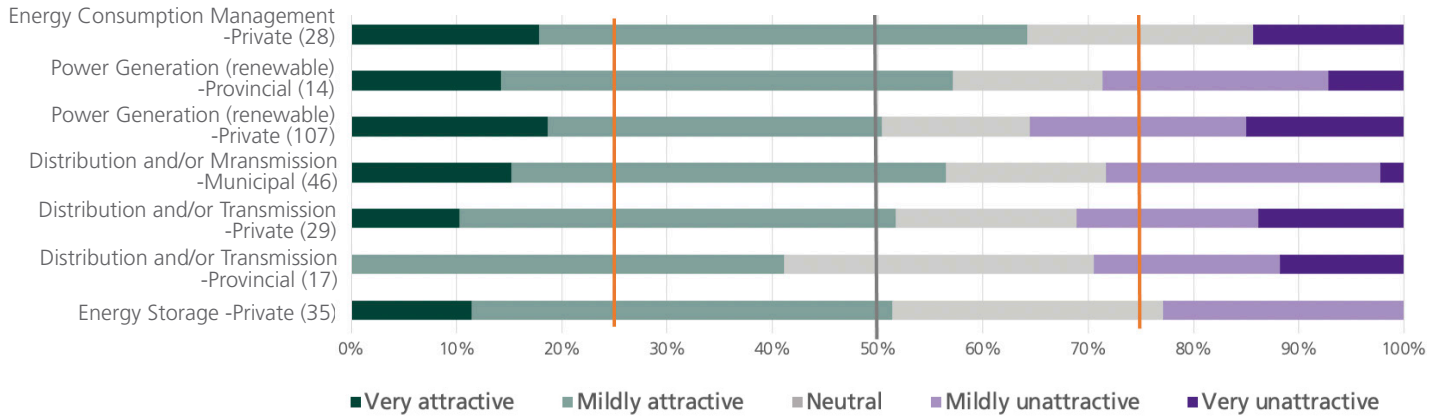
B. Province



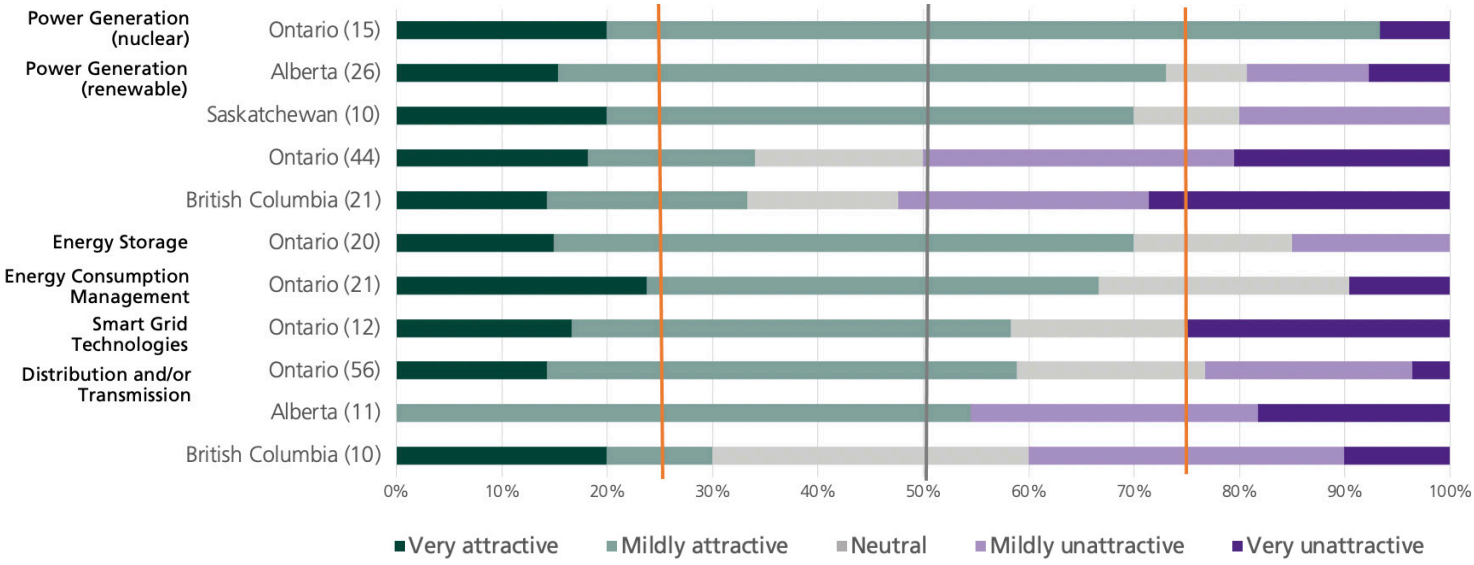
C. Ownership



D. Technology/Ownership



E. Technology/Province



Note: Other Provinces includes Manitoba, Newfoundland and Labrador, and Prince Edward Island

There were also notable contrasts between executives' perceptions of investment conditions between provinces for a given technology, and within the same province for different technologies (See Figure 2E). Respondents viewed investment conditions for renewable generation to be mildly to very attractive in Alberta and Saskatchewan but mildly to very unattractive in Ontario and British Columbia, which is consistent with respondents' stated investment intentions (Figure 1E) and the direction of the different provincial renewable energy policies. Investment conditions for distribution/transmission in Ontario were considered attractive but neutral to unattractive in British Columbia. Respondents with distribution/transmission businesses in Alberta were largely split with 53% of respondents considering conditions to be mildly attractive and 47% considering conditions to be mildly to very unattractive.

In Ontario, there was a marked difference between a positive assessment of investment conditions for nuclear power and a negative assessment for renewable power generation, reflecting the government's pause on renewable power procurement and feed-in tariffs.

iii. Economic and Policy Factors Affecting Investment in the Electricity Sector

In order to better understand why investment conditions vary across technologies and jurisdictions, the survey asked executives to assess the impact of multiple economic and policy factors on investment decisions by their companies (see Table 3).[17] A number of core findings emerge from the responses.

First, at an aggregate level, the policy environment was viewed as having a broadly neutral effect on investment in the electricity sector, but there are important exceptions that warrant attention (Tables 3a and 3b). Federal energy policy, support for innovation and R&D, and intellectual property rights protection were generally rated as neutral to somewhat favourable for investment decisions, but provincial policy and regulation were regarded less favourably on average. Federal energy policy and regulation, and federal environmental standards were considered to be unfavourable for investment in natural gas and coal fired generation, reflecting the impact of federal policies to phase out coal-fired generation across Canada.

Among the provinces, British Columbia and Ontario were viewed as having relatively unfavourable provincial regulatory frameworks, while overall policy conditions in Quebec and the Territories ranked relatively favourably (Table 3a). Provincial regulatory frameworks and approval processes were deemed by respondents to be problematic for multiple types of businesses, with the exception of energy storage in Ontario and renewable generation in Alberta (Table 3b). Provincial energy policy in Ontario was viewed as having an unfavourable impact on investment in renewable generation, energy consumption management, and smart grid technologies in Ontario. Innovation/R&D support, however, was considered particularly favourable for energy storage businesses in Ontario. Understanding the specific reasons for negative evaluations could help identify regulatory reform options at the provincial level.

Policy conditions for investment by private firms in transmission/distribution networks were seen as unfavourable, on average, especially as compared to investment by provincially- or municipally-owned utilities (Table 3b). While various governments have focused attention recently on stimulating low emission power generation technologies, the perceived weakness in the policy environment for transmission and distribution is a potential concern given the forecast need for complementary investment in this component of the industry, including from private corporations.

The second core finding is that economic conditions have a more positive impact, on average, on investment decisions than do policy conditions (Tables 3c and 3d). The top two ranked economic factors were access

to financial capital (apart from for nuclear power generation and energy consumption management) and natural resource availability. All economic factors rated as mildly favourable, except for one — market prices/regulated rates — which rated as slightly below neutral on average. Respondents in all sectors, apart from nuclear power generation, viewed market prices and regulated rates as having a slightly negative impact on investment. Geographically, this was especially marked in British Columbia and Saskatchewan, where unfavourable prices/rates contrasted with favourable labour market, supplier, natural resource, and financial capital conditions. Table 3d shows that concerns about prices and rates were particularly acute in Ontario for renewable power generation, smart grid technology firms and municipally-owned distributors, and for privately-owned electricity sector firms in British Columbia.

iv. Survey Respondent Policy Priorities

The survey asked respondents to identify reform priorities for government policy and regulatory frameworks (provincial or federal) that would have the greatest impact on improving the investment climate for their businesses. The most frequently mentioned priority was increased policy support for clean energy technologies, including renewable and nuclear power generation, energy storage, and energy consumption management technologies. Respondents advocated for improved financial incentives and tax credits to encourage investment, increased financial support for R&D, and policies to expand access to global capital markets.

Improving the transparency and stability of provincial energy policies and regulatory conditions, in order to foster greater investment certainty, was another frequently mentioned priority. This was a particular issue for Ontario, where respondents identified the need for clarification on the province's approach to future project procurement and remuneration, and for a more defined role for government in the process. Several respondents also noted concerns about the sustainability of consumer electricity price subsidies.

Many respondents identified the need for more clearly specified GHG policies, standards, and requirements to better direct future investment towards clean energy technologies. Other reform priorities included the need for reduced regulatory burden for energy storage, improvements in rates of return on distribution assets, rate of return allowance for projects that demonstrate environmental benefits, and better coordination between federal and provincial energy policy and regulation.

CONCLUSIONS

Canada, along with many other countries, is exploring the potential role for increased electrification of the economy as a way to reduce national greenhouse gas emissions and to meet Paris Agreement emission reduction targets. Although the complexities and implications of a transition towards electrification are not yet properly understood, it is clear that such a move would require massive investment in new electricity sector infrastructure—both in traditional wires and generation assets and in newer and emerging energy technologies. Fostering a favourable investment environment will thus be a prerequisite for Canada to compete for and attract globally mobile financial capital.

The analysis presented in this report, based on an extensive survey of senior executives in the electricity sector, suggests that while overall investment conditions are viewed somewhat positively at an aggregate national level, there are notable weak spots in regulatory and policy factors in some provinces and also for some technologies within the electricity value chain. Even within provinces, conditions are more favourable for some technologies than others, leading to an inconsistent patchwork of 'warm' and 'cool' investment environments. Since electrification is likely to require coordinated investments—for instance in renewable power generation and in high voltage transmission links within and/or between provinces—weakness in investment conditions in one part of the electricity sector can stymie investment in other parts.

In order to achieve electrification objectives, provincial governments should take a holistic approach to reviewing and strengthening policy and regulation across all elements of the electricity sector, traditional and new; and to reduce the aggregate cost of infrastructure investment needed to implement electrification policies, provincial governments should explore regional opportunities for cooperation and resource planning.

Table 3: Impact of Policy and Economic Factors on Investment Decisions

(a) Policy Factors

Business	Prov. Govt. energy policy	Fed Govt. energy policy	Prov. Reg. frameworks & approval processes	Fed Reg. frameworks & approval processes	Prov. Env. Standards & assesments	Fed. Env. Standards & assesments	Corporate tax & royalty regime	Innovation / R&D Support	Intellectual property rights protection	Average Policy Factors Rating
Power Generation (nuclear) (19)	4.7	3.7	3.6	2.8	3.4	2.6	3.1	3.6	3.6	**3.4**
Energy Storage (33)	3.1	3.8	2.7	3.3	3.2	3.3	3.0	3.7	3.3	**3.2**
Energy Consumption Management (29)	2.6	3.1	2.7	2.8	2.9	3.0	3.0	3.6	3.5	**3.0**
Power Generation (renewable) (109)	2.7	3.5	2.6	3.0	2.9	3.2	3.2	3.0	3.2	**3.0**
Smart Grid Technologies (15)	2.7	3.4	2.6	2.9	2.9	3.0	2.8	3.0	3.3	**3.0**
Distribution and/or Transmission (83)	2.9	2.8	2.5	2.7	2.8	2.7	2.8	3.0	3.2	**2.8**
Power Generation (natural gas or coal) (15)	2.9	2.3	2.7	2.2	2.9	2.3	2.8	2.7	3.0	**2.6**
Average (303)	**2.9**	**3.2**	**2.7**	**2.9**	**2.9**	**2.9**	**3.0**	**3.2**	**3.3**	**3.0**

Province	Prov. Govt. energy policy	Fed Govt. energy policy	Prov. Reg. frameworks and approval processes	Fed Reg. frameworks and approval processes	Prov. Env. Standards and assesments	Fed. Env. Standards and assesments	Corporate tax & royalty regime	Innovation / R&D Support	Intellectual property rights protection	Average Policy Factors Rating
Territories (12)	3.8	4.4	3.2	3.8	3.6	4.0	3.3	3.5	3.1	**3.6**
Quebec (12)	3.4	3.7	3.3	3.5	3.3	3.5	3.1	3.4	3.3	**3.4**
New Brunswick (13)	3.5	3.8	2.8	3.2	2.7	2.6	3.0	3.6	3.8	**3.2**
Other Provinces (18)	3.5	3.4	2.6	2.9	3.3	3.1	2.9	2.8	3.3	**3.1**
Saskatchewan (14)	3.2	3.3	3.2	3.1	3.1	2.8	3.2	2.9	2.9	**3.1**
Alberta (50)	3.2	3.1	2.8	2.8	3.1	3.0	3.1	3.2	3.3	**3.1**
Ontario (154)	2.6	3.1	2.5	2.7	2.8	2.8	3.0	3.2	3.3	**2.9**
British Columbia (30)	2.7	3.0	2.5	2.5	2.6	2.7	2.6	3.2	3.0	**2.8**
Average (303)	**2.9**	**3.2**	**2.7**	**2.9**	**2.9**	**2.9**	**3.0**	**3.2**	**3.3**	**3.0**

Ownership Type	Prov. Govt. energy policy	Fed Govt. energy policy	Prov. Reg. frameworks and approval processes	Fed Reg. frameworks and approval processes	Prov. Env. Standards and assesments	Fed. Env. Standards and assesments	Corporate tax & royalty regime	Innovation / R&D Support	Intellectual property rights protection	Average Policy Factors Rating
Government-owned (province/territory) (35)	3.7	3.6	3.2	2.9	3.1	2.8	3.0	3.4	3.0	**3.2**
Private (204)	2.9	3.3	2.8	2.9	3.0	3.0	3.0	3.2	3.3	**3.0**
Government-owned (municipal) (64)	2.6	2.8	2.1	2.6	2.7	2.8	2.9	2.9	3.3	**2.7**
Average (303)	**2.9**	**3.2**	**2.7**	**2.9**	**2.9**	**2.9**	**3.0**	**3.2**	**3.3**	**3.0**

Assigned values: Unfavourable=1, Somewhat unfavourable=2, Neutral=3, Somewhat favourable=4, Favourable=5. Cells coloured in purple reflect unfavorable impacts, white or grey neutral, and green favourable. Other Provinces includes Manitoba, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island.

(b) Policy Factors

Business-Ownership	Prov. Govt. energy policy	Fed Govt. energy policy	Prov. Reg. frameworks and approval processes	Fed Reg. frameworks and approval processes	Prov. Env. Standards and assesments	Fed. Env. Standards and assesments	Corporate tax & royalty regime	Innovation / R&D Support	Intellectual property rights protection	Average Policy Factors Rating
Energy Storage - Private (30)	3.2	3.9	2.7	3.3	3.2	3.2	3.1	3.8	3.4	3.3
Distribution and/or Transmission - Provincial (13)	3.5	3.5	3.2	2.9	2.9	2.7	2.8	3.0	2.8	3.0
Power Generation (renewable) - Private (93)	2.7	3.5	2.6	3.0	2.9	3.3	3.2	2.9	3.2	3.0
Energy Consumption Management-Private (25)	2.5	3.1	2.7	2.8	2.9	3.0	3.0	3.6	3.5	3.0
Distribution and/or Transmission - Municipal (43)	2.8	2.8	2.2	2.8	2.8	2.8	3.1	3.2	3.3	2.9
Distribution and/or Transmission - Private (27)	2.7	2.3	2.6	2.2	2.7	2.5	2.4	2.8	3.1	2.6
Average (231)	**2.8**	**3.2**	**2.6**	**2.9**	**2.9**	**3.0**	**3.0**	**3.2**	**3.2**	3.0

Business-Province	Prov. Govt. energy policy	Fed Govt. energy policy	Prov. Reg. frameworks and approval processes	Fed Reg. frameworks and approval processes	Prov. Env. Standards and assesments	Fed. Env. Standards and assesments	Corporate tax & royalty regime	Innovation / R&D Support	Intellectual property rights protection	Average Policy Factors Rating
Energy Storage - Ontario (18)	2.9	3.4	2.7	2.9	3.4	3.4	3.2	3.5	3.2	3.2
Power Generation (renewable) - Alberta (23)	3.0	3.6	2.6	3.0	3.2	3.5	3.0	2.9	3.1	3.1
Distribution and/or Transmission - Ontario (53)	2.8	3.0	2.4	2.8	2.8	2.8	2.9	3.2	3.3	2.9
Power Generation (renewable) - Ontario (38)	2.2	3.4	2.5	2.9	2.6	2.9	3.2	2.8	3.2	2.9
Energy Consumption Management-Ontario (18)	2.3	3.0	2.3	2.6	2.7	2.8	2.7	3.2	3.3	2.8
Smart Grid Technologies - Ontario (11)	2.4	3.1	2.1	2.7	2.7	2.8	2.7	3.0	3.5	2.8
Power Generation (renewable) - British Columbia (18)	2.7	3.1	2.4	2.5	2.7	2.6	2.8	3.1	3.1	2.8
Distribution and/or Transmission - Alberta (10)	3.1	2.0	2.4	2.4	2.7	2.2	3.2	3.0	3.4	2.7
Average (189)	**2.6**	**3.1**	2.4	**2.8**	**2.8**	**2.9**	**3.0**	**3.1**	**3.2**	2.9

(c) Economic Factors

Business	Market price / regulated rate of energy product / service	Demand conditions for energy product/service	Natural resource availability	Cost & availability of financial capital (debt & equity)	Supplier, equipment and matierial costs and availability	Labour costs, availability and skill sets	Average Economic Factors Rating
Energy Storage (33)	2.7	4.0	3.1	3.5	3.7	3.5	3.4
Power Generation (renewable) (109)	2.7	3.0	3.9	3.6	3.5	3.4	3.3
Power Generation (nuclear) (19)	3.4	3.8	3.6	2.8	3.3	2.7	3.3
Smart Grid Technologies (15)	2.8	3.3	3.3	3.3	3.5	3.3	3.2
Distribution and/or Transmission (83)	2.7	2.9	3.6	3.9	3.2	3.2	3.2
Energy Consumption Management (29)	3.0	3.6	3.4	2.4	3.5	3.2	3.2
Power Generation (natural gas or coal) (15)	2.6	3.0	3.6	3.5	3.3	3.1	3.2
Average (303)	**2.8**	**3.2**	**3.6**	**3.5**	**3.4**	**3.3**	3.3

Province	Market price/regulated rate of energy product/service	Demand conditions for energy product/service	Natural resource availability	Cost & availability of financial capital (debt & equity)	Supplier, equipment and matierial costs and availability	Labour costs, availability and skill sets	Average Economic Factors Rating
Saskatchewan (14)	2.4	3.1	3.7	4.1	3.9	3.8	3.5
Alberta (50)	3.0	3.2	4.0	3.3	3.5	3.8	3.5
New Brunswick (13)	2.8	3.9	3.5	2.9	4.0	3.1	3.3
Territories (12)	3.3	3.8	3.5	3.3	3.2	2.8	3.3
British Columbia (30)	2.5	2.7	4.0	3.5	3.6	3.6	3.3
Other Provinces (18)	2.8	3.4	3.8	3.2	3.4	3.4	3.3
Quebec (12)	3.0	2.9	3.3	3.6	3.4	3.2	3.2
Ontario (154)	2.7	3.2	3.5	3.6	3.3	3.1	3.2

Ownership Type	Market price/regulated rate of energy product/service	Demand conditions for energy product/service	Natural resource availability	Cost & availability of financial capital (debt & equity)	Supplier, equipment and matierial costs and availability	Labour costs, availability and skill sets	Average Economic Factors Rating
Government-owned (province/territory) (35)	3.0	3.1	3.6	3.9	3.3	3.3	3.4
Private (204)	2.8	3.3	3.7	3.3	3.5	3.4	3.3
Government-owned (municipal) (64)	2.5	3.0	3.3	4.0	3.1	3.0	3.2
Average (303)	**2.8**	**3.2**	**3.6**	**3.5**	**3.4**	**3.3**	3.3

(d) Economic Factors

Business-Ownership	Market price/regulated rate of energy product/service	Demand conditions for energy product/service	Natural resource availability	Cost & availability of financial capital (debt & equity)	Supplier, equipment and matierial costs and availability	Labour costs, availability and skill sets	Average Economic Factors Rating
Energy Storage -Private (30)	2.7	3.9	3.1	3.4	3.7	3.6	3.4
Power Generation (renewable) -Private (93)	2.7	3.0	4.0	3.5	3.5	3.4	3.4
Distribution and/or Transmission -Private (27)	2.7	2.7	3.9	3.6	3.6	3.4	3.3
Energy Consumption Management -Private (25)	3.0	3.6	3.5	2.3	3.5	3.2	3.2
Distribution and/or Transmission -Provincial (13)	2.8	2.9	3.4	3.6	3.2	3.5	3.2
Distribution and/or Transmission -Municipal (43)	2.6	3.1	3.4	4.1	3.0	3.0	3.2
Average (231)	**3.2**	**3.7**	**3.5**	**3.4**	**3.4**	**3.3**	3.4

Business-Province	Market price/regulated rate of energy product/service	Demand conditions for energy product/service	Natural resource availability	Cost & availability of financial capital (debt & equity)	Supplier, equipment and matierial costs and availability	Labour costs, availability and skill sets	Average Economic Factors Rating
Distribution and/or Transmission - Alberta (10)	3.0	2.7	4.2	4.3	3.7	4.0	3.7
Energy Storage - Ontario (18)	2.8	4.1	3.4	3.5	3.5	3.4	3.5
Power Generation (renewable) - British Columbia (18)	2.6	2.7	4.2	3.6	3.7	3.4	3.4
Power Generation (renewable) - Alberta (23)	3.1	3.0	4.0	3.1	3.2	3.7	3.3
Distribution and/or Transmission - Ontario (53)	2.7	3.1	3.5	4.0	3.1	3.0	3.2
Energy Consumption Management- Ontario (18)	3.2	3.6	3.1	2.6	3.5	2.9	3.1
Power Generation (renewable) - Ontario (38)	2.2	2.8	3.5	3.8	3.5	3.1	3.1
Smart Grid Technologies - Ontario (11)	2.5	3.1	3.4	3.2	3.3	3.2	3.1
Average (189)	**2.7**	**3.1**	**3.6**	**3.6**	**3.4**	**3.2**	3.3

APPENDIX A: SURVEY INSTRUMENT

Q1. Please indicate the energy industries in which your company is active in Canada (Select all that apply):

Electricity: [Distribution and/or transmission / Power Generation (natural gas or coal) / Power Generation (nuclear) / Power Generation (renewable, e.g., wind, solar, hydro, biogas, biomass, geothermal) / Other (specify)]

Oil: [Oil exploration, extraction, and/or production / Oil refining and/or upgrading / Petrochemical processing / Other (specify)]

Gas: [Natural gas gathering, extraction, and/or processing / Natural gas transmission and/or distribution / Natural gas trading, wholesale and/or retail / LNG fractionation/processing / Other (specify)]

Pipelines: [Pipeline bulk transportation and storage of crude oil, natural gas, and/or refined petroleum products / Other (specify)]

Clean Technology: [Energy consumption management technologies and services / Emissions management technologies and services (e.g. CO_2 capture, methane reduction, scrubbers) / Energy storage (e.g. batteries, compressed air, flywheels) / Hydrogen and/or fuel cells / Smart grid technologies / Other (specify)]

Q2. Please indicate the provinces/territories in which your company is active for each of the following industries (Select all that apply): [Selected Industries in Q1 will appear here] and [Alberta / British Columbia / Manitoba / New Brunswick / Newfoundland and Labrador / Nova Scotia / Ontario / Prince Edward Island / Quebec / Saskatchewan / Territories]

Q3.0. Please indicate the industries and jurisdictions that are currently the most important for your company in Canada (Select up to three)

Q3.1. In your opinion, how is the level of investment by your company likely to change over the next three years in the industries and jurisdictions listed below? [Top 3] and (Select one of Decrease significantly, Decrease slightly, No change, Increase slightly, Increase significantly)

Q4. In your opinion, how attractive are the current overall investment conditions in the industries and jurisdictions listed below? [Top 3] and (Select one of Very unattractive, Mildly unattractive, Neutral, Mildly attractive, Very attractive)

Q5. In your opinion, how have the overall investment conditions changed over the last three years in the industries and jurisdictions listed below? [Top 3] and (Select one of Deteriorated, No Change, Improved)

Q6.1.2.3. In your opinion, what is the current impact of the factors listed below on investment decisions by your company in the following industry and jurisdiction: [Pairs 1.2.3] and (Select one of Unfavorable, Somewhat unfavorable, Neutral, Somewhat favorable, Favorable)

[List of Factors: Government energy policy (Provincial/State) / Government energy policy (Federal) / Regulatory frameworks and approval processes (Provincial/State) / Regulatory frameworks and approval processes (Federal) / Environmental standards and assessment processes (Provincial/State) / Environmental standards and assessment processes (Federal) / Corporate tax and royalty regime / Innovation/R&D support / Intellectual property rights protection / Market price/regulated rate of energy product/service / Demand conditions for energy product / service / Natural resource availability / Cost & availability of financial capital (debt & equity) / Supplier, equipment and material costs and availability / Labour costs, availability, and skill sets / Public opinion / COVID-19 / Other (specify)]

Q7. In your opinion, how is your company's overall carbon emissions in Canada likely to change in the next three years? (Select one of Decrease significantly, Decrease slightly, Remain the same, Increase slightly, Increase significantly)

Q8. In your opinion, how is your company's expenditure on the following environmental technologies and services likely to change over the next three years (where applicable)? (Select one of Decrease significantly, Decrease slightly, Remain the same, Increase slightly, Increase significantly)

[List of technologies and services: Energy consumption management technologies and services / Renewable power generation / Smart grid technologies / Energy storage (e.g. batteries, compressed air, flywheels) / Hydrogen and/or fuel cells / Emissions management technologies and services (e.g. CO_2 capture, methane reduction, scrubbers) / Other (specify)]

Q9. In your opinion, how important are the following financing sources for your company's future expenditures: [Equity / Debt / Retained earnings / Venture founders' personal capital / Government funds (e.g. grants, subsidies, loans) / Other (specify)] and (Select one of Not important, Somewhat important, Very important)

Q10. Please indicate the age of your company: (< 2 years / 2–5 years / 6–10 years / 11–19 years / > 20 years)

Q11. Please indicate the size of your company in terms of employment: (< 10 employees / 11–49 employees / 50–249 employees / 250 to 999 employees / >= 1000 employees)

Q12. Over the past 12 months, has employment at your company approximately increased, decreased or remained the same? (Select one of Decrease significantly, Decrease slightly, Remain the same, Increase slightly, Increase significantly)

Q13. Please indicate the primary scope of responsibilities that you have in your company: [Board Director / C-level / Senior Management / Middle Management / Founder / Other (specify)]

Q14. Please indicate the number of years of employment experience you have in the energy sector: [< 5 years / 6–10 years / 11–20 years / 21–30 years / > 30 years]

Q15. In your opinion, what 1–2 changes in government policy/regulatory frameworks (provincial or federal) would have the greatest impact on improving the investment climate for companies like yours in Canada?

APPENDIX B: OWNERSHIP AND STRUCTURE OF CANADA'S ELECTRICITY SECTOR

Legislative and regulatory authority over Canada's electricity sector is shared between the federal and provincial/territorial governments, with the provinces holding most of the decision-making powers. Under Canada's constitution, each province is granted the exclusive power to make laws in relation to the "development, conservation and management of sites and facilities in the province for the generation and production of electrical energy."[18] The federal government's authority is limited to the regulation of interprovincial and international energy trade and infrastructure, which is enforced by the Canadian Energy Regulator, and the use of nuclear energy and materials to protect health, safety, security and the environment, enforced by the Canadian Nuclear Safety Commission.[19]

Each province has shaped the structure of its electricity sector to advance provincial energy objectives (see Table B-1). A key distinction between the provinces is in ownership (government or private) and market structure (vertical integration or separation of generation, transmission, and distribution functions). The hydroelectric-dominated provinces – British Columbia, Manitoba, Quebec and Newfoundland and Labrador – and the provinces of Saskatchewan and New Brunswick, organize their electricity sectors as provincially-owned, vertically-integrated utilities.[20] Nova Scotia and PEI have privately-owned, vertically-integrated electricity sectors. Ontario and Alberta restructured their electricity sectors in the late 1990s and early 2000s by requiring vertical separation of generation, transmission, and distribution functions, and introducing competition in generation through the creation of competitive wholesale electricity markets administered by independent, non-profit system operators.

Both private and municipal ownership of electricity assets exists in all provinces, including those organized as provincially-owned, vertically-integrated utilities. There are many privately-owned generators in British Columbia (80), Ontario (>100), and Quebec (40) that sell electricity to the provincial utility through bilateral contracts. Newfoundland, PEI, Ontario, and Alberta have more than one transmission entity, with at least one privately owned. All but three provinces (Manitoba, Saskatchewan, and New Brunswick) have more than one privately or municipally-owned local distribution company.

The generation mix varies considerably by province, in part due to resource availability but also because of different policy choices. In Manitoba, Newfoundland and Labrador, Quebec and British Colombia, hydroelectric generation accounted for between 90% and 97% of total provincial production in 2020 (see Figure B-1). Only Ontario and New Brunswick use nuclear generation (58% and 42% of total production, respectively). There are four provinces that produce electricity from coal: New Brunswick, Saskatchewan, Nova Scotia and Alberta. In Saskatchewan, Nova Scotia and Alberta, fossil fuel thermal generation (coal, natural gas, oil) is the dominant source of supply, representing 83%, 70%, and 91% of total provincial production, respectively. In Prince Edward Island, electricity is produced primarily through wind (99% of total production), with minimal production from oil-fired generation and biomass sources.[21]

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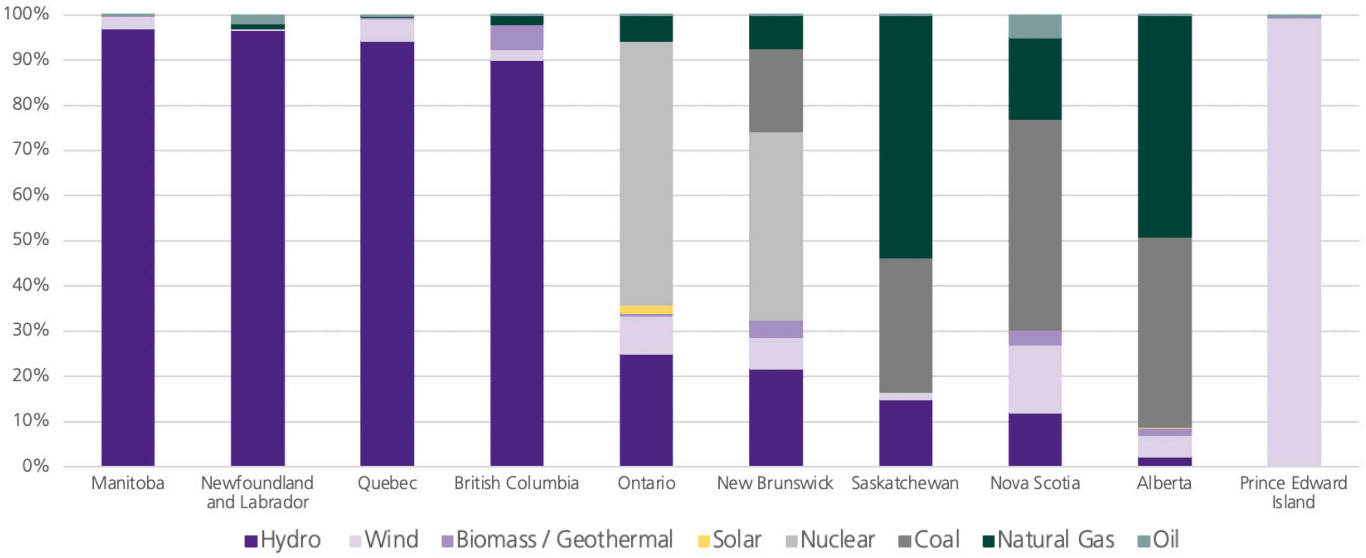
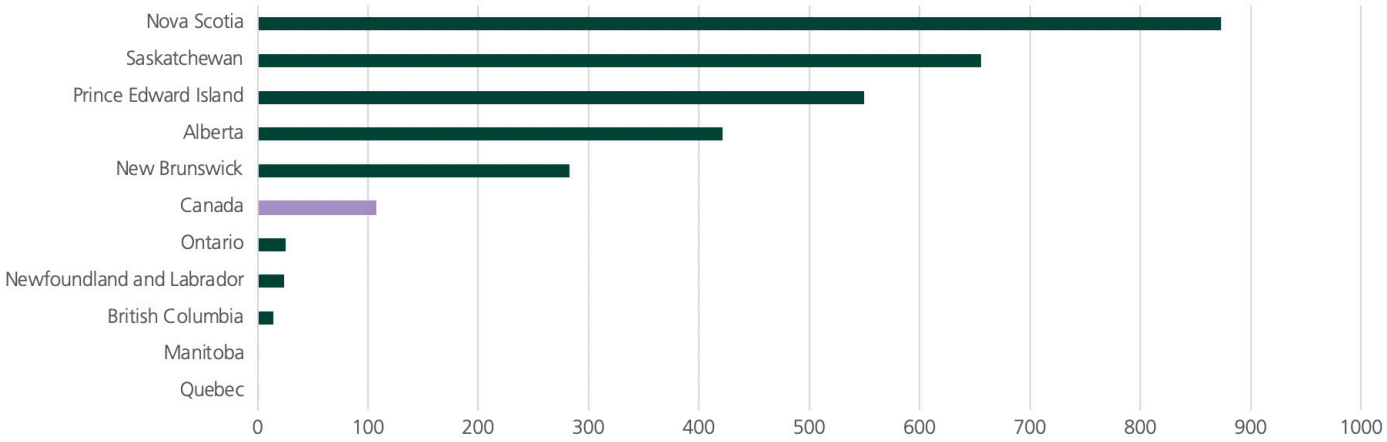
Figure B-1: Electricity Production by Fuel Type as a Share of Total Provincial Production, 2019



Source: Canadian Energy Regulator, "Canada's Energy Future 2020"

Figure B-2: Canada's Electricity Sector GHG Emission Intensity (gCO2/kWh), 2019



Source: Canadian Energy Regulator, "Canada's Energy Future 2020"

The generation mix in each province has a direct effect on its electricity sector's GHG emission intensity. The fossil fuel-dominated provinces have the highest GHG emission-intensive electricity industries (Figure B-2).

Another distinction between the provinces is in respect of their commercial orientation towards electricity trade. Canada is the world's third largest net exporter of electricity, exporting 60 TWh of electricity to the United States in 2019.[22] Approximately 95% of Canadian electricity exports in 2019 came from four provinces, Quebec (43% of Canadian exports to the United States), Ontario (28%), Manitoba (13%) and British Columbia (11%).[23] In British Columbia, Quebec and Manitoba, selling electricity that is surplus to the needs of the provincial ratepayers, at commercial rates to the United States and to other provinces, is a strategic objective of the provincially owned utilities.[24] In Ontario and Alberta, some private companies purchase electricity from the wholesale market for export to other provinces and neighbouring markets in the United States to arbitrage jurisdictional price differences on a for-profit basis.[25]

Table B-1: Electricity Sector Ownership and Structure by Province

Province	Market Structure	Generation, 2017[26]	Transmission	Interconnections	Electricity Trade, 2019 [30] (Trading Companies)	Distribution
Manitoba	Provincially-Owned, Vertically Integrated Utility	Provincially-Owned Manitoba Hydro owns 95% of the province's 6,288 MW total capacity. The remaining capacity is owned by 2 Independent Power Producers or Private Industry. 100% and 8% of the province's wind capacity and fossil fuel capacity is privately owned.	Manitoba Hydro	Ontario, Saskatchewan, North Dakota, Minnesota	0.4 TWh imported from the United States, and 0.7 TWh and 7.7 TWh exported to other provinces and the United States respectively (Manitoba Hydro and 1 Privately-Owned company).	Manitoba Hydro
Newfoundland & Labrador	Provincially-Owned, Vertically Integrated Utility	Provincially-owned NL Hydro[27] owns 94% of the province's 7,404 MW total capacity. The remaining capacity is owned by 3 Independent Power Producers or Private Industry. 100%, 5%, 95% of the province's wind, hydro and gas capacity is privately owned.	NL Hydro & Newfoundland Power (Fortis)	Quebec	0.2TWh imported from other provinces and 30.2 TWh and 1.1 TWh exported to other provinces and the United States respectively (NL Hydro).	NL Hydro & Newfoundland Power
Quebec	Provincially-Owned, Vertically Integrated Utility	Provincially-owned Hydro-Québec (HQ) Production owns 85% of the province's 45,369 MW total capacity. The remaining capacity is owned by roughly 40 Independent Power Producers or Private Industry. 96%, 10% and 63% of the province's wind, hydro a gas capacity is privately owned.	HQ TransÉnergie et équipement	Ontario, New Brunswick, NL, New England, New York	32.4 TWh and 0.1 TWh imported from other provinces and the United States respectively and 9.9 TWh and 25.9 TWh exported to other provinces and the United States respectively (HQ and 1 Privately-Owned company)	HQ Distribution and 9 Municipally-Owned distributors
British Columbia	Provincially-Owned, Vertically Integrated Utility	Provincially-owned BC Hydro owns 73% of the province's 17,665 MW total capacity. The remaining capacity is owned by approx. 80 Independent Power Producers or Private Industry. 78%, 18%, and 92% of the province's wind, hydro and gas capacity is privately owned.	BC Hydro	Alberta, Washington State	0.9 TWh and 11.2 TWh imported from other provinces and the United States respectively and 2.6 TWh and 6.8 TWh exported to other provicnes and the United States respetively (BC Hydro and 5 Privately-Owned companies).	BC Hydro, FortisBC (investor-owned), some Municipal Ownership
New Brunswick	Provincially-Owned Vertically Integrated Utility[20]	Provincially-owned NB Power owns 87% of the province's 4,222 MW total capacity. The remaining capcity is owned by 11 Independent Power Producers. 100%, 7%, and 77% of the province's wind, hydro and fossil fuel capacity is privately owned.	NB Power	Quebec, Nova Scotia, PEI, New England, Northern Maine	3.9 TWh and 0.1 TWh imported from other provinces and the United States respectively and 2 TWh and 1.4 TWh exported to other provinces and the United States respectively. (NB Power and 2 Privately-owned companies).	NB Power
Saskatchewan	Provincially-Owned Vertically Integrated Utility	Provincially-owned SaskPower owns 80% of the province's 4,642 MW total capacity. The remaining capacity is owned by approx. 11 Independent Power Producers or Private Industry. 27% and 79% of the province's wind and coal/gas is privately owned.	SaskPower	Alberta, Manitoba, North Dakota	0.2 TWh and 0.1 TWh imported from other provinces and the United States respectively and 0.2 TWh exported to other provinces. (Sask Power, 2 Privatetly-Owned companies).	SaskPower
PEI	Privately-Owned Vertically Integrated Utility	Privately-owned Maritime Electric (Fortis) owns 44% and Suez Renewable Energy owns 31% of of the province's 350 MW total capacity. Provincially-Owned PEI Energy Corporation and the City of Summerside Electric Utility ownd the remaining capacity.	Maritime Electric (Fortis), PEI Energy Corporation	New Brunswick	1.1 TWh imported from other provinces and 0.3 TWh exported to other provinces. (Maritime Electric)	Maritime Electric (Fortis) City of Summerside Electric Utility
Nova Scotia	Privately-Owned Vertically Integrated Utility	Privately-Owned NS Power (Emera) owns 79% of the province's 2,977 MW total capacity. The remaining capacity is owned by approx. 5 Independent Power Producers or Private Industry. 100% of the provinces wind capacity is privately owned.	NS Power	New Brunswick	0.7 TWh imported from other provinces and 0.1 TWh exported to other provinces. (NS Power)	NS Power and 6 Municipally-Owned distributors
Ontario	Vertical Seperation, Competitive Wholesale Energy Market with Centralized Procurement, Regulated Transmission and Distribution	Provincially-Owned OPG[28] owns approx. 50% of the province's 40,489 MW total capacity. The remaining capcity is onwed by over 100 Privately-Owned companies.	Hydro-One (49% Provincial, 51% Private) 2 Privately-Owned 4 Private-Public Partnerships[29]	Quebec, Manitoba, New York, Michigan, Minnesota	6.8 TWh and 0.2 TWh imported to other provinces and the United States respectively and 2.2 TWh and 17 TWh exported to other provinces and the United States respectively. (OPG and over 30 Private Companies)	Hydro-One Networks Inc and 58 mainly Municipally-Owned distributors
Alberta	Vertical Seperation, Competitive Wholesale Energy Market, Regulated Transmission and Distribution	Roughly 50 Privately-Owned companies own 87% of the province's 15,395 MW total capacity. The remaining capacity is owned by Municipaly-owned ENMAX and EPCOR.	Municipally-owned, ENMAX and EPCOR Privately-Owned, ATCO, AltaLink	BC, Saskatchewan, Montana	2.9 TWh and 1.2 TWh imported from other provinces and the United States respectively and 0.9 TWh and 0.4 TWh exported to other provinces and the United States respectively. (12 Private Companies)	Municipally-Owned ENMAX and EPCOR 2 Privately-Owned, 1 Non-Profit

ENDNOTES

[1] Environment and Climate Change Canada, "Canada's Achievements at COP26." Available at https://www.canada.ca/en/services/environment/weather/climatechange/canada-international-action/un-climate-change-conference/cop26-summit/achievements-at-cop26.html. Accessed December 9, 2021. Canada's commitments leading up to COP26 included: committing to an enhanced target of reducing emissions by 40 percent to 45 percent from 2005 levels by 2030; enshrining this target in law, as well as Canada's commitment to achieve net zero by 2050 through the Canadian Net-Zero Emissions Accountability Act; and doubling its international climate finance for developing countries. During COP26, Canada reinforced its commitment to phase out coal-fired generation and committed to accelerating its clean energy transformation by working with provinces, territories, industry, and other stakeholders to ensure that the electricity grid achieves net-zero emissions by 2035.

[2] International Energy Agency, "Key World Energy Statistics 2020," August 2020.

[3] International Energy Agency, "Electricity Market Report," December 2020.

[4] Langlois-Bertrand, S., Vaillancourt, K., Beaumier, L., Pied, M., Bahn, O ., Mousseau, N., "Canadian Energy Outlook 2021 — Horizon 2060," with the contribution of Baggio, G., Joanis, M., Stringer, T. Institut de l'énergie Trottier and e3c Hub, 2021. These are the estimated gross annual investment costs in generation, transmission, and storage. This estimate does not include residential and commercial end-use consumer investment expenses in new electricity infrastructure, such as electric space and water heating systems, electric appliances, electric passenger vehicles and charging stations, or heavy industry end-use consumer expenditure on new electrified production and manufacturing processes.

[5] These include Vaillancourt, Bahn, Frenette, & Sigvaldason, "Exploring deep decarbonization pathways to 2050 for Canada using an optimization energy model framework," (Applied Energy, 195, 774-785, 2017), Langlois-Bertrand, Vaillancourt, Bahn, Beaumier, Mousseau, "Canadian Energy Outlook," (Institut de l'énergie Trottier and e3 Hub, 2018, Canadian Energy Regulator, "Canada's Energy Future 2021: Energy Supply and Demand Projections to 2040," 2021., Langlois-Bertrand, S., Vaillancourt, K., Beaumier, L., Pied, M., Bahn, O ., Mousseau, N. (2021),"Canadian Energy Outlook 2021 — Horizon 2060," with the contribution of Baggio, G., Joanis, M., Stringer, T. Institut de l'énergie Trottier and e3c Hub, 2021.

[6] See Langlois-Bertrand, S., Vaillancourt, K., Beaumier, L., Pied, M., Bahn, O ., Mousseau, N. (2021),"Canadian Energy Outlook 2021 — Horizon 2060," with the contribution of Baggio, G., Joanis, M., Stringer, T. Institut de l'énergie Trottier and e3c Hub, 2021, and Canadian Energy Regulator, "Canada's Energy Future 2021: Energy Supply and Demand Projections to 2040," 2021.

[7] See "Implications of Policy Driven Electrification in Canada," A Canadian Gas Association Study Prepared by ICF, October 2019.

[8] See Langlois-Bertrand, S., Vaillancourt, K., Beaumier, L., Pied, M., Bahn, O ., Mousseau, N. (2021),"Canadian Energy Outlook 2021 — Horizon 2060," with the contribution of Baggio, G., Joanis, M., Stringer, T. Institut de l'énergie Trottier and e3c Hub, 2021. The total investment amounts of $840 billion to $1.25 trillion are based on investment cost estimates for different generation technologies found in Table A11.

[9] See Dolter, B., and Rivers, N., The Cost of Decarbonizing the Canadian Electricity System (January 30, 2017). Available at SSRN: https://ssrn.com/abstract=2907924 or http://dx.doi.org/10.2139/ssrn.2907924 and Rodrigues-Sarasty, Debia, Pineau, "Deep Decarbonization in Northeastern North America: The value of electricity market integration and hydropower," Energy Policy, 152 (2021).

[10] Rodrigues-Sarasty, Debia, Pineau, "Deep Decarbonization in Northeastern North America: The value of electricity market integration and hydropower," Energy Policy, 152 (2021), note that cooperation is primarily limited to regional operating reserve sharing and export of surplus energy and capacity.

[11] See Borenstein, S., and Kellogg, R., "Challenges of a Clean Energy Transition and Implications for Energy Infrastructure Policy" in Rebuilding the Post-Pandemic Economy, ed. Melissa S Kearney and Amy Ganz Washington D.C.: Aspen Institute Press, 2021.

[12] The remaining sections present results for provinces and technologies with at least 10 responses. Responses for Manitoba, Newfoundland and Labrador, and Prince Edward Island are reported together as Other Provinces.

[13] The survey grouped natural gas and coal generation together in a single category. Given the federal government's policy to phase out coal-fired generation by 2030, it is likely that much of the expected increase in investment in this combined category will be in natural gas generation.

[14] For Ontario, see Ministerial Directive to the IESO, "Wind Down of Feed-in Tariff and Large Renewable Procurement Contracts." Available at https://www.ieso.ca/en/Corporate-IESO/Ministerial-Directives/Wind-Down-of-Feed-in-Tariff-and-Large-Renewable-Procurement-Contracts. Accessed on December 9, 2021. For British Columbia, see Comprehensive Review of BC Hydro: Phase 1 Final Report – on February 14, 2019. Available at https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/electricity/bc-hydro-review/final_report_desktop_bc_hydro_review_v04_feb12_237pm-r2.pdf. Accessed on December 9, 2021.

[15] See Alberta Energy, "Phasing out emissions from Coal." Available at https://www.alberta.ca/climate-coal-electricity.aspx and SaskPower, "The Path to 2030: SaskPower Updates Progress on Renewable Electricity." Available at https://www.saskpower.com/about-us/media-information/news-releases/2018/03/the-path-to-2030-saskpower-updates-progress-on-renewable-electricity. Both accessed on December 9, 2021.

[16] See Alberta Electric System Operator, "Delivered Cost of Electricity Report," May 2020.

[17] Response categories with less than 10 replies are not included as individual rows in Table 3 but they contribute to the calculation of reported Average scores. Table 3 also does not include respondent views on the impact of the COVID-19 pandemic on investment decisions, which was generally seen as having a somewhat unfavourable impact on investment.

[18] The Constitution Acts, 1867 to 1982, article 92A.1.(c).

[19] Nuclear Safety and Control Act (S.C. 1997, c. 9). The federal government can also affect the electricity sector through environmental legislation and through its support of clean energy projects and technologies. The Supreme Court of Canada has upheld the federal government's Greenhouse Gas Pollution Pricing Act as a valid exercise of Parliament's power to make laws for the "Peace, Order and Good Government" of Canada, which legitimizes the federal government's authority to regulated GHGs in Canada.

[20] In 2003, the New Brunswick government amended the Electricity Act to restructure New Brunswick Power into four divisions: NB Power Distribution and Customer Service, NB Power Generation, NB Power Nuclear, and NB Power Transmission, with the intent to opening the non-nuclear generation business to competition. This plan was abandoned in 2013 and NB Power was re-established as a single vertically integrated utility.

[21] Prince Edward Island relies heavily on imported electricity as approximately 60% of the province's electricity consumption is supplied with imports from New Brunswick. See Statistics Canada. Table 25-10-0021-01 Electric power, electric utilities and industry, annual supply and disposition.

[22] International Energy Agency, "Key World Energy Statistics 2020," August 2020.

[23] Statistics Canada. Table 25-10-0021-01 Electric power, electric utilities and industry, annual supply and disposition.

[24] Pineau, Pierre-Olivier. "Fragmented markets: Canadian electricity sectors' underperformance." Evolution of global electricity markets. Academic Press, 2013. 363-392.

[25] See Canadian Energy Regulator, Table 2A Export Summary Report by Source, Authorization and Exchange Type and Table 2B Import Summary Report by Destination, Authorization and Exchange Type, available at https://apps.cer-rec.gc.ca/CommodityStatistics/Statistics.aspx?language=english, for a list of private and public companies that export and import electricity between provinces and the United States.

[26] Statistics Canada. Table 25-10-0022-01. Installed plants, annual generating capacity by type of electricity generation, data reported for 2017.

[27] NL Hydro is a subsidiary of Nalcor Energy Inc, a Crown Corporation. In June 2021, it was announced the Nalcor would be folded into NL Hydro.

[28] Ontario Power Generation's generation facilities are rate-regulated. OPG acquired ownership of several privately-owned gas plants in 2020. The Statistics Canada data from 2017 do not reflect this acquisition.

[29] These Limited Partnerships are all with Hydro One.

[30] Statistics Canada. Table 25-10-0021-01. Electric power, electric utilities and industry, annual supply and disposition, data reported for 2019.

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