



ADVISORY COUNCIL on CLIMATE ACTION

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Government
of Canada

Gouvernement
du Canada

Canada

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Context

Introduction

Accelerating the transition to sustainable, resilient transportation systems and buildings will be essential to meeting Canada's commitments under the Paris Agreement. The economic opportunities for businesses and workers in a clean economy provide a clear motivation to address remaining barriers in these sectors and effect meaningful change. The Government of Canada alone cannot realize these opportunities. The federal government does, however, have important tools that can be used to clarify and amplify promising market trends emerging in Canada and globally.

Since the beginning of the Advisory Council's mandate, as announced in the 2018 Fall Economic Statement, we have engaged in thoughtful conversations with select experts and considered analysis of effective policy tools in the transportation and built environment sectors. In March 2019, we provided interim recommendations on key measures to encourage the uptake of zero emissions vehicles across Canada, including a purchase incentive of up to \$5,000. We were pleased to see many essential points of this advice reflected in Budget 2019.

In our final report, we have identified what we believe to be the most promising opportunities to enhance the current suite of federal policies to reduce greenhouse gas (GHG) emissions from transportation and buildings. Our advice, in particular on how to strengthen market demand for building retrofits, complements the work of the Expert Panel on Sustainable Finance. While the Expert Panel's mandate included broader range of topics related to sustainable finance and climate-related risk disclosure, we benefitted from the insights on building retrofits and sustainable infrastructure gained through the Expert Panel's discussions and engagement over the previous year.

Given the short duration of our mandate, this report is not intended to be a comprehensive roadmap of desirable policies across these sectors. Our recommendations focus on areas that are within the Government of Canada's jurisdiction, and in particular areas where government action can catalyze the development of a broader market. In the built environment sector, the Government of Canada can prime the retrofit market for growth by disseminating information and best practices, including through scaled-up demonstration projects within its diverse portfolio of owned and leased assets. In the transportation sector, we recommend that the Government of Canada build on its current efforts to promote Zero Emission Vehicles by mandating supply commitments from manufacturers in order to ensure long-term market certainty and stability. We also briefly explore potential avenues to reduce emissions from other modes of transportation, noting the need for an integrated strategy to guide these efforts.

Rapid changes in technology and falling costs have opened a window of opportunity to modernize buildings and transportation systems in ways that will create more livable towns and cities. Choosing a zero emission vehicle or constructing a highly efficient building no longer involves trade-offs between environmental, financial, and health benefits; all of these advantages are aligned. The task that remains is for government to set the right conditions for private sector ingenuity to move the broader economy towards these desirable outcomes.

Scale of the Challenge: Built Environment and Transportation Sector Trends

Together, transportation and the built environment sectors account for over a third of Canada's GHG emissions. While emissions are projected to decline in both of these sectors by 2030, the pace and scale of these reductions are not aligned with the targets that Canada has committed to under the Paris Agreement.

In 2016, 25% of Canada's GHG emissions came from the transportation sector and 12% were from the built environment sector.¹ Based on the most recent available emissions projections that Environment and Climate Change Canada published in late 2018, emissions from transportation are expected to decline from 173 megatonnes (Mt) in 2016 to 155 Mt in 2030, and built environment emissions are projected to remain fairly steady at 81 Mt in 2016 and 80 Mt in 2030. With additional measures that have been proposed but not yet fully implemented - including stronger building codes, more stringent energy efficiency standards for appliances and equipment, additional vehicle fuel efficiency standards, and the clean fuel standard - emissions would further decline by 14 Mt for transportation and 15 Mt from the built environment.² The additional measures scenario represents a 25% reduction below 2005 levels of emissions in 2030 for the built environment sector and a 13% reduction in the transportation sector. Greater ambition will be needed to bend the emissions curve towards deeper decarbonisation.

In the built environment sector, emissions are almost evenly divided between the residential and commercial sectors. Energy efficiency improvements have helped to offset the effects of population growth, which has driven demand for increased housing and commercial and institutional building stock. Similarly, fuel efficiency gains have dampened the emissions impacts as more vehicles have been added to Canada's roads and kilometers driven have increased. While overall passenger vehicle emissions have declined, and are projected to continue to decline as uptake of zero emissions vehicles increases, emissions from ground freight, off-road and other vehicles are projected to grow.

These trends point to opportunities for emissions reductions that the recommendations in this report seek to unlock. Emissions from buildings are slowly decreasing from efficiency gains, but additional reductions could be realized through deeper retrofits of more of the building stock while ensuring that new construction is built to high standards. Similarly, greater longer-term reductions from transportation could be achieved through scaled-up electrification, beginning with passenger vehicles in the near term and expanding to other modes as new technologies mature. Low-carbon biofuels and modal shifts will also need to be part of the solution to achieve deep reductions in transportation emissions.

¹ Excluding indirect emissions from electricity

² More recent federal, provincial and territorial policy developments, such as the Clean BC plan and changes to Ontario's policies, are not captured in these projections. Emissions projections are updated annually.

Summary of Recommendations

Built Environment

- The Government of Canada should ensure that tools to support standardized building labelling are available for adoption by provinces and territories, and maintain these tools on an ongoing basis.
- The Government of Canada should lead by example and publicly disclose energy use ratings for all federal buildings.
- The Government of Canada should accelerate the pace of deep retrofits in its assets and communicate the results of these projects, including through an open database with project-level information on performance.
- The Government of Canada should ensure that standardized tools and approaches to measure the expected and actual performance of retrofit projects are broadly available. The Canada Infrastructure Bank should be operationalized with expertise to disseminate these best practices, and to build and aggregate pipelines of local retrofit projects.
- The Government of Canada should consider implementing a performance-based incentive for retrofit activities in the form of an accelerated capital cost allowance, similar to that of the United States
- Based on an assessments of needs, the Government of Canada should increase investment in capacity-building activities, including to promote energy literacy and technology demonstration.

Transportation

- The Government of Canada should begin a regulatory process to implement a Zero Emission Vehicle mandate by 2022-23 that will position Canada to ensure that ZEVs represent at least 10% of new vehicle sales in 2025, 30% in 2030 and 100% in 2040.
- The Government of Canada, working with partners and stakeholders, should develop an integrated strategy to reduce emissions across modes of transportation, including actions to support modal shifts. The strategy should identify opportunities to accelerate the adoption of low-carbon technologies by federally regulated entities and ensure that federal policies and investments in infrastructure are targeted and coherent.

Built Environment

Context

Canada's building stock is diverse; there is no one-size-fits-all approach to reducing emissions from single family homes, multi-unit residential buildings, and commercial and institutional buildings that have been built to evolving standards over the course of many decades and are adapted to different climate and weather conditions across the country.

One of the best long-term solutions to creating a low-carbon building sector is to ensure new construction is built to high standards. Ambitious building codes are the main policy tool to achieve this. As committed under the Pan-Canadian Framework on Clean Growth and Climate Change, the federal government is developing a series of new model building codes, with the goal that a "net-zero energy ready"³ model building code will be ready for provinces and territories to adopt by 2030. While the federal government can provide information, tools, and support (for instance, model building codes and funding for research and development), it falls under provincial and territorial jurisdiction to adapt and adopt building codes as they see fit. Recent analysis by the Canada Green Building Council shows that it is feasible and economical to build zero carbon buildings now, based on a 25-year lifecycle. There is a strong case for ensuring that new buildings are consistent with Canada's long-term climate change targets, in order to avoid costly retrofits in the future.

British Columbia's Energy Step Code sets performance targets for new construction that are more ambitious than the current building code. Local governments can choose to require or incentivize a given step. By 2032, the BC Building Code will move toward the higher steps of the BC Energy Step Code as a minimum requirement. This approach enables the building industry to steadily improve performance over time, as new techniques and technologies become more readily available and cost-effective.

Buildings already standing today will account for about 75% of Canada's building stock in 2030. This means that retrofitting existing buildings to make them more efficient and resilient must be a major focus of any strategy to transition to a low-carbon building sector. Less than 10% of Canada's buildings are under renovation in any given year, and retrofits that achieve significant energy savings are only happening in about 1% of floor space across Canadian buildings per year. A recent study by the International Energy Agency (IEA) found that buildings have the most untapped potential for further GHG reductions beyond what is already being pursued – greater than any other sector in Canada including transportation and industry. Building retrofits create clear economic as well as environmental benefits, since they contribute to job creation and save on energy costs. A study by Dunskey Energy Consulting for Clean Energy Canada found that implementing all of the energy efficiency actions in the Pan-Canadian Framework would add 118,000 jobs and increase GDP by 1%, largely driven by household and business savings on their energy bills.

If there are clear benefits to energy efficiency retrofits, why is the rate of uptake so low? Our recommendations in the sections that follow focus on how to build a more mature building retrofit market, through better information and targeted supports. In some cases, particularly in the residential

³ A "net-zero energy" building generates as much energy as it consumes (e.g., through the use of solar panel or other renewables energy sources). A "net zero-energy ready" building is constructed with the necessary infrastructure to become net-zero energy, but may still rely on fossil fuels or electricity if sufficient renewable capacity isn't added to the building.

sector, certain technologies and building techniques still require upfront investments that have longer timelines to pay back through energy savings than are desirable to most building owners. However, there are many opportunities, especially in larger buildings, where investments in energy efficiency could be recovered within a few years and generate ongoing savings over the life of the building.

One key way to unlock energy efficiency savings involves getting the right information to the right people. For example, lenders and financial institutions need to have confidence in information on expected energy savings in order to understand the opportunity and structure financial products appropriately. Similarly, building owners need to know how investments in energy efficiency will perform in order to assess them relative to other possible investments, and to have assurance that their investments will generate returns within the expected timelines. Better information is also a first step to finding solutions to structural barriers in the building sector, like split incentives – for example, when a tenant pays utility costs but the property owner is responsible for the capital investments that affect those costs.

Providing information and tools are primary levers at the federal government’s disposal in the built environment sector. There is a clear imperative for the federal government to expand on its current commitments to lead by example, including through retrofits of buildings that it owns or leases. In some areas, financial supports and investments by the federal government may also be needed to encourage market development and reduce risk, though these should be carefully targeted to ensure that they encourage rather than discourage investment by the private sector.

Information

Clear, credible information is the foundation on which to build the case for investments in energy efficiency. Understanding how much energy a building uses and why is a necessary first step to designing effective measures to reduce energy use, and to track the effectiveness of those measures over time. Operational costs, including energy use, are also relevant considerations in sales and leasing decisions.

Providing information to building owners, tenants, and the public is a proven and effective tool that can help to reduce energy use, inform real estate transactions, and contribute to the development of well-designed policies and supports.

Energy **benchmarking** is the ongoing review and comparison of a building's energy consumption to determine its level of performance.

An energy **label** shows how a building performs, relative to other similar buildings. Labels are based on a standardized rating system, like an ENERGY STAR score.

Disclosure involves the reporting of the energy performance to jurisdictions or to the public

Benchmarking, Labelling, and Disclosure: Examples from Other Jurisdictions

The **European Union** first introduced labelling requirements for large public buildings in 2002, and has expanded and strengthened this policy over time. While some design aspects of Energy Performance Certificates (EPC) are at the discretion of member states, there are general requirements to provide potential buyers or tenants with information on the energy performance of a building and to include recommendations for improvements that can be made at a reasonable cost. Evaluations to date have generally found that EPCs are effective in encouraging consumers to buy or rent more energy efficient buildings. Some jurisdictions have introduced more stringent requirements. For example, a minimum energy performance grade is now required before property in the United Kingdom can be leased or sold.

New York City has required benchmarking of large buildings since 2009, and extended this requirement to mid-sized buildings in 2016. These buildings must display energy efficiency scores at a public entrance. Between 2010 and 2015, 4,229 regularly benchmarked buildings cut their energy use by more than 10% and their total greenhouse gas emissions by almost 14%. These programs are supported through outreach and training resources and a financing entity to help building owners comply. Information is made publicly accessible through the New York City Energy and Water Performance Map and data disclosure reports published on the New York City government website.

Washington State enacted the “Efficiency First” Senate Bill (SB 5854) in 2009, which required large public buildings to benchmark and rate energy performance, and disclose this information. Utilities are also required to collect and maintain energy consumption information for these buildings on an annual basis, and make it publicly available through the Environmental Protection Agency’s Energy Star Portfolio Manager website. As of 2018, Washington State had benchmarked 99% of public agencies and 74% of state owned and leased buildings, including universities and community colleges. Senate Bill 5854 also resulted in an estimated 3,800 new jobs in the state.

In late 2016, signatories to the Pan-Canadian Framework on Clean Growth and Climate Change committed that federal, provincial, and territorial governments will work together with the aim of requiring labelling of building energy use by as early as 2019. Natural Resources Canada has been working in collaboration with provinces and territories to develop operational energy rating and public reporting mechanism for Canadian buildings, which will be made accessible through a national public database.

An evaluation of the European Union’s experience with building labelling pointed to the lack of consistency in methodologies and in the presentation of information as a shortcoming of this policy, which makes it difficult to compare building performance across countries. This underscores the

importance of federal investments in tools that provinces and territories can adapt easily and cost-effectively, in order to support consistent national information on building performance.

More generally, limiting administrative burden is an important consideration in designing building labelling policies. Standardized methodologies are one form of support towards this end, which could be complemented by enhanced efforts to work with utilities on data provision. The most recent update to the Energy Performance of Buildings Directive in the European Union also recognized the growing potential of building automation and electronic monitoring of technical building systems to effectively replace inspections in verifying and monitoring building performance.

While most direct requirements for building labelling fall outside of federal jurisdiction, the Government of Canada could show leadership by committing to publicly disclose ratings for buildings that it owns or leases. Building labelling could complement other initiatives for transparency on the environmental impact of government operations, including reporting on the Government of Canada's GHG inventory.

Recommendations:

- The Government of Canada should ensure that tools to support standardized building labelling are available for adoption by provinces and territories, and maintain these tools on an ongoing basis.
- The Government of Canada should lead by example and publicly disclose energy use ratings for all federal buildings.

Demonstration

While providing public information on how energy-efficient the buildings that the federal government owns or occupies would be a good first step, the Government of Canada could contribute more concretely to building market demand for retrofits through demonstration projects in its assets. The federal government has set a target to reduce GHG emissions from its facilities and fleets by 40% by 2030 (or earlier) and 80% by 2050 relative to 2005 levels. While the federal government is making progress towards these targets, there is potential to accelerate action and enhance the demonstration effects of these activities.

Retrofits of government assets have significant potential to build a market demonstration effect given their size and diversity. The Government of Canada has a large real property portfolio that ranges from office buildings and warehouses, to laboratories, to correctional institutions, to aircraft hangars on military bases. Just the Department of National Defence's property in Canada includes approximately 2.2 million hectares of land and 20,000 buildings. The portfolio of commercial, institutional and residential buildings all across Canada that are federally owned or occupied provides ample opportunity to demonstrate the effectiveness of different types of retrofit projects under various conditions. The Government of Canada should seek out partners to complete these projects, both to demonstrate new models for delivering and financing deep retrofits and to ensure that results are replicable in the market.

Washington State is one example of a jurisdiction with leading policies to translate information collected through benchmarking to government leadership and demonstration. In 2012, Washington State enacted Executive Order 12-06, which introduced benchmarking requirements to state agency buildings to identify which buildings had greater than average energy use. These buildings would then be subject to an audit and improvement protocol. These measures were subsequently strengthened with

additional requirements for a group of state government departments to evaluate progress and develop recommendations for improving the efficiency of public buildings, using benchmarking to determine which buildings were inefficient. The Government of Canada could draw on these best practices to identify and commit to prioritizing improvements in buildings that it owns or occupies with below average performance.

Transparency and effective communication of results should be key priorities to maximize the demonstration effects of investments in retrofits of federal assets. In alignment with its more general commitment to open and transparent data, the Government of Canada could provide open-source, project-level information to share experience with retrofits of its assets. This database could be developed in consultation with financial institutions and other stakeholders in order to ensure that it includes the data most relevant to their interests and needs. This would provide additional information to the market and lenders, particularly as the performance of these retrofits is monitored and validated over time. While the standard for federal retrofits should be set high, it should also be accessible and replicable by other building owners. For instance, the Government of Canada could commit to achieving net zero energy or zero carbon performance in its retrofit projects and document lifecycle savings. Careful tracking and active efforts to communicate successes and lessons learned would help to ensure these projects are replicable and provide valuable information to broader market participants.

Incremental resources will be required to retrofit buildings owned by the federal government, and to leverage efficiency improvements in spaces leased by the federal government if needed. The allocation of this budget should take into account both the direct energy savings to government and the market demonstration benefits more broadly.

Recommendation:

- The Government of Canada should accelerate the pace of deep retrofits in its assets and communicate the results of these projects, including through an open database with project-level information on performance.

Standardization & Aggregation

The Government of Canada could also play a role in creating and disseminating tools that standardize best practices for building retrofits, and in aggregating smaller projects for investment at scale.

The Investor Confidence Project's Investor Ready Energy Efficiency™ (IREE) Certification is a quality mark, like LEED, but for retrofits. It attests that a project has been planned and executed to an acceptable standard. Efforts to pilot this certification are currently underway in Canada.

For example, the Investor Confidence Project provides a global standard that incorporates best practices and independent verification to build confidence in the reliability of energy savings, reduce transaction costs, and mitigate investor risk.

The Government of Canada could adopt this standard, or a similar protocol, for retrofit activities within its own operations, and work with other stakeholders to more actively encourage a consistent approach to standardization. The Canada Infrastructure Bank (CIB) could, for instance, work with financial institutions to establish an accepted underwriting standard and certification for developing and measuring energy efficiency and carbon reduction in retrofits. The uptake of this standard could

be encouraged through financial mechanisms at the disposal of the CIB and other federal institutions, for example by enabling projects that meet this standard preferred access to credit enhancement tools or lower cost capital.

There may also be a role for the federal government to provide standardized tools for measurement and verification, such as modelling of carbon reduction outcomes of retrofit projects. In particular for smaller projects, some proponents lack the capacity to reliably and consistently measure expected and actual performance outcomes. This lack of consistency limits comparability of projects, which presents a barrier to quantification and evaluation of project outcomes and to aggregation of projects for investment at scale.

Projects that follow standardized approaches and best practices generate more reliable outcomes that build investor confidence. This also enables smaller projects to be packaged together to generate investment opportunities that are sufficiently large to attract institutional investors. The Government of Canada, through the Canada Infrastructure Bank or other institution could play a role in aggregating smaller projects, and act as an intermediary to provide a level of validation and assurance that projects will generate the expected level of savings. Local project pipelines could be generated through utilities or other entities (for example, The Atmospheric Fund has a project portfolio with a value of approximately \$12 million).

There is currently a window of opportunity as the Canada Infrastructure Bank is operationalized to ensure that this new institution is fully engaged in the building retrofit market. We encourage the

Government of Canada to ensure that the Canada Infrastructure Bank has the necessary tools, mandate and direction to serve as a project aggregator and a center of expertise.

Recommendation:

- The Government of Canada should ensure that standardized tools and approaches to measure the expected and actual performance of retrofit projects are broadly available. The Canada Infrastructure Bank should be operationalized with expertise to disseminate these best practices, and to build and aggregate pipelines of local retrofit projects.

Targeted Incentives

Government spending power should be used judiciously, but may be warranted to catalyze certain segments of the retrofit market. There should be a clear linkage between any incentives provided and over-arching market development objectives. Supports should be proportionate to need.

Some incentive programs to date have focused on relatively low-effort and low-cost retrofit measures that generate energy savings quickly (e.g., installing more efficient lighting). Deeper retrofits that generate higher energy saving are typically a more complex package of measures, some of which take longer to recover the upfront investment than others. If the lower-cost, quick payback measures have already been targeted by incentives, owners may be reluctant to invest in comprehensive retrofits that generate deeper energy savings over longer time horizons. This can unintentionally push owners towards shallow, lower-cost retrofits that generate lower energy savings.

In the residential sector, upfront costs remain a barrier to energy efficiency improvements. While the Government of Canada has made investments residential energy efficiency, most recently through funding to the Federation of Canadian Municipalities in Budget 2019, further efforts may be required. For instance, there could be scope for the Canadian Mortgage and Housing Corporation to develop tools such as an underwriting framework for retrofit loans or loan guarantees for local programs that enable homeowners to repay upfront costs of energy improvements over time through energy savings.

Budget 2019 provided \$1.01 billion to the **Federation of Canadian Municipalities** to increase energy efficiency in residential, commercial and multi-unit buildings. This investment will support programming in three primary areas:

- **Sustainable Affordable Housing Innovation** in new and existing housing
- **Community EcoEfficiency Acceleration**, which will build on the success of initiatives like Halifax's Solar Cities and provide access to municipal financing for home energy retrofits, including through the use of the Property Assessed Clean Energy (PACE) model that allows homeowners to repay retrofit costs through their property tax bills.
- **Collaboration on Community Climate Action**, which will support community pilot and demonstration projects in municipalities across Canada. In 7 major urban centers, this work will be done through networks established through Low Carbon Cities Canada (L3C)

In Class A commercial buildings – newer and well-located buildings that are professionally managed and command the highest rents – information tools may be sufficient to accelerate retrofit rates. If stronger signals are required, these owners are also generally well-positioned to comply with more stringent regulations. While access to capital is not usually a primary barrier in Class A buildings, it may be a challenge in Class B or Class C buildings, which tend to be older, not professionally managed and located outside of prime real estate areas. An understanding of specific circumstances and local needs should be central to financial supports by the federal government.

The federal government should also consider how targeted supports can be used to promote broader objectives of building market confidence through transparent, high-quality data. For example, financial incentives could be tied to verifiable performance outcomes. Under an accelerated capital cost allowance policy in place for over a decade in the United States, performance-based outcomes from energy savings had to be achieved in order to be eligible for tax benefits. This measure would be most effective if put in place for a consistent period of several years, in order to ensure sufficient time to plan, execute, and measure project results. Capacity-building measures, such as support to hire energy managers or conduct energy audits, could also help to promote energy literacy and build the business case for investments in retrofits.

Finally, there are areas where investment in further research, development, and demonstration have more impact than direct incentives. This is particularly true when research investments can be coherently translated to demonstration projects that provide a rationale for raising the level of ambition of regulatory standards.

The Atmospheric Fund completed a series of demonstration projects to test the performance of boilers in multi-unit residential buildings, and was able to show based on the data collected that greater efficiency was both possible and cost-effective. This evidence contributed to the development of more stringent minimum energy performance standards.

Recommendation:

- The Government of Canada should consider implementing a performance-based incentive for retrofit activities in the form of an accelerated capital cost allowance, similar to that of the United States
- Based on an assessments of needs, the Government of Canada should increase investment in capacity-building activities, including to promote energy literacy and technology demonstration.

Transportation

Context

Sources of transportation emissions consist of passenger transportation, including cars, light trucks, and motorcycles; heavy-duty trucks; rail; aviation; and marine. In general, there are three main ways to reduce emissions from transportation: improve efficiency to use less fuel; switch to cleaner fuels, including electricity; or through shifts to lower-emissions forms of transport or avoiding unnecessary trips. The best strategy in any given transportation subsector depends on a number of factors, like technological development, cost-effectiveness, convenience, and infrastructure availability. To date, regulations to improve fuel efficiency have been a primary tool to reduce emissions from passenger vehicles and freight. Complementary policies, like carbon pricing and the clean fuel standard, will provide additional impetus to reduce the emissions intensity of the transportation sector.

However, we see an opportunity to accelerate the adoption of Zero Emission Vehicles⁴ (ZEV) in the near term. Many ZEV technologies, particularly battery-electric and plug-in hybrid vehicles, are already widely commercially available and a viable option for many Canadians. Recent polling by Abacus Data and Clean Energy Canada indicates Canadians are interested in electric vehicles; most respondents (64%) said that if it were up to them, electric cars would become the majority of vehicles that consumers drive at some point in the future. When asked what the ideal timing for this shift would be, 79% hoped it would happen in 10 years or less, including about half (49%) who would like to see it within 5 years.

Some of the key barriers to ZEV adoption include higher up-front costs, concerns about refueling infrastructure availability and vehicle range, lack of supply at dealerships, and low consumer awareness. In a letter to the Minister of Finance and the Minister of Environment and Climate Change in March 2019, we made some initial recommendations to address these barriers. These included:

- A federal purchase incentive of up to \$5,000 to help Canadians purchase zero emissions vehicles or plug-in hybrids for a period of at least two years
- Encouraging manufacturers to set voluntary supply targets for zero emission and hybrid vehicles
- Scaled up investment in enabling measures, including charging infrastructure, research and development efforts, and consumer awareness programs

Budget 2019 proposed funding for a purchase incentive of up to \$5,000 for fully electric vehicles, as well as tax incentives to encourage businesses to invest in ZEVs. The federal ZEV incentive program was launched following the Budget and has been in place since May 1st 2019. The Budget also proposed additional funds for investment in charging infrastructure, and to support efforts to establish voluntary supply targets with manufacturers.

While these measures send positive signals and will increase uptake of ZEVs, we do not believe they will be sufficient to meet the targets set by the Government of Canada to increase ZEV sales to 10% of new vehicle sales by 2025, 30% in 2030, and 100% by 2040. As noted in our interim recommendations, currently only about 2% of new vehicles sold in Canada are ZEVs.

In our view, there is a need to send a clear, regulatory signal to manufacturers to increase the supply of ZEVs. By providing purchase incentives, investing in infrastructure, and establishing voluntary

⁴ As defined by Transport Canada, a ZEV is a vehicle that has the potential to produce no tailpipe emissions. This includes battery-electric, plug-in hybrid electric and fuel cell vehicles. ZEVs may still have a conventional internal combustion engine, but must also be able to operate without using it.

agreements now, there will be sufficient time to allow Canada's ZEV market to mature and for vehicle manufacturers to plan for this transition.

There are emerging opportunities for electrification in other transportation subsectors that may also require government policy support to realize over the medium term. A smooth transition to a low-carbon transportation system will need to be guided by a comprehensive approach that leverages strategies to reduce emissions across all subsectors and takes into account opportunities to better integrate different modes of transportation.

Zero Emission Vehicle Mandate

In our interim recommendations, we suggested ZEV supply agreements with vehicle manufacturers could initially be voluntary targets, but that the federal government should be prepared to implement mandatory sales targets if voluntary measures do not sufficiently address supply issues.

Regulations requiring manufacturers to ensure a certain percentage of their fleets are ZEVs, a policy also known as a ZEV mandate, are already in place in a number of jurisdictions. In Canada, a ZEV mandate is in place in Quebec and under development in British Columbia.

As other jurisdictions have shown, ZEV mandates can complement other policies, including Light Duty Vehicle (LDV) fuel efficiency regulations. While Canada's current LDV regulations incorporate some provisions that encourage manufacturers to produce ZEVs, this is not the primary intent of the regulations. A stronger, targeted policy would send a more effective signal to manufacturers.

Near-term voluntary targets would help manufacturers prepare for a phase-in of regulatory requirements. Many experts now project that electric vehicles will reach price parity with internal combustion vehicles as early as 2022-23. Given that regulatory processes typically require years for consultation, policy design and legislative drafting, the Government of Canada should begin efforts in the near term to introduce a ZEV mandate. This regulatory requirement would build on voluntary sales targets, and provide long-term certainty with sufficient lead-time to ensure that manufacturers are well-positioned to comply at a reasonable economic cost. A ZEV mandate should be ready for implementation by 2022-23, to coincide with projected price parity of electric vehicles and to support the achievement of the current target that 10% of new vehicle sales in Canada will be ZEVs by 2025.

Case Study: ZEV Mandates in Other Jurisdictions

California first introduced a Zero Emission Vehicle requirement in 1990, which has evolved over the past 30 years. Manufacturers are required to produce ZEVs and plug-in hybrids in sufficient numbers to meet credit requirements, which rise over time. ZEVs are awarded credits based on factors like vehicle range. Current projections indicate that the regulation will require about 8% of sales to be ZEVs by 2025. California's ZEV policies have contributed to technological innovation and development. Several U.S. states – including **Connecticut, Maine, Maryland, Massachusetts, New York, New Jersey, Oregon, Rhode Island, Vermont,** and most recently, **Colorado**, have adopted California's policy. Recent data shows that ZEV registrations in states with mandates are about 4.5 times higher than in other states, including those with targets or other policies.

In January 2018 a ZEV regulation very similar to that of California entered into force in **Quebec**. Quebec's policy uses the same credit system as California, but requirements are phased in slightly more gradually over the first two years of the policy. **British Columbia** is also in the process of designing and implementing a similar policy in order to meet its targets that 10% of new vehicle sales will be ZEVs in 2025, rising to 30% in 2030, and 100% by 2040.

China's New Energy Vehicle (NEV) mandate policy entered into force in April 2018, and uses the same general premise of awarding credits based on vehicle characteristics and requiring manufacturers to meet certain minimum thresholds. The NEV mandate is linked to China's fuel efficiency regulation; manufacturers can use surplus NEV credits to offset corporate average fuel consumption credits, which creates additional flexibility for compliance with the existing fuel efficiency regulations. Analysis from the International Council on Clean Transportation (ICCT) estimates that China's NEV share of new passenger vehicle sales will go from roughly 2% in 2017 to about 3% in 2019 and 4% in 2020. Combined with NEVs in the commercial sector, the Chinese government would achieve its cumulative target of 5 million NEV sales in 2020.

Designing a ZEV mandate in consultation with stakeholders will also provide an opportunity to examine how Canada is positioned to capitalize on shifting and emerging trends in global auto manufacturing. Major vehicle manufacturers have announced significant investments in ZEVs, largely in response to growing momentum around the world to accelerate the shift to low-carbon vehicles. If Canada does not act decisively, there is a risk of losing out on both adequate supply of ZEVs to meet consumer demand and on manufacturing and component exports, from batteries to rare and other minerals.

Recommendation:

- The Government of Canada should begin a regulatory process to implement a Zero Emission Vehicle mandate by 2022-23 that will position Canada to ensure that ZEVs represent at least 10% of new vehicle sales in 2025, 30% in 2030 and 100% in 2040.

Building a Low-Carbon Transportation System

While emissions from ground freight, off-road and other vehicles are currently projected to grow, there are a number of emerging opportunities to reverse this trend. A comprehensive approach will require increased efforts to scale up electrification and switching to other clean fuels, as well as shifts from higher- to lower- emitting modes of transportation.

The rapid technological improvement that has resulted in more compact, powerful, and affordable batteries for electric passenger vehicles also opens significant opportunity for expanded electrification of other modes of transit. There are growing numbers of examples of new technologies, prototypes, and demonstration projects that point to a near-tipping point where widespread electrification of some types of aviation and marine vessels, ports, and other commercial and freight vehicles could become commercially viable. Expanding fleets of electric buses are already on the roads in several Canadian cities. Municipalities are exploring how to reduce both emissions and operating costs by electrifying vehicles that they use to provide services to citizens, from waste collection, to ice resurfacing, to maintaining parks and utility services. Companies are piloting the use of electric trucks, both in urban centers and over longer distances. Bloomberg New Energy Finance's (BNEF) 2019 Electric Vehicle Outlook included detailed projections on the commercial vehicle market for the first time, and forecasts that by 2040, 56% of light commercial vehicle sales in Europe, the U.S. and China will be electric models, as well as 31% of medium commercial vehicle sales and 19% of heavy trucks. BNEF also projects that 81% of municipal bus sales will be electric by 2040. Increased use of clean electricity for various modes of transport would significantly decrease emissions and improve air quality.

Emerging Opportunities to Electrify Transportation by Air, Land, and Sea

Ferries: In **Norway**, an electric ferry using battery technology from Canadian company Covrus Energy Storage System has been operating since 2015. Based on the success of this ferry – which reduced operating costs by 80% and carbon dioxide emissions by 95% – Norway is continuing to rapidly expand its fleet of electric ferries. In 2018, **Washington State** announced plans to convert its three largest ferries to hybrid-electric engines, and install onshore charging stations to maximize the use of clean electricity. **British Columbia** has announced plans to add hybrid-electric ferries to four of its routes over the coming years.

Airplanes: Short-range flights may be the next mode of transportation to benefit from electrification. **British Columbia**-based Harbour Air recently announced a partnership with magniX, a company that offers electric propulsion systems for aircraft, to build the world's first all-electric airline. Harbour Air operates commercial service to 12 destinations with a fleet of 40 planes, which it eventually plans to convert into a fully electric fleet. The first aircraft is scheduled to begin test flights later in 2019.

Trucks: **Quebec**-based Lion Electric Company is expanding from its established offering of electrified school buses, and plans to deliver its first urban truck with a range of up to 400 km later in 2019.

Opportunities for scaled-up electrification go beyond on-road transportation. For example, the Port of Vancouver was one of the first in the world to install shore power, a technology that enables compatible ships to shut down their diesel engines and use land-based electricity. Since 2009, shore power installations at the Port of Vancouver cruise ship terminal have eliminated 582 tonnes of air pollutants and 20,757 tonnes of greenhouse gases. Shore power is now available at two container ship terminals as well. The Port of Vancouver encourages shipping lines to use shore power by offering discounted harbor dues for ships that are shore-power enabled.

Further action could be taken to enhance the use of electricity and other low-carbon fuels in ports across Canada. The Government of Canada should explore possible tools and approaches to incentivize the adoption of low-carbon technologies by federally regulated entities. For instance, there could be opportunities to improve the environmental performance of airports by electrifying ground support equipment.

Options for electrification in other types of off-road vehicles are also emerging, including in traditional resource sectors. For instance, Suncor recently announced that it would add 150 autonomous electric haul trucks to its oil sands mining operations over the next six years. Goldcorp is constructing its Borden project as all-electric mine, with anticipated savings of \$9 million annually on diesel, propane and electricity. As resource extraction evolves with new technologies to reduce its environmental footprint and becomes increasingly data-driven and automated, shifts to the labour force and skills required will also need to be taken into consideration.

While electrification is one promising strategy to reduce emissions from the transportation sector, other approaches will also have important roles to play. Biofuels and other low-carbon fuels may be better suited to reduce emissions in some segments of the transportation sector. For instance, Gatineau, Quebec-based biofuel producer Agrisoma has developed a jet fuel alternative made out of Carinata, an oilseed crop. Agrisoma and refinery World Energy have partnered with Australia's Qantas Airway and United Airlines on two long-distance flights to date, most recently replacing 30% of the petroleum jet fuel on a commercial flight from San Francisco to Zurich. Carinata has additional benefits for soil health, complements existing crop production without replacing food crops, and yields a high-protein animal feed as a by-product of biofuel production.

A comprehensive approach to reducing transportation emissions will involve pursuing deep reductions within each mode of transportation – including trucks, ports, and planes – while simultaneously shifting from higher- to lower- emitting modes of transportation. A system with better linkages between modes and more coordination on improved logistics to consolidate transportation of goods would both improve efficiency and reduce emissions. This is a complex undertaking that would require targeted infrastructure investments and ensuring that the right incentives are in place. There are, for instance, near-term opportunities to reduce emissions by shifting the transportation of goods from trucks to rail. However, reliability for time-sensitive deliveries by rail is a key barrier that would require additional capital and infrastructure investment to overcome.

A strategic effort by the Government of Canada could help to accelerate the shift towards a more integrated, efficient, low-carbon transportation system. The Government of Canada could play a role in convening relevant stakeholders to develop a strategy and ensure that federal policies and investments are coherent with this direction, working with provinces and territories to target infrastructure investments as appropriate. The Canada Infrastructure Bank should be engaged in this process. The Government of Canada can also play a role in ensuring that federally regulated entities, such as ports and airports, contribute to the accelerated adoption of low-carbon technologies.

Recommendation:

- The Government of Canada, working with partners and stakeholders, should develop an integrated strategy to reduce emissions across modes of transportation, including actions to support modal shifts. The strategy should identify opportunities to accelerate the adoption of low-carbon technologies by federally regulated entities and ensure that federal policies and investments in infrastructure are targeted and coherent.

Conclusion

This report has offered a series of recommendations focused on how government action can spur accelerated action to reduce emissions in the built environment and transportation sectors. In both of these sectors, emissions are falling and there are positive global trends indicating demand for new technologies. Actions taken today by the Government of Canada can help to ensure that Canada has the right information and tools, a skilled and prepared labour force, and enabling infrastructure needed for a smooth transition to a high-growth, low-carbon economy.

The actions we have proposed will require investments, but would generate environmental and economic benefits in the near and longer term. As recently reported by ECO Canada, the energy efficiency sector already employs 463,000 Canadians, with projected growth of over 8% over the next year. A stronger building retrofit market would create jobs, save energy, and ensure that Canada's building stock is aligned with the long-term objectives of the Paris Agreement. Increased electrification will be needed to achieve deeper emissions reductions over time. Canada's clean electricity grid can be used to power the transportation sector, beginning with passenger vehicles in the near term and expanding to other modes of transportation over time. Clear regulatory signals to automotive manufacturers will ensure that Canadians have the opportunity to purchase ZEVs, and provide an impetus to direct investment to low-carbon technologies. With the costs of renewable energy falling even faster than expected and exponential improvements in energy storage, scaling up the use of clean electricity to support widespread electrification is eminently achievable.

There is global momentum to transition to a low-carbon economy, and strong leadership will accelerate this change. We have suggested areas where the Government of Canada can collect and communicate information and make strategic investments in order to prime markets. Creating state-of-the-art buildings and transportation systems will take a whole-of-economy effort, and the private sector will need to lead both the demand for and supply of solutions. Canada has many innovative companies and supportive institutions, with significant untapped potential for growth in emerging sectors and markets. Targeted government policies can send clear signals to amplify these positive trends across the market. A stronger, cleaner economy can be realized by building on successes to date and focusing on benefits to Canadian businesses and workers.