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The Low Carbon Policy Ecosystem: Leaving Small and Medium Sized Enterprises Behind

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Executive Summary

The private sector will play a significant role in the emergence and momentum driving Canada's transition to a low carbon economy.¹ However, to date there have been relatively few reports or descriptive analyses of the emission reduction policy ecosystem in which Canadian firms are currently operating. This report provides such analysis based on a dataset of 178 policies adopted by the Canadian, Ontario, as well as selected municipal governments.

The primary finding of this report is that there is limited support or engagement with small and medium sized enterprises (SMEs)—firms with fewer than 500 employees—to reduce emissions by any order of government. Provinces are best positioned to offer this kind of support, however the current Ford government in Ontario has deemphasized the importance of climate governance in favour of a broader approach to address environmental degradation in general. The Ford government has further signalled that the introduction of new measures to reduce emissions or support voluntary decarbonization in the private sector is unlikely in the near future.

While Ontario municipalities appear to be willing to engage on climate change mitigation, most of the policies outlined in municipal plans are focused on reducing the municipalities' corporate emissions, with minimal support offered to local businesses. This is likely because municipal governments lack capacity to provide the kinds of funding incentives and programming necessary to support energy efficiency assessments, retrofits, or adoption of low carbon technologies. Similarly, municipal governments only have direct or indirect control over approximately 44% of community emissions,² however municipalities typically have even less control over SMEs emissions in particular, as these firms often do not own the building they operate from.

In contrast, the federal government has demonstrated both the capacity and willingness to engage with the private sector to reduce emissions. The Pan-Canadian framework was released in December 2016 and outlined specific steps the federal government will take to meet Canada's emission reduction targets under the Paris Agreement. To address private sector emissions, the framework outlines a national pollution pricing scheme to cap emissions by larger emitters, as well as an ambitious policy mix to spur cleantech innovation. However, engagement with SMEs in the framework still remains limited: out of 99 federal policies and programs, we only identified five that are aimed at supporting emissions cuts by SMEs, two of which are only available to businesses based in provinces that have not instituted their own pollution pricing system.

The omission of SMEs in government climate change programming is significant: Canadian SMEs currently produce approximately 30% of national emissions which totals more than the combined annual emissions of Quebec, Manitoba, Saskatchewan, and the Atlantic Provinces.³ A growing body of research demonstrates that SMEs lack the capacity to make this

1 Stewart Elgie et al., "Clean Technology and Business Innovation," Clean Economy Working Paper Series (Smart Prosperity, January 2018), 6.

2 Sara Hughes, "Reducing Urban Greenhouse Gas Emissions: Effective Steering Strategies for City Governments" (Toronto, Canada: Institute on Municipal Finance and Governance, 2017), 1.

3 ClimateSmart, "200 Million Tonnes of Opportunity," 2018, 6.

transition without government-led support, and so it is unlikely that these limited programs will produce robust results among SMEs. Canadian SMEs comprise 98% of Canadian businesses,⁴ employ more than 70% of the Canadian private sector workforce,⁵ and overall represent the driving force of Canadian business culture. Driving the transition towards a low carbon economy will require a groundswell of support from SMEs in particular, and yet SMEs remain an untapped resource for pursuing transformative national change in the private sector.

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Introduction

This report surveys and descriptively analyzes both programs and policies adopted by federal, provincial (Ontario), and selected municipal governments aimed at regulating and incentivizing voluntary emission reductions in the private sector. We compiled a dataset of

4 Innovation, Science and Economic Development Canada, “Key Small Business Statistics, January 2019”, Ottawa, Canada: Government of Canada, 2019, 3.

5 Ibid, 12.

policies and programs implemented by all three orders of government and conducted a review of both the intended and actual outcomes of these policies to date.

The motivation behind this report is twofold: first, we sought to understand the climate change mitigation policy ecosystem in which Canadian businesses are currently operating. A transition to a low carbon economy will require a holistic and coordinated effort from all orders of government to engage, prompt, and support Canadian firms to make strategic, tactical and operational changes to reduce their emissions. Understanding how Canadian governments have already approached this issue represents a crucial first step in fine re-calibrating governance strategies over time, as well as coordinating responsibilities across governments. The second motivation behind this report is to identify gaps and omissions in the current governments' approaches to supporting the private sector in order to better understand how nongovernmental organizations may fit into climate change governance.

The main finding of this report is that SMEs are currently underserved by government programming and policies aimed at reducing private sector emissions. This is somewhat unsurprising because SMEs are notoriously difficult for governments to engage with, due in large part to their number and diversity. Likewise, programming that requires adjudication for proposed projects requires a significant investment on the backend by government. However, it is crucially important that small and medium sized businesses are supported because they cannot (and in some cases, will not) make this transition alone: SMEs require more external prompting than larger corporations to make sustainability changes to their business,⁶ and also tend to be more resistant to taking on voluntary corporate social responsibility projects or sustainability measures compared with larger firms and when sustainability changes are taken up, SMEs are less likely to report seeing a “business” case for doing so.⁷ Likewise, changes to reduce emissions that are most frequently taken up by SMEs, which include environmental audits and recycling among others, tend to be less effective compared with transformative (and expensive) measures such as life cycle planning, retrofits, or fuel switching.⁸ In other words, these businesses need both funding and guidance to achieve meaningful emission reductions.

Given that SMEs are difficult to engage with, due to their diversity and number, but also represent a crucial set of private sector stakeholders in Canada's transition to a lower carbon economy, nongovernmental organizations may provide a critical service in the post-COVID19 economic recovery to support and engage SMEs. We aim to explore how nongovernmental organizations may fill SME gap identified in this report in a future study.

Dataset Methodology

Our dataset includes federal, provincial (Ontario), and selected municipal government policies and programming relating to decarbonization and emission reduction from 2015-2020,

6 Andrea Revell and Robert Blackburn, “The Business Case for Sustainability? An Examination of Small Firms in the UK's Construction and Restaurant Sectors,” *Business Strategy and the Environment* 16, no. 6 (September 2007): 404–20, 406.

7 Erik G Hansen and Johanna Klewitz, “Publicly Mediated Inter-organizational Networks: A Solution for Sustainability-oriented Innovation in SMEs?,” in *Entrepreneurship, Innovation, and Sustainability*, ed. Marcus Wagner (Routledge, 2012), 25.

8 María Quintás, Ana Martínez-Senra, and Antonio Sartal, “The Role of SMEs' Green Business Models in the Transition to a Low-Carbon Economy: Differences in Their Design and Degree of Adoption Stemming from Business Size,” *Sustainability* 10, no. 6 (June 20, 2018): 2109.

beginning with the first term of the Trudeau government. Some policies that pre-date 2015 were also included if updates to that policy came into effect or were updated after 2015: for example, the Renewable Energy Feed-in Tariff was established by the Government of Ontario in 2009 but was cancelled in 2018. This policy was included in the dataset but was coded as a “cancelled” policy.

A broad definition of decarbonization was used as inclusion criteria: any government course of action that has been implemented, or has been announced but not yet adopted, which aims to transition an economy or sector to become less carbon intensive, or to reduce greenhouse gas emissions broadly. Both supply and demand side policies and programs are included in this dataset. We also include all specific projects that were officially announced by an order of government or are mentioned by a government planning document and have publicly available evidence that the government has made efforts towards implementing the project. We do not include broad or general public commitments made by governments that do not have a specific program, project, regulation, or funding commitment attached to it. For example, we excluded non-specific commitments, such as commitments to “improve standards and regulations” or to “collaborate with the private sector” unless a specific policy was announced to fulfill this commitment.

Resilience and adaptation measures are excluded from this dataset, as the primary objective of such policies are to adapt to changing climates rather than to mitigate human impact on the environment. The establishment of working groups, non-specific inter-governmental collaboration partnerships, and fungible block transfers between orders of government were not included in this dataset. Projects that treat decarbonization as a “co-benefit” of the policy are not included in this dataset unless there are specific and measurable emission reduction targets associated with the policy, or if emissions reduction is stated directly in the description of the policy on government websites or press releases. In other words, to be included in this dataset, there must be evidence that a policy or program has support for implementation that comes from a specific government program/financing, and the intended outcome must be explicitly related to emission reduction in descriptions of the policy or program.

Federal Policies

The federal government is responsible for the majority of policies and programming we identified, and the clear focus of the federal approach is supply-side mitigation to regulate or support voluntary private sector emission reduction: approximately 55% of the policies identified in our dataset are federal policies, and roughly three quarters of the federal policies and programs we identified are supply-side policies that target production. Approximately 18% target emissions reduction on the demand side, and 10% are explicitly aimed at both.

The sectoral breakdown of federal policies roughly mirrors the sectoral breakdown of Canada’s emissions: 35% of Canada’s emission come from the energy sector, 25% from transportation, 13% from building leakage and unintended sources, 10% from agriculture, and 6% from waste production (including construction).⁹ Energy and transportation make up the

⁹ Environment and Climate Change Canada, “Greenhouse Gas Emissions,” April 15, 2020, <https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/greenhouse-gas-emissions.html>.

largest share of federal policies (roughly approximate to the sectoral share of emissions). Multisectoral policies target emitters from a variety of sectors including heavy industry, however the centerpiece of the federal approach to addressing heavy industry and large emitters more broadly is the pollution pricing system.

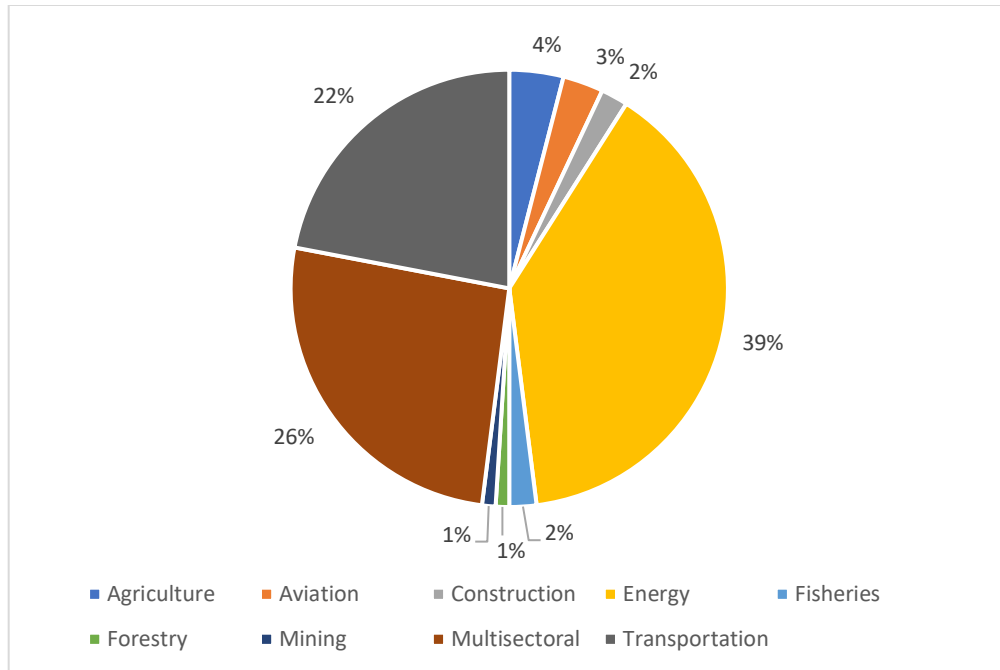


Figure 1: Target Sector of Federal Policies

In terms of a national plan to reduce Canada’s supply-side (private sector) emissions, we conceptualize an effective policy mix as a three-pronged approach that incorporates measures to address large industrial emitters, supports the development of low carbon technology, and incentivizes voluntary decarbonization by small and medium sized firms.

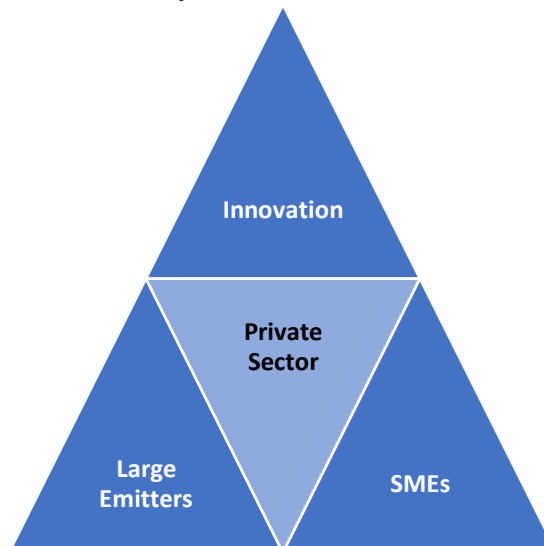


Figure 2: Supply-side Policy Targets

National Carbon Price

Under the 2015 Paris Agreement, Canada committed to reducing emissions by 30% below 2005 levels by 2030. The Liberal government also set a net-zero emissions by 2050 target in the 2019 election.¹⁰ To achieve this goal, the federal government passed the Greenhouse Gas Pollution Pricing System which came into force on June 21, 2018. The pricing system (also called the federal backstop) is comprised of two fees: a national price on fuel levied at consumption, and a pollution credit trading system for industry called the Output Based Pricing System. However, federal government only imposed these taxes in provinces that do not institute their own carbon tax or cap-and-trade policy that meets or exceeds the federal backstop. In 2019, the provinces that apply the federal backstop in place of developing their own system were Ontario, Manitoba, New Brunswick and Saskatchewan.

The consumption tax is levied on all liquid fuels, natural gas and electricity produced from emissions-intensive energy sources. Starting in 2019, the consumption tax priced carbon at \$20 a tonne, however this price will increase by \$10/tonne/year, rising to \$50 per tonne by 2022. The purpose of the consumption tax is to influence consumer behavior and reduce demand for carbon-intensive fuels. However, the tax is revenue-neutral, as the proceeds of the tax will be redistributed back to the provinces, who will in turn rebate about 90% the revenue back to taxpayers, with the remaining 10% put towards reducing emissions in the MUSH sectors (Municipalities, Universities, Schools, and Hospitals). As of June 2020, Alberta has not applied a fuel consumption tax, as the Alberta Court of Appeal ruled the application of the federal carbon tax to be unconstitutional. The appeal of this decision by the federal government is currently under review at the Supreme Court of Canada.¹¹

While the consumption tax is the centerpiece of the federal government's strategy to address demand-side mitigation, we also identified a few other complementary demand-oriented programs that support the consumption tax which include **Canada's Energy Efficient Buildings Program**, which provides \$48.4 million to support the development and implementation of high efficiency codes and retrofits of existing buildings, as well as the **Green Infrastructure Fund**, which provides \$5 billion over five years in intergovernmental transfers for low carbon infrastructure projects, as well as several electric and low-emission vehicle support programs that are aimed at demand-side emission reduction as well.

The Output Based Pricing System (OBPS) comprises the supply-side strategy of the federal carbon pricing, and functions as a cap-and-trade system. OBPS encourages industrial facilities to reduce their greenhouse gas emissions by setting a ceiling on allowable emissions. Industrial facilities that produce less than the allowable ceiling can earn surplus credits that these firms can either bank for future use or sell to other firms. Firms that exceed the allowable emissions can either choose to pay a tax on emissions that exceed the emissions ceiling (priced at the same rate as the consumption tax) or buy credits, either from surplus credits from other firms

¹⁰ United Nations Environment Programme, "The Emissions Gap Report 2019" (United Nations, 2019), <https://www.unenvironment.org/resources/emissions-gap-report-2019>.

¹¹ Saskatchewan also challenged the imposition of the federal backstop in the Saskatchewan Court of Appeal; however the Saskatchewan courts upheld the federal backstop.

or offset credits approved by the Minister. The OBPS only addresses emissions from Canada's largest industrial emitters that produce more than 50 kilotonnes of carbon emissions, while smaller facilities have the option to voluntarily opt-in to the OPBS.

The logic behind the OBPS is that such a program reduces the impact of a carbon tax on industrial competitiveness in Canada by providing firms with flexibility in how they approach emissions reduction. Likewise, the OBPS aims to reduce carbon leakage that might have occurred if firms were not given a “relief” program, as many firms might choose to move operations to a country or region with a less stringent regulatory environment. However, critics have argued that the national carbon tax is priced too low to effectively capture externalized costs associated with carbon—a 2019 report from the IMF found that even a \$75 per tonne carbon tax would not allow Canada to meet its emission reduction goals under the Paris Agreement,¹² and the Canada Ecofiscal Commission projected that the federal government would need to price carbon at \$210 per tonne to meet its targets.¹³ The OBPS price also does not apply to all emissions from heavy emitters, as it is a marginal price that exempts 70%-90% of emissions in certain sectors (such as cement production).¹⁴ As such, it remains an open question whether the OBPS will produce robust reductions among larger emitters.

It is important to note that small and medium sized businesses are purposely excluded from the OBPS—meaning there is no federal regulatory impetus for these businesses to reduce emissions beyond the diffuse influence of the carbon price. The exclusion of SMEs from a regulatory emission requirement is reasonable for two reasons. First, most SMEs are not prepared, and likely lack the capacity, to meet a federal regulatory requirement: a report from Chartered Professional Accountants of Canada indicates that the majority of Canadian businesses (63% of those surveyed) are not currently tracking, and have no plans to track, GHG emissions.¹⁵ Second, the federal government is likely not the most appropriate order of government to engage SMEs on this issue, as energy regulation and air pollution control are provincial responsibilities, and so the energy consumption and pollution output of small emitters are most appropriately regulated by provinces. Likewise, the needs of SMEs vary significantly by region in Canada: for example, in Ontario is Canada's manufacturing heartland, with 47% of Canada's manufacturing produced in Ontario.¹⁶ The ability to reduce emissions by small businesses in Ontario is likely to be significantly different than small businesses operating in British Columbia, which has a much more service-oriented economy.

Innovation Policy Mix

To support the national carbon pricing system, the federal government also introduced a plan to foster innovation in low carbon technologies. The federal government has committed to

12 International Monetary Fund, “Fiscal Policies for Paris Climate Strategies—from Principle to Practice” (Washington, D.C., 2019), <https://elibrary.imf.org/view/IMF007/25996-9781498311717/25996-9781498311717/25996-9781498311717.xml>, 40.

13 Canada's Ecofiscal Commission, “Bridging the Gap: Real Options for Meeting Canada's 2030 GHG Target,” November 2019, 15.

14 “Federal Government Adjusts Output-Based Carbon Pricing System for Industrial Emitters,” *GHG Accounting* (blog), September 4, 2018, <http://ghgaccounting.ca/tag/canadian-federal-carbon-pricing-backstop/>.

15 Chartered Professional Accountants of Canada, “Are Canadian Businesses Aware of the Need to Manage Greenhouse Gas Emissions?,” 2018, 5.

16 Anil Khurana et al., “The Future of Manufacturing - Canada” (Global Manufacturing & Industrialization Summit, 2020), 4.

funding a considerable amount of cleantech R&D, particularly for small start-ups; in particular, the Clean Growth Hub was established in 2017 for the express purpose of supporting cleantech innovation in Canada. More details on the funding streams associated with the Clean Growth Hub are available on page 12 of this report.

The pivotal role that governments play in innovation is well-established;¹⁷ from infrastructure investments to basic research, governments have historically provided essential support for the creation of new technologies and emerging industries. Since the 1950s, the Canadian federal government supported innovation through investment in basic research as well as sector-specific spending, such as in the defence industry.¹⁸ Historically, this has been accomplished primarily through tax subsidies and procurement, however, more recently the federal government has adopted a “policy mix” approach to innovation support¹⁹ which refers to a wide set of different policy tools used by a government to deliver a particular outcome.²⁰

Research is one of the primary outcomes by which governments have historically supported private sector innovation.²¹ By funding basic research, governments help produce information that is durable and costless for businesses to use,²² and also help safeguard against unfairly tilting the playing field by picking industry “winners” through direct subsidies or funding tied directly to particular projects. The bulk of federal innovation policy mix is focused on short-term funding opportunities for both basic and applied research: almost half of all federal climate policy instruments identified in our dataset are funding opportunities, of which approximately 60% are aimed at innovation support in particular. This approach is in line with a significant body of literature that finds that cleantech industries are particularly capital intensive and high risk and are thus often heavily reliant on public funding to get off the ground.²³

Providing funding for young firms to test out new ideas can also sometimes produce a “halo effect” that increase the ability of recipient firms to secure other external financing.²⁴ For example, recent research has found that the patenting activity of cleantech start-ups significantly increases with governmental support when compared to those start-ups that did not seek support from government, meaning firms were more productive with government support; the same study also found that receiving government support signals the viability of the company to private sector investors, as private financing deals increase by 155% for every additional license

17 David C. Mowery and Richard N. Langlois, “Spinning off and Spinning on(?): The Federal Government Role in the Development of the US Computer Software Industry,” *Research Policy* 25, no. 6 (September 1996): 963.

18 David A. Wolfe, “Innovation by Design: Impact and Effectiveness of Public Support for Business Innovation,” *Annals of Science and Technology Policy* 3, no. 3 (2019): 258–347, <https://doi.org/10.1561/110.00000014>, 267.

19 Wolfe, “Innovation by Design”, 321.

20 Kieron Flanagan, Elvira Uyarra, and Manuel Laranja, “Reconceptualizing the ‘Policy Mix’ for Innovation,” *Research Policy* 40, no. 5 (June 2011): 702–13, 706.

21 Ammon J Salter and Ben R Martin, “The Economic Benefits of Publicly Funded Basic Research: A Critical Review,” *Policy Research* 30 (2001): 509–32, 509.

22 Wolfe, “Innovation by Design”, 294.

23 Elgie et al., “Clean Technology and Business Innovation”, 18.

24 Paul Cunningham, Abdullah Gök, and Philippe Laredo, “Handbook of Innovation Policy Impact,” Nesta Working Paper Series (Nesta, 2013), 42.

from a government organization.²⁵ See “Clean Growth Hub” below for more details about innovation funding. It is not yet clear whether federal funding arrangements have aided start-ups in securing private funding, although this will be an important question for future research.

Another way that research can support innovation is by increasing the internal capacity for firms to produce innovation. This may be done through publicly led research projects that produce feasibility studies or analysis of consumer data that firms may not be able to conduct themselves. Collaborative/Public R&D was identified in our dataset as funding for research that was conducted, at least in part, by government itself. 20% of the federal policies we identified are aimed at providing information, support or training such as smart infrastructure feasibility studies, or to collect industry or consumer data. Some examples of this kind of external research and support to firms include the **Solar Ready Guidelines**, which is a report by Natural Resources Canada that outlines a number of design considerations and modifications builders can make to retrofit existing buildings with solar panels, or the **Path to Net Zero Project**, which is a four year study led by Natural Resources Canada to develop guidelines and codes for energy efficient homes.

This kind of information is particularly useful for nascent industries, like new or emerging cleantech, however, these programs tend to disproportionately benefit larger companies with greater internal capacities. SMEs and small start-ups often lack internal technical or research capacity (also called “absorptive capacity”)²⁶ and so often cannot review, synthesize or apply research, even if it is freely available.²⁷ In other words, the availability of publicly funding basic and applied research tends to disproportionately benefit larger firms compared with SMEs. Relatedly, several studies indicate government support for R&D must extend beyond that pilot programs and collaborative research projects to overcome the “technology valley of death”, which is the middle stage in the innovation chain between laboratory and export, where most tech-intensive start-ups tend to fail.²⁸ Similarly, scholars have noted that the ability of firms in risky sectors, such as clean tech, to procure private financing to scale up business operations has significantly declined since the 2008 Financial Crisis.²⁹ Only 20% of federal funding opportunities that identified in our dataset are aimed at supporting the commercialization and export stages of product development.

While R&D funding has been shown to be an important source of support in order to de-risk experimentation by the private sector in issue areas where the development path remains unclear (such as low carbon energy technology) an overreliance on R&D spending is unlikely to produce robust results. In comparison to the wide range of funding opportunities the federal

25 Claudia Dobliger, Kavita Surana, and Laura Diaz Anadon, “Governments as Partners: The Role of Alliances in U.S. Cleantech Startup Innovation,” *Research Policy* 48, no. 6 (July 2019): 1458–75, <https://doi.org/10.1016/j.respol.2019.02.006>.

26 Wesley M. Cohen and Daniel A. Levinthal, “Innovation and Learning: The Two Faces of R & D,” *The Economic Journal* 99, no. 397 (September 1989): 569, <https://doi.org/10.2307/2233763>.

27 Kira R. Fabrizio, “Absorptive Capacity and the Search for Innovation,” *Research Policy* 38, no. 2 (March 2009): 255–67, 265.

28 Mary Jean Bürer and Rolf Wüstenhagen, “Which Renewable Energy Policy Is a Venture Capitalist’s Best Friend? Empirical Evidence from a Survey of International Cleantech Investors,” *Energy Policy* 37, no. 12 (December 2009): 4997–5006, 5001.

29 Michael Migendt et al., “Beyond Venture Capital: An Exploratory Study of the Finance-Innovation-Policy Nexus in Cleantech,” *Industrial and Corporate Change* 26, no. 6 (December 1, 2017): 973–96, 978.

government has made available to start-ups, there are relatively few government policies that use financing tools, such as equity and debt financing, Green Bonds, etc. to help emerging or established businesses access funds to move to commercialization. Moving from R&D to commercialization is the stage of innovation that Canadian firms have historically struggled with the most: it has been widely acknowledged that Canadian firms tend to lack a “culture of commerce” in which technology firms have limited knowledge of successful sales, marketing and management skills.³⁰ While Canada is well positioned to be competitive in cleantech innovation, with an educated workforce well-above the OECD average,³¹ many young Canadian firms still struggle to scale up and gain entry into international markets.³²

The start-up and growth phases are currently well-supported by Canadian R&D innovation policy, however the federal policy mix only provides limited support to firms in the later commercialization phases of development (see page 14 for more details).³³ It has also been argued that governments choose to fund basic research in lieu of more targeted approaches, such as commercialization or export support, because it is seen as the least interventionist way to support innovation (in line with neo-classical conceptions of economics).³⁴ Another reason why R&D has tended to be the focus of Canadian innovation support is that universities have been one of the best organized and most effective lobby groups in the innovation policy arena. The research community has a vested interest in the development and expansion of government-led supply side R&D funding arrangements, sometimes at the expense of more targeted policies and programs³⁵. In contrast, SMEs in need of commercialization and export support have much weaker lobbying power, given their significant diversity. In light of these concerns, there is a clear opportunity for the federal government to focus greater efforts towards financing instruments that help businesses, particularly SMEs, commercialize and internationally export products and services that reduce emissions.

Clean Growth Hub

As previously noted, innovation funding appears to be the primary policy lever in the federal climate plan to target private sector emissions (outside of the national carbon pricing system). The \$2.2 billion Clean Growth Hub (CGH), announced in Budget 2017 and the Pan-Canadian Framework, is the centerpiece of the federal government’s cleantech innovation strategy. The CGH provides “leverage existing knowledge, expertise and relationships across the Government of Canada while providing an easy, single point of contact for clean technology users and producers”.³⁶ The CGH platform hosts funding opportunities from 16 different federal

30 Wolfe, “Innovation by Design”, 306.

31 Innovation, Science and Economic Development Canada, “An Inclusive Innovation Agenda: The State of Play” (Government of Canada, June 2016), <https://www.ic.gc.ca/eic/site/062.nsf/eng/00014.html>.

32 Stewart Elgie and Michelle Brownlee, “Accelerating Clean Innovation in Canada,” Policy Brief (Ottawa: Smart Prosperity Institute, 2017), 9.

33 Elgie et al., “Clean Technology and Business Innovation”, 5.

34 G. Doern, Peter W. B. Phillips, and David Castle, *Canadian Science, Technology, and Innovation Policy: The Innovation Economy and Society Nexus* (Queen’s University Press, 2016), 41.

35 Nicola Celeste Hepburn, “Minding the Gap between Promise and Performance: The Ontario Liberal Government’s Research and Innovation Policy, 2003-201” (Dissertation, University of Toronto, 2014), 257.

36 Environment and Climate Change Canada, “Second Annual Report on Clean Growth and Climate Change” (Gatineau: Government of Canada, December 2018), 39.

departments aimed at promoting clean technology creation, commercialization, export, and adoption. There are five funding streams under the CGH that host over 38 distinct programs:

- General Innovation (1)
- R&D and Demonstration (28)
- Scale-Up (2)
- Export (4)
- Adoption (3)

Five out of the six streams seek to target firms with new, innovative technologies or products, and so firms that sell existing green technologies or green existing “brown” technologies are not eligible to apply for funding under these five streams. Only the Adoption stream may be accessed by “brown technology” firms that are attempting to green their internal operations. As such, the clear focus of the CGH is to stimulate innovation, rather than “green” operations of existing Canadian firms or support later stages of product development. A full list of programs associated with the CGH is listed in the appendix of this report.

We identified 28 distinct funding opportunities associated with the CGH which suggests that the primary objective of the hub is to support Canadian innovation. However, only 2 programs hosted by the CGH are part of the commercialization and export stream, and only one has an explicit funding contribution attached: in January 2018, the Departments of Innovation, Science and Economic Development and Environment and Climate announced an investment of \$700 million to the **Business Development Bank of Canada** to help finance higher risk investments related to clean technology. The other program, **Export Development Canada**, led by Global Affairs, created specialized project financing options to help advance high-impact clean technology projects, however no specific investment is listed pertaining to this program. The CGH also hosts 4 programs that are aimed at supporting Canadian firms in later export stages of product development. Notably, none of the export-oriented programs list any specific funding contributions, but instead provide research and information support for Canadian firms reaching the export state of development.

The **Impact Canada** initiative was listed in both the Pan-Canadian framework and under the CGH to stimulate innovation in a number of key sectors identified by the federal government. There are two funding approaches used under Impact Canada: a series of “challenge” initiatives that issues prizes to entrepreneurs, researchers or companies that find a solution to a clearly defined problem, and a “pay-for-results” approach, in which funding is issued to recipients for achieving positive and measurable societal outcomes.³⁷ This approach to innovation funding is theoretically well-supported as a means by which governments can support sectors in which the path to achieving outcomes is uncertain, as is the case in low-carbon technologies.³⁸

37 Government of Canada, “About the Impact Canada Initiative,” Impact and Innovation Unit, August 7, 2018, <https://www.canada.ca/en/innovation-hub/services/impact-canada-initiative/about.html>.

38 Farrah Andersen et al., “Unlocking Private Capital Infrastructure to Finance Sustainable Infrastructure” (Meister Consultants Group, Environmental Defense Fund, October 2017), 20.

While this approach has been used in development and public health contexts, this style of funding is still relatively new, and there is a lack of evidence about whether or not these kinds of programs are more effective than traditional funding arrangements.³⁹ One concern that has been raised about this approach is that it may overlook the fact that scientific and technological developments usually do not follow a linear development path⁴⁰ --funding outcomes, rather than processes, may not be an optimal way to support low carbon technological innovation. Additionally, a growing body of research suggests that stable, long-term funding sources should be provided in place of short-term or one-time opportunities in order to galvanize broader private investment and send predictable signals to the private sector.⁴¹

Given that most of the funding measures in the Pan-Canadian framework were only introduced in 2017, it is unclear whether “pay-for-results” or funding challenges will produce robust results. However, it is encouraging to see new kinds of funding arrangements piloted by the federal government, and this kind of experimentation will likely lead to some important future findings for cleantech support. Some early announcements of recipient projects look promising: for example, the **Breakthrough Energy Solutions** program funded 10 SME projects to produce a variety of infrastructure and energy efficiency projects to significantly reduce emissions including the development of new solar energy materials, energy storage systems, electric vehicle batteries, low carbon infrastructure modernization, among others—all of which are likely to have a direct impact on emissions reduction in Canada (see Appendix for recipient lists).

However, some funding streams under the Clean Growth Hub are somewhat vaguely related to emissions reduction outcomes, as the funding streams define clean technology very broadly and appear to have diverse objectives. For example, the **Aquaculture Clean Technology Adoption Program** (listed in the Pan-Canadian framework), is a national contribution program that provides \$20 million in funding over 4 years (2017-2021) to support fisheries and aquaculture industries to improve their environmental performance. However, only one third of the recipients of this funding opportunity was dispersed to projects that list emissions reduction, fuel switching, or energy efficiency as either a primary or secondary outcome of the investment. The majority of funded projects related to reducing point-source pollution, water treatment, plastic waste reduction, or operational modernization more generally. Emissions reduction may be a second-order effect these projects but is not the primary outcome of the funding.

This is not to say that other environmental outcomes, such as water quality or plastic waste reduction are themselves not worthwhile or important objectives, but rather that these projects do not necessarily reflect a targeted approach to low carbon technological innovation. Moreover, such projects may not significantly contribute significantly towards Canada’s Paris goals (which is the nominal objective of the Pan-Canadian framework under which these

39 Ricarda Milstein and Jonas Schreyoegg, “Pay for Performance in the Inpatient Sector: A Review of 34 P4P Programs in 14 OECD Countries,” *Health Policy* 120, no. 10 (October 2016): 1125–40, 1125.

40 Joshua D Sarnoff, “Government Choices in Innovation Funding (with Reference to Climate Change),” *Emory Law Journal* 62 (2012), 71.

41 Hal Harvey and Laura Segafredo, “Policies That Work: How to Build a Low Emissions Economy” (San Francisco: ClimateWork Foundation, December 2011), 3.

programs are listed). From a decarbonization perspective, the multiple objectives of these funding opportunities may result in suboptimal emission reduction innovation outcomes. This is particularly significant, given that Canada is currently not on track to achieve its 2030 Paris target according to the 2019 UN Emissions Gap Report.⁴²

Many of the programs included under the Clean Growth Hub pre-date the creation of the hub in 2017, and thus the primary objective for many of these programs is to support broader innovation goals rather than spurring rapid and transformative low-carbon technology adoption specifically. Put differently, many CGH funding streams have multiple (if not competing) objectives, of which emissions reduction is just one. While funding programs that pursue multiple objectives is often warranted, and sometimes preferred, it does mean that emissions reductions achieved through innovation funding may be constrained in order to pursue other policy objectives. Given that the window for capping global emissions is closing quickly, recalibrating programs to more narrowly pursue emissions reductions may be warranted.

SME Support

Small and medium sized enterprise (SMEs) represent 98% of the Canadian economy, contribute to more than half of Canada's total private sector GDP,⁴³ and employ more than 70% of the Canadian private sector workforce.⁴⁴ Canadian SMEs produce approximately 30% of national emissions—more than the combined annual emissions of Quebec, Manitoba, Saskatchewan, and the Atlantic Provinces⁴⁵—however, we identified just 5 SME-specific policies out of a total of 99 federal policies. This suggests a significant omission in the current federal approach to emissions reduction.

There are three federal policies that are aimed to help existing SMEs reduce their emissions through infrastructure and operational efficiency investments. The **Energy Manager Program**, hosted by Natural Resources Canada, provides funding to SMEs to hire an energy manager or conduct a corporate or fleet energy assessment. Eligible firms must be excluded from the Output-Based Pricing System in the federal Greenhouse Gas Pollution Pricing Act, and must be based in one of the four provinces that utilize the federal backstop (Ontario, Saskatchewan, Manitoba, and New Brunswick) as the program is funded by proceeds of the federal carbon pollution pricing system. A total of \$3.1 million in funding was split between the four eligible provinces in the 2019-2020 period for this program. SMEs based in provinces outside of the national pollution pricing system have no equivalent federal incentive. For reference, there Innovation, Science and Development Canada list 643,188 SMEs based outside of the four provinces that are eligible for this funding.⁴⁶

The **Climate Action Incentive Fund** was established by Environment and Climate Change Canada using proceeds from the federal pollution pricing system and delivered \$218

42 United Nations Environment Programme, "The Emissions Gap Report 2019" (United Nations, 2019), <https://www.unenvironment.org/resources/emissions-gap-report-2019>, 9.

43 Innovation, Science and Economic Development Canada, "Key Small Business Statistics, January 2019", 3.

44 Ibid, 12.

45 ClimateSmart, "200 Million Tonnes of Opportunity", 12.

46 Innovation, Science and Economic Development Canada, "Key Small Business Statistics, January 2019", 5.

million in programming during its first year of operation (2019-2020). There are three streams of funding available under the Climate Action Incentive Fund: the MUSH stream, which provides support to municipalities, universities, colleges, schools and hospitals to undertake energy saving and efficiency projects, the SME stream, which provides funding to SMEs to take up energy efficiency retrofit projects, and the rebate stream, which provides support to businesses to purchase energy efficient equipment and appliances (however this stream is not yet active, as of June 2020). Like the Energy Manager Program, eligible firms must be based in Ontario, Saskatchewan, Manitoba or New Brunswick to qualify for support.

The SME stream of the Climate Action Incentive Fund was oversubscribed in Ontario⁴⁷, and the program's funding envelope was insufficient to meet interest and demand from SMEs. In their 2019 report, Innovation, Science and Economic Development Canada report 426,486 SMEs based in Ontario.⁴⁸ \$72 million was provided by the SME stream of the Climate Action Incentive Fund in 2019-2020, meaning if every SME registered in Ontario accessed the fund, they would each receive approximately \$168. For reference, the average price of a commercial energy audit alone in Ontario ranges from \$1,000-\$15,000, and so the funding attached to this program is not commensurate with the support that would be necessary to produce robust engagement from the SME business community. The administration of the Fund likely excluded many SMEs from being able to access funding: the cost floor for the Climate Action Incentive Fund is \$20,000, of which the federal government will provide up to 25% of the associated costs. More than half of Canadian SMEs have fewer than four employees, and so the upfront costs associated with a qualifying project (\$15,000 or more) would likely exceed the cash holdings of smaller businesses, particularly in the economic wake of the COVID-19 shut down.

The federal government also established the \$2 billion **Low Carbon Economy Fund** to generate clean growth and reduce carbon emissions in Canadian communities. The fund is comprised of two programs: The Leadership Fund, which provides intergovernmental transfers of up to \$30 million to each province and territory for a total of \$1.4 billion. The remaining \$600 million funds the Low Carbon Economy Challenge provides funding to innovative projects to reduce community greenhouse gas emissions. This is further divided into two streams of funding, the Champions stream, which gives \$450 million to provinces, territories, and the Partnerships stream. The first intake of the Partnerships stream provided \$60 million in funding to indigenous communities, non-profits and small municipalities and SMEs, and the second intake provides \$10 million in dedicated funding to SMEs. Of the full \$2 billion in initial funding, SMEs are only eligible to access \$70 million directly, of which only \$10 million is dedicated specifically to SME emission reduction projects.

In terms of SME innovation support in the cleantech industry, there are two dedicated federal funding streams: **Innovative Solutions Canada**, listed under the Clean Growth Hub, was established as a procurement program to provide \$100 million in dedicated funding to support the scaling up and growth of Canadian SMEs. The Trudeau government also announced a funding extension of \$400 million over five years in Budget 2017 for the **Sustainable Development Technology Fund** (also under the CGH), which provides funding to SMEs that

47 Authors' interview with Green Economy Canada staff, February 11, 2020.

48 Innovation, Science and Economic Development Canada, "Key Small Business Statistics, January 2019", 5.

advances innovative pre-commercial technologies. Eligible projects must demonstrate quantifiable benefits in one or more of four issue areas: climate change, clean air, clean water, or clean soil.

While these programs provide funding that is specifically earmarked for SME innovation, both the Innovative Solutions program and the SD Tech Fund define clean technology in an extremely broad way (much like many of the other funding instruments listed under the Clean Growth Hub). Of the 54 calls for proposals listed under the Innovative Solutions program (as of June 2020), only 3 of the calls for proposals list emission reduction as an indirect outcome of the project, and none of the calls for proposals are directly related to developing technology to reduce emissions. Importantly, both the SD Tech Fund and Innovative Solutions Canada predate the Clean Growth Hub, and thus, like some of the other Clean Growth Hub programs, balance emissions reduction among multiple other objectives, (approximately half of SD Tech 2019-2020 recipients relate to renewable energy, emission reduction, or energy efficiency outcomes).

While programs like the Energy Manger program and the Climate Action Incentive Fund provide much needed support to SMEs, overall federal engagement with small businesses remains minimal. Given the centrality of SMEs to the Canadian economy, their importance from an emissions perspective, as well as their pivotal role in the lives of Canadian employees, a greater emphasis on SME focused programming would considerably strengthen the current federal approach to decarbonization.

Provincial Policies

Of the provincial policies identified in our dataset, approximately 75% have either been cancelled or have ended without being renewed following the June 2018 election of the Ford government in Ontario. The change in government resulted in the cancellation of the majority of climate related projects and policies, and it is likely that no new projects or policies related to decarbonization will be pursued while the current government remains in power.⁴⁹ While the Ford government instituted an Advisory panel on Climate Change in November 2019, the purpose of the panel is to determine the impacts of climate change for Ontario and is not aimed at emission reduction or mitigation efforts.⁵⁰ Of the remaining policies, the majority are regulations put in place prior to the election of the Ford government that have not been repealed, with 3 forthcoming regulations: **Bio-Based Contents Requirements for Gasoline**, provincially mandated **Building Code Updates**, and **Increasing Renewable Content in Fuels** regulations.

In 2018, the Ford government released its Made-in-Ontario Environmental Plan to replace the previous government's Five Year Climate Action Plan. Climate change related policies make up a relatively small component of the Ford government's new environmental plan, and very few specific measures are outlined in the plan. The centerpiece of the province's current approach to supply-side mitigation are financing mechanisms aimed at commercialization of cleantech innovation: the **Ontario Carbon Trust**, which provides \$400

49 Environmental Defense, "Failure to Launch: A Progress Report on Ontario's Change Actions," October 2019, 3.

50 Ministry of the Environment, Conservation and Parks, "Ontario Appoints Advisory Panel on Climate Change," Government of Ontario, November 28, 2019, <https://news.ontario.ca/ene/en/2019/11/ontario-appoints-advisory-panel-on-climate-change.html#:~:text=The%20advisory%20panel%20on%20climate,Mader%20as%20the%20Vice%2DChair>.

million over four years to partner with the private sector on the development of green technologies and includes a \$50-million “reverse auction” that encourages businesses to bid on government contracts awarded based on the lowest cost per tonne of greenhouse gas emissions.

Additionally, the Ford government has maintained the **Ontario Green Bond Program** which issues low interest loans to finance projects relating to energy conservation, public transit, and other climate related public investments. Ontario is currently the largest issuer of Canadian dollar Green Bonds, however all 19 projects that have been financed under the Green Bond Program have been public infrastructure investments which include hospital and public transportation development or college campus expansions. No private-sector projects have yet been financed through the Green Bond Program.

The only program or initiative in Ontario that may apply to some SMEs is the **Ontario’s Energy and Water Reporting and Benchmarking (EWRB)** initiative, which mandates that commercial and residential facilities larger than 100,000 square feet report energy and water use to the province. The objective of this policy is for businesses to voluntarily reduce emissions: energy use in commercial and residential buildings can be reduced by as much as 30% just by tracking and monitoring consumption.⁵¹ However, it is unclear how many SMEs actually participate in this program, given that the majority of SMEs in Ontario rent space for their business operations and are not building owners themselves.

There are currently 3 provincial funding streams that are active, all of which have established end-dates and it is unclear whether they will be renewed by the Ford government. These funding streams include the **Municipal Energy Plan** program, an intergovernmental transfer that covers 50% of costs associated with the creation of an energy reduction plan for Ontario municipalities (up to a maximum of \$90,000), the **Autonomous Vehicle Innovation Network**, which is funded by the Ontario Ministry of Economic Development, Job Creation and Trade as well as the Ontario Ministry of Transportation to support research and development, talent recruitment, and technology acceleration and demonstration of autonomous vehicle manufacturing, and the **Prosperous Greenbelt/Resilient Greenbelt** program, administered through the Greenbelt Foundation to support projects that enhance the health of the Greenbelt's natural systems and address climate change. While such reforestation projects may mitigate some carbon through sequestration, this can be considered a co-benefit of the program which is mainly aimed at ecological preservation of Ontario’s Greenbelt.

Overall, the current provincial approach to emission reduction in the private sector is likely not sufficient to achieve robust results. Mitigation programming remains limited, and many important policies, such as the feed-in tariff and engagement in the regional cap-and-trade scheme instituted by the previous Liberal government, have been rolled back. The provincial approach to target climate change as one of many environmental threats that Ontario faces is not optimal to achieve the kind of transformational change that is required to transition to a low carbon economy and to support businesses to make meaningful modifications to their operations and long-term plans. The EWRB serves an important first step in identifying and tracking

51 Lora Rigutto, “Initiative to Boost Energy and Water Efficiency in Ontario Buildings,” *Circuitmeter*, February 25, 2019, <https://www.circuitmeter.com/industry-articles/ewrb-ontarios-mandatory-energy-and-water-reporting/>.

emissions for large firms, however this requirement has not been expanded to incorporate the majority of businesses (SMEs) operating in Ontario.

Municipal Policies

We reviewed the municipal climate policies of seven municipalities in Ontario: Hamilton, York Region, Kingston, Ottawa, Waterloo, London, and Sudbury. Four of these seven municipalities have an active climate change action plan in place: The Air Quality and Climate Change Management Plan adopted by the City of Ottawa in 2014, the Climate Action Plan for Waterloo Region adopted in 2013 and updated in 2017, the 2014 Kingston Climate Action Plan and the Hamilton Community Climate Change Action Plan adopted in 2015. A Community Energy Action Plan and the Corporate Energy Management Programs was adopted by the City of London in 2014 (and updated subsequently in 2019), both of which contain emission reduction strategies. The majority of policies outlined in these three plans are related to improving the city's energy efficiency, as well as demand-side mitigation policies such as low carbon transportation initiatives. None of these municipal climate plans include programs or initiatives to engage with the local private sector specifically.

Specific and measurable policies outlined in these municipal plans are included in this dataset. Municipal policies make up approximately just 18% of total decarbonization policies identified in our dataset. This is unsurprising, as the majority of municipalities we included have populations of less than 1 million, (and some with significantly less—for example, Sudbury has a population of approximately 160,000). While many studies have shown that municipalities are, in many respects, more active than other orders of government in areas related to decarbonization⁵², however this tends to hold true more so for large, metropolitan cities with a larger global presence and greater resources. With the exception of York Region and Ottawa, are likely have significant resource constraints that may limit the ability of these municipalities to unilaterally take on decarbonization projects outside of reducing the municipality's own corporate emissions.

However, at the time of writing, all seven municipalities have announced their intention to create climate change action plans after contemporaneously declaring a climate emergency. On March 13, Kingston declared a climate emergency but did not commit to the creation of a new climate plan beyond the transportation and energy efficiency initiatives already in place. On March 18, 2020, the City of Hamilton declared a climate emergency, but while the city already had an active climate plan in place, city council further committed to the establishment of a Climate Change Task Force to find emission reductions and efficiencies in city operations. Likewise, The City of London declared a climate emergency on April 23, 2019, and council has since publicly expressed its intention to develop a Climate Action Plan, but such a plan has not yet been publicly released or adopted. The City of Ottawa declared a climate emergency on April 24, 2019 and will be releasing a new climate action plan sometime in 2020.

⁵² Eg. Matthew J. Hoffmann, *Climate Governance at the Crossroads: Experimenting with a Global Response after Kyoto* (Oxford; New York: Oxford University Press, 2011); Sara Hughes, Eric K. Chu, and Susan G. Mason, eds., *Climate Change in Cities*, The Urban Book Series (Cham: Springer International Publishing, 2018); Harriet Bulkeley and Vanesa Castán Broto, "Government by Experiment? Global Cities and the Governing of Climate Change," *Transactions of the Institute of British Geographers* 38, no. 3 (July 2013): 361–75.

The city of Sudbury declared a climate emergency on May 29, 2019 and began working on a Community Energy Emissions Plan in collaboration with over 150 community groups. Several municipalities in York region have declared a climate emergency, including Vaughn and Newmarket, while Richmond Hill decided to postpone a decision about whether to declare a climate emergency. York Region has also submitted a draft version of its Climate Change Action Plan to the public for comment, but the plan has not yet been adopted (as of June 2020). The City of Waterloo was the last to declare a climate emergency on October 9, 2019, but already had aggressive carbon reduction goals in place: Waterloo's 2017 Climate Plan set a city-wide target of reducing emissions by 80% compared with 2010 levels, and city council has since publicly discussed the possibility of implementing a regional carbon budget as a means to achieve this goal, however this policy has not been formally tabled by city council.

Given that all seven municipalities declared a climate emergency within 6 months of one another, it is clear that there is regional momentum for municipalities to be more engaged in climate governance. However, because the majority of these cities only made broad commitments to create new climate actions, it is difficult to say whether and how the climate emergency declarations will translate into specific mitigation policies or programming to support community or private sector emission reductions. Based on the three existing climate plans, which contain very limited measures for incentivizing decarbonization in the private sector, it seems likely that the forthcoming municipal plans will focus largely on reducing the city's corporate emissions, such as improving building and energy efficiency, as well as implementing demand-side emission reduction strategies, such as low carbon transportation policies. Considering the significant deficit that many Canadian municipalities are facing in the wake of the COVID-19 shut down, it is unlikely that we should expect to see SME support or incentive funding for private sector retrofits in forthcoming municipal climate action plans.

Conclusion

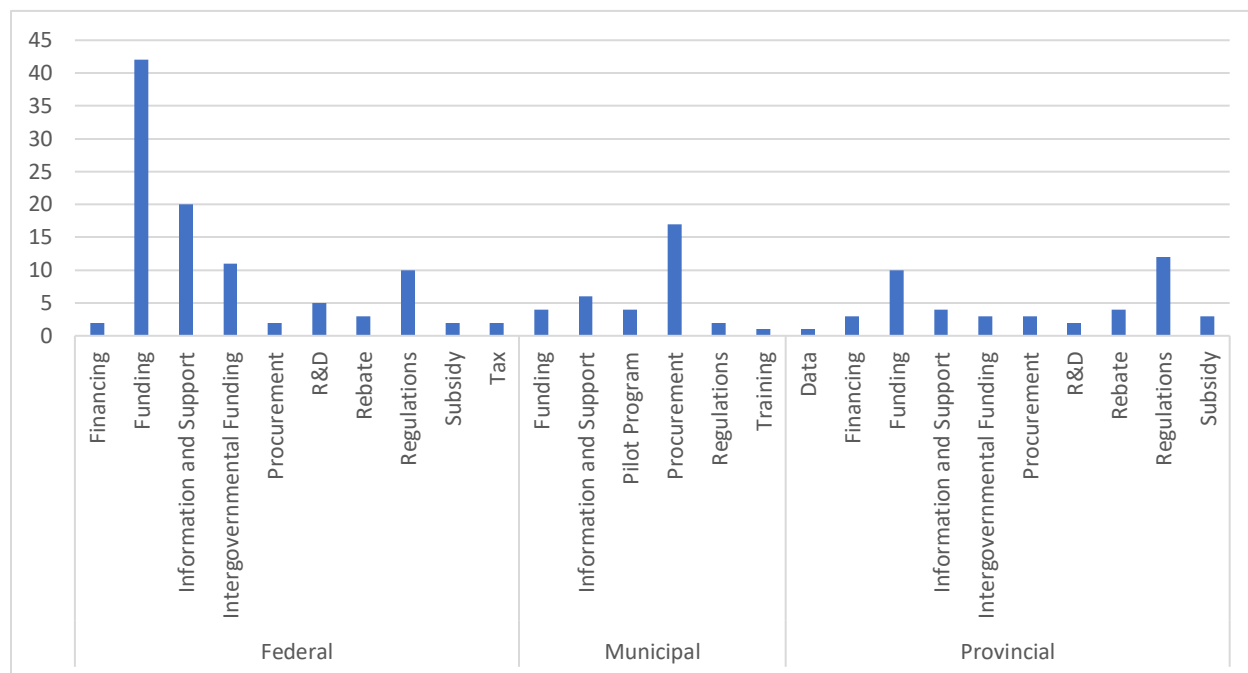
This review the policy ecosystem to support decarbonization in the private sector suggests that the provincial government is best positioned to incentivize businesses to voluntarily reduce emissions. However, the current Ford government has signalled that climate change-specific policies and programs are unlikely to be the focus of its environmental governance approach in the future. In the absence of provincial leadership on this issue, municipalities have become increasingly engaged on issues relating to climate change, however the majority of municipal climate planning reviewed in this study is still in nascent phases of development, with little focus on the private sector in particular.

In contrast, the federal Pan-Canadian framework introduced a variety of programs and policies to regulate and support decarbonization in the private sector—in particular, the national carbon pricing scheme is an important first step in regulating the emissions of large producers, and several promising programs to fund and support cleantech innovation were initiated under the Pan-Canadian framework. While the focus of several of the cleantech programs is not well constrained around emissions reductions outcomes in particular, these funding streams are largely reflective of best-practices and demonstrate some innovative approaches to stimulating innovation.

However, a clear omission in the current federal plan are incentive funding and technical support for SMEs, which make up the vast majority of Canada’s private sector. SMEs lack the technical capacity, financing opportunities, knowledge, and impetus to make the transition to a low carbon economy without government support. However, SMEs represent a significant latent capacity to help Canada meet its Paris Agreement targets: SMEs are waiting and willing to engage on these issues, but will need flexible, specific, and continuous funding support to do so. Non-governmental initiatives, which are typically more agile than government, and tend to have better grassroots knowledge of the needs and priorities of small and medium sized firms, may be well positioned as a strategic partner for the federal government to engage in order to deliver effective SME programming in the future. An exploration of the potential for government-non-governmental partnerships to deliver this kind of SME-focused programming may be an important avenue for future research.

Appendix

Policy and Program Instruments



Methodology

A list of policy instruments was inductively generated. Policy instruments are categorized under the following criteria:

Policy Instrument	Definition
Financing	Aimed at helping businesses, entrepreneurs, and researchers finance projects related to emission reduction. This includes both research and development, as well as

	commercialization of technologies. For example, debt and equity financing tools, Green Bonds, etc.
Funding	Aimed at providing resources to businesses, entrepreneurs or researchers to take on a specific program, project, initiative, or applied research project. This category excludes internal research projects (“R&D”) as well as targeted funding to other orders of government for decarbonization projects (“Intergovernmental Funding”)
Information, Training, and Support	Aimed at providing either consumers, companies, non-profits, or other orders of government with reports, data, staff training, or information about decarbonization or technologies
Intergovernmental Funding	Targeted grants or funds that are paid from one order of government to another to finance decarbonization projects or programs. Block funding or funding for projects that treat decarbonization as a co-benefit are excluded
Pilot Program	Includes feasibility studies or experimental trials to conduct a small-scale, short-term experiment
Procurement	Aimed at the procurement of goods, services and construction on behalf a government agency. Examples include the Federal Government’s Greening Government Strategy to replace government fleets with electric vehicles
Collaborative R&D	Funding for research that is conducted internally by the government itself or projects taken on by federal researchers in partnership with private industry. Funding for projects that are entirely outside of government research are classified as “funding”
Rebate	A demand-side post-purchase incentive that provides a partial refund to consumers or companies to incentivize the consumption of low-carbon goods and services
Regulations	A rule or directive to that restricts levels of carbon emissions
Subsidy	A demand-side pre-purchase incentive to encourage the consumption of low-carbon goods and services

Tax	A compulsory charge levied against consumers, businesses, etc. that is intended to disincentivize carbon consumption and fund other decarbonization projects
Voluntary Certification	Programs that aim to regulate the emissions of businesses without legal enforcement, usually a public-private partnership

Breakthrough Energy Solutions Finalists

(Funded recipients are highlighted in grey)

Recipient	Project	Target
ADC Technologies Inc.	Direct Air Capture	Heat Waste
Agora Energy Technologies	Energy Storage	Renewable Energy
Biome Renewables	Wind Farm Pilot	Renewable Energy
Carbon Upcycling Technologies Inc	Coal Upcycling	Carbon Utilization
CarbonCure Technologies Inc.	Concrete Production	Carbon Utilization
CERT Systems Inc.	Chemical Manufacturing	Carbon Utilization
Edgehog Tech	Solar Technology	Renewable Energy
Ekona Power Inc	Hydrogen Production	Renewable Energy
Ensyn Technologies Inc	Thermal Technology	Low Carbon Fuel
Evercloak Inc	Manufacturing	Energy Efficiency
e-Zn Inc	Energy Storage	Renewable Energy
Fortran Traffic Systems Limited	Transportation Management	Low Emission Transportation
Gbatteries	Energy Storage	Low Emission Transportation
Havelaar Canada Industrial R&D Lab	Electric Vehicle Infrastructure	Low Emission Transportation
Hydrostar Inc	Energy Storage	Renewable Energy
Intelligency City	Construction	Carbon Neutral Buildings
Oneka Technologies	Tidal Energy	Renewable Energy
Opus One	Software	Low carbon Energy Grid
Peak Power	Software	Low carbon Energy Grid
Smarter Alloys Inc	Manufacturing	Smart Materials
Thermal Frost Intl. Inc	Energy Storage	Energy Efficiency

Aquaculture Clean Technology Adoption Program Recipients

Project	Funding	Primary Outcome	Co-benefit
Advanced Industrial Water Treatment System	\$303,750	Waste Reduction	

Advanced Trawl Sonar Installation	\$321,262	Catch Efficiency	
Air-filled high-density polyethylene buoys	\$6,656	Plastic Reduction	
Air-filled polyethylene floatation	\$48,871	Plastic Reduction	
AquaLogic incubator for salmonid eggs	\$29,043	Incubation Efficiency	Point-source Pollution
Auxiliary engine and longline replacement	\$34,470	Emissions	Fuel Consumption
Energy Efficient Algae Photobioreactor	\$318,640	Plastic Reduction	Energy Efficiency
Energy Efficient Algae Photobioreactor	\$52,470	Plastic Reduction	Energy Efficiency
Energy Efficient Algae photobioreactor	\$95,000	Plastic Reduction	Energy Efficiency
Energy efficient algal bioreactor	\$113,000	Energy Efficiency	Alternative Food Source
Energy Efficient Electrical Winch System	\$1,200,000	Energy Efficiency	
Energy Efficient Water Pumps	\$74,714	Energy Efficiency	
Engine Performance	\$41,063	Fuel Consumption	
Enhanced Rockfish Conservation and Awareness	\$74,437	Conservation	
Environmentally Friendly Ice Slurry System	\$416,000	Refrigerant Modernization	
Environmentally Friendly Oil Extraction	\$10,107	Point-source Pollution	
Environmentally Friendly Oil Extraction	\$22,431	Point-source Pollution	
Environmentally Friendly Oil Extraction	\$7,155	Point-source Pollution	
Environmentally Friendly Trawl Doors	\$48,000	Energy Efficiency	Fuel Consumption
Environmentally Friendly Trawl Equipment	\$88,177	Catch Efficiency	
Environmentally-controlled Bulk Harvest Tanks	\$52,032	Energy Efficiency	Emissions
Environmentally-friendly trawl equipment	\$74,582	Conservation	Fuel Consumption
Environmentally-friendly trawl equipment to reduce bycatch	\$336,803	Conservation	
Equipment energy optimization and carbon footprint reduction	\$37,246	Fuel Switching	Emissions
Equipment Energy Optimization and Carbon Footprint Reduction	\$99,999	Fuel Switching	Emissions
Equipment energy optimization and carbon footprint reduction	\$120,947	Fuel Switching	Emissions
Equipment energy optimization and carbon footprint reduction	\$42,977	Fuel Switching	Emissions
Equipment energy optimization and carbon footprint reduction	\$65,876	Fuel Consumption	Emissions

Gas generator replacement	\$5,391	Fuel Switching	Emissions
Heat reclamation from outfall seawater	\$33,535	Fuel Switching	Emissions
High Efficiency Nets for Invasive Species Management	\$57,749	Catch Efficiency	Fuel Consumption
Hybrid energy system project	\$37,313	Fuel Switching	Emissions
Identification of Sensitive Areas with Improved Sonar Technology	\$51,855	Conservation	
Improve environmental performance of algae culture by acquiring an automated photobioreactor	\$51,953	Energy Efficiency	Plastic Reduction
Improved Energy Generation - Solar Panel Technology	\$75,000	Fuel Switching	Emissions
Improved Engine Performance	\$16,312	Fuel Switching	Emissions
Improved mapping and fuel efficiency	\$52,810	Conservation	Energy Efficiency
Improved Water Quality and Filtration – Recirculating Technology	\$296,310	Water Treatment	
Increase production capacity	\$22,072	Water Treatment	
Installing state of the art processing technology	\$1,000,000	Water Treatment	Emissions
Integrated Waste Conversion	\$101,817	Fuel Switching	Emissions
Integration of a recirculating aquaculture system (RAS) technology	\$97,500	Water Use	
Marine net sensors	\$75,156	Catch Efficiency	Fuel Consumption
Multibeam Sonar Mapping Technology	\$28,195	Catch Efficiency	Conservation
Multibeam Sonar Mapping Technology	\$38,072	Catch Efficiency	Conservation
Multibeam Sonar Mapping Technology	\$40,154	Catch Efficiency	Conservation
New hydro-powered heat pumps	\$50,000	Energy Efficiency	Emissions
Non-polluting retrofit for shellfish rafts	\$43,125	Plastic Reduction	
Replacement of Styrofoam floats	\$19,900	Plastic Reduction	
Seabed Mapping System	\$13,595	Catch Efficiency	Fuel Consumption
Solar Energy System	\$305,169	Fuel Switching	Emissions
Solar Powered Compost System	\$54,728.44	Waste Reduction	Point-source Pollution
Solar powered heating system	\$43,488	Fuel Switching	Emissions

State of the Art Processing Technology	\$424,219	Water Treatment	Point-source Pollution
UV filters	\$22,500	Catch Efficiency	
Waste Water Treatment and Recycling System	\$384,000	Water Use	

Strategic Innovations Recipients

Firm	Funding
Abraham Innovation Systems Inc.	\$7 million
Advantech Satellite Networks (now Spacebridge)	\$11.5 million
Aerospace Innovation and Research Network (AIR) – (Aerospace Industries Association of Canada)	\$49 million
AGS Automotive Systems	\$7 million
Alcoa Loralco Management Company	\$10 million
Algoma Steel	\$30 million
Algoma Tubes Inc. and Prudential Steel Ltd. (Tenaris)	\$16 million
Aluminerie Alouette Inc.	\$15 million
ArcelorMittal Canada Inc.	\$49.9 million
Bell Helicopter Textron Canada Ltd and partners	\$49.5 million
BioVectra	\$37.5 million
BlackBerry QNX	\$40 million
Blue Solutions Canada Inc.	\$9 million
Bluedrop Performance Learning Inc.	\$7.6 million
Burloak Technologies	\$14 million
CAE Inc.	\$150 million
Canada Kuwait Petrochemical Corp.	\$49 million
Canadian Agri-Food Automation and Intelligence Network (CAAIN)	\$30 million
Canadian Food Innovators Network (CFIN)	\$49.5 million
Carbon Engineering Ltd.	\$25 million
CBN Nano Technologies Inc. and Canadian Bank Note Company, Limited	\$40 million

Cognitive Systems Corp.	\$7.3 million
Coulson Aircrane Ltd.	\$3.4 million
Creative Destruction Lab	\$25 million
Digital Health and Discovery Platform (DHDP) - Terry Fox Research Institute / Imagia	\$49 million
Domtar Inc.	\$28.8 million
Elysis Limited Partnership	\$60 million
EVRAZ	\$40 million
exactEarth	\$7.2 million
General Fusion	\$49.3 million
Gerdau Ameristeel Corporation	\$20 million
Heico Canada Holding Company	\$18 million
High Q	\$6.5 million
Industry Consortium for Image Guided Therapy (ICIGT) -Sunnybrook Research Institute	\$49 million
Innovation ENCQOR	\$66.7 million
Inter Pipeline	\$49 million
ISARACorporation	\$7.2 million
JP Bowman Ltd.	\$2.7 million
Kruger Inc.	\$13.8 million
Lakeside Plastics Ltd.	\$1.1 million
Linamar Corporation	\$49 million
LNG Canada Development Inc.	\$220 million
Maple Leaf Foods Inc.	\$49 million
Marwood Metal Fabrication Ltd.	\$20 million
Mastercard Technologies Canada ULC	\$1 million
Meridian Lightweight Technologies Inc.	\$0.3 million

MindBridge Analytics Inc.	\$14.5 million
Nokia	\$40 million
North Inc.	\$24 million
Northstar	\$9.5 million
NOVA Chemicals	\$35 million
Nova Steel Inc.	\$7.4 million
Nova Tube Inc.	\$14 million
Ranovus	\$20 million
Rockport Networks Inc.	\$12 million
Sciometric Instruments Inc.	\$2.9 million
Siemens Canada	\$35.7 million
Stelco Inc.	\$49.9 million
STEMCELL Technologies	\$22.5 million
SWITCH Materials Inc.	\$8.3 million
Synergx Technologies Inc.	\$0.8 million
Tekna Plasma Systems	\$20 million
Telesat Canada	\$85 million
Toyota Motor Manufacturing Canada	\$110 million
Woodbridge Foam Corporation	\$20 million

Innovative Solutions Canada Calls for Proposals

Call for Proposals	Outcome
Plastics challenge — Recycled plastic ceiling tiles	Plastics
Turning pixels into data: Imaging for accessibility	Data
COVID-19 Challenge: An intelligent digital clearing house	Data
Plastics challenge — Textiles and microfibers	Plastics
Plastics challenge — Sustainable alternatives to plastic packaging	Plastics

Plastics challenge — Diverting end of life vehicle plastics from landfills	Plastics
Outdoor Air Purifier	Conservation
Eco-friendly Waste Converter	Emissions
Plastics challenge — E-waste	Plastics
Plastics challenge — In-situ sensing Othernology for monitoring microplastics in the marine environment	Plastics
Nanocomposite Fabrics Production System	Materials
Surveying objects across an air-water interface	Data
AI Software for Photonics Semiconductor Fabrication	Other
Alternate Format Business Othernology Challenge	Other
Secure and confidential rule matching	Other
Energy Producing Window Coverings	Energy Efficiency
Call for prototypes to help combat COVID-19	Health
COVID-19 Challenge - Point of Care and Home Diagnostic Kit for COVID-19	Health
COVID-19 challenge – Low-cost sensor system for COVID-19 patient monitoring	Health
COVID-19 Challenge: Made in Canada filtration material for the manufacture of N95 respirators and surgical masks	Health
User-Centric Verifiable Digital Credentials	Data
Foot-and-mouth disease vaccine matching	Health
Hybrid Ceramic Powder Processing System	Chemical
Stable Liposomes as Drug Carriers	Health
Data Centre Discovery Tool with Options Analysis	Data
Identification of Microbial Mixtures	Health
Point of Care Diagnostics to combat Antimicrobial resistance	Health
Machine learning to improve organ donation rates and make better matches	Health
Automated redaction of video recordings for the purposes of Access to Information requests	Health
Plastics Challenge — Development of Next Generation Bio-Based Foam Insulation	Emissions
Portable Package Auto Sampler	Border/Postal Services
Postal Small Packet and Package Inspection	Border/Postal Services
Kinetic Energy Harvesting on Marine Vessels	Emissions
Coal Mine Tailings Pond	Pollution
Tracing the Steel Industry Supply Chain	Data
Advanced Decision Support for First Responder Command and Control	Data
Logistics and Resource Management of Emergency Response Assets	Data
Up Hands Free Fire Fighting	Data
Marine Biotxin Detection Devices for Shellfish	Pollution
Innovative Device for Plant Pest Surveillance	Conservation

Innovative Attractants to Wood Boring Insects	Conservation
Audio Quality Enhancements for Remote Interpretation Services	Data
Improving Robot-Environment Interaction	Conservation
Moulding of High Performance Composites Materials	Defense
Composite Material Manufacturing Simulation Software	Other
Preventing Contraband Delivery via Air and Ground	Border/Postal Services
Detection System for Wireless Communication	Data
Plastics Challenge — Sustainable Fishing and Aquaculture Gear	Conservation
Life Sign Monitoring System (LSMS)	Data
Improving the Internet Connectivity of Users in Remote Locations	Other
Enhancing Pedestrian and Cyclist Road Safety	Data
Scaling Down Precision Agriculture	Conservation
Efficient Soil Sampling Otherniques	Conservation
Plastics Challenge — Remove and Manage Ghost Fishing Gear and Marine Debris	Conservation
Plastics Challenge — Improved Compostibility of Bioplastics	Plastics
Plastics Challenge — Construction Waste	Plastics
Plastics Challenge — Separation of Mixed Plastics	Plastics
Plastics Challenge — Recycling of Glass Fiber-Reinforced Plastic	Plastics
Plastics Challenge — Food Packaging	Plastics
Earth Observation Images Processing and Management System	Data
Innovative Platform to Facilitate Evidence-Informed Decision-Making	Data
Haptic System	Data
Electroencephalography (EEG) and Vital Signs Integrated Existing Virtual and Augmented Reality (VR/AR) sets	Health
Measurement of Cold Spray	Aviation
Platform Corrosion Detection and Prevention	Other
High Energy Lasers	Other
Night Vision Ergonomics Enhancement	Other
Additive Manufacturing for High Performance Systems	Other
Advanced Coatings and Materials for Personal Protective Ensembles	Other
Robust "Beyond Line of Sight" (BLOS) Communications in Satellite-Denied Environments	Data
Artificial Intelligence and Big Data Analytics for Advanced Autonomous Space Systems	Data
Engineered Surfaces Challenge	Other
3D Printing and Additive Manufacturing: Metal Powder Bed Density Test Equipment	Other
Connected Vehicle and Engineered Surfaces Challenge	Other

Sustainable Development Technology Fund Recipients

Recipient	Target	Funding
RecycleSmart Solutions	Operational Efficiency	\$1.68 million
Synauta	Energy Efficiency	\$1.2 million
Anaergia	Emissions Reduction	\$6 million
Fibracast	Pollution Control	\$2.5 million
Equispheres	Energy Efficiency	\$8 million
Smarter Alloys	Operational Efficiency	\$4.8 million
Borealis Wind	Renewable Energy	\$1.4 million
Axis	Operational Efficiency	\$3.5 million
E-Zn E-Zn	Renewable Energy	\$2 million
Xanadu	Computer Tech	\$4.4 million
Pyrowave	Waste Reduction	\$3.3 million
SomaDetect	Operational Efficiency	\$4 million
DMF Medical	Emissions Reduction	\$0.7 million
Global Spatial Technology Solutions	Operational Efficiency	\$3 million