Cities, Emissions and Climate Change[*]

Jennifer Winter[†]

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[†] Associate Professor, University of Calgary. Email: jwinter@ucalgary.ca.

Introduction

Canada has an ambitious net zero target — reducing emissions by 280 million tonnes compared to 2019. Cities have an integral role mitigating emissions but are often overlooked, particularly given recent federal-provincial jurisdictional fights over environmental policy. Broad-based emissions pricing underpins Canada's expected emissions reductions, but behavioural changes in response to carbon taxes will depend on local choices. In 2021, almost 72% of Canadians lived in one of 35 census metropolitan areas [CITE], and 83% of Canadians lived in a municipality with a population over 10,000 [CITE]. Cities, and policy and design choices by cities, have an important role in effectively meeting Canada's emissions-reduction ambitions.

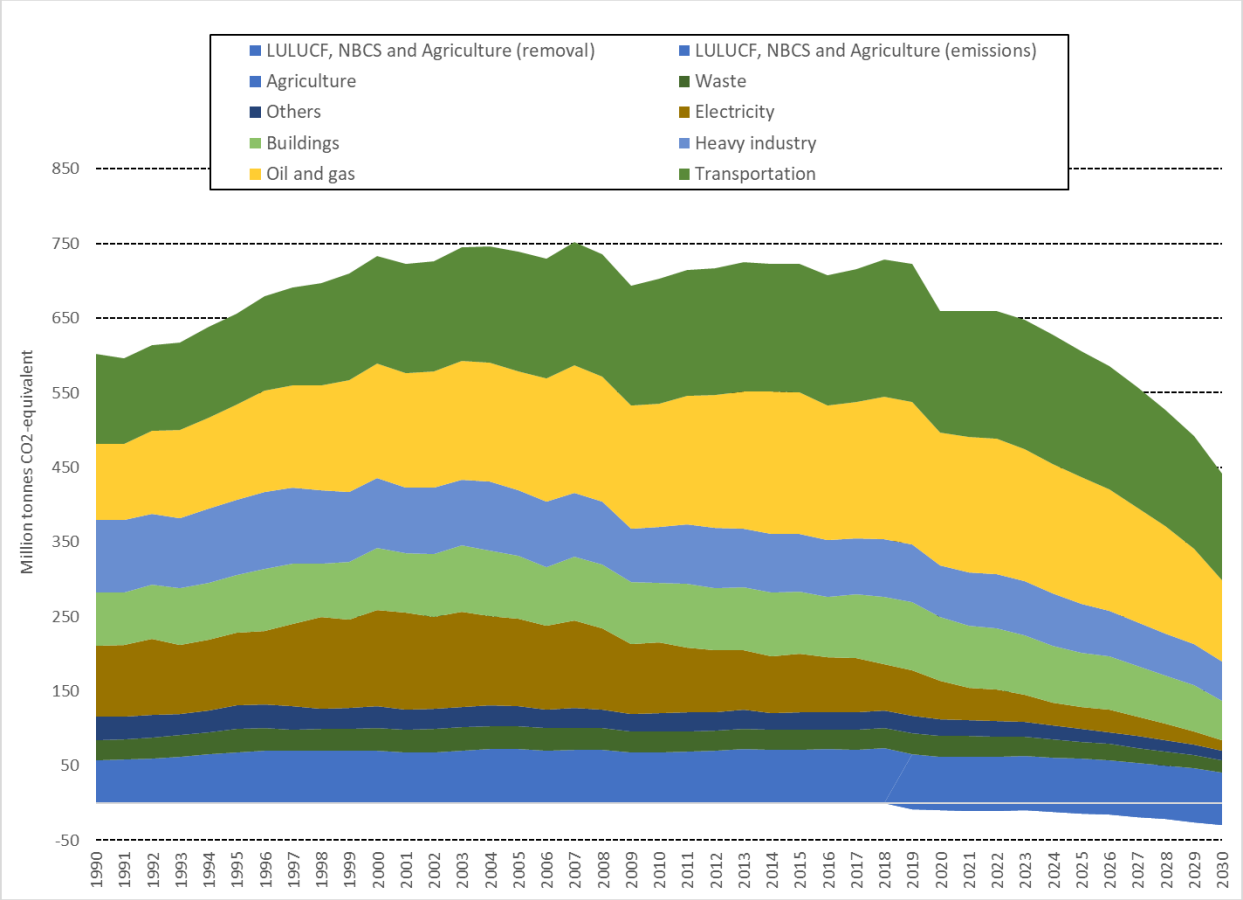
Importantly, 2030 is less than eight years away. In government terms, this is two mandates at federal, provincial and territorial levels, and three mandates for municipalities. Policies that affect how individuals live and work have crucial importance in reducing emissions in the near- and longer-term. Canada's municipalities have multiple, interrelated tools at their disposal to support emissions-reductions within their borders and improve their residents' quality of life. This short essay discusses the challenges and tools for municipalities.

The Big Picture: Current Emissions and Canada's 2030 Target

Building on a series of climate plans starting in 2016[1], the Government of Canada released its 2030 emissions-reduction plan in late March 2022. Canada's original commitment under the Paris Agreement was a reduction of 30% below 2005 levels, from 739 million tonnes of CO_2-equivalent (CO_2e) to 517 Mt CO_2e. The ambition of the target increased in late 2020, with a new target of 32-40% below 2005 levels [CITE], and again in Budget 2021 with a target of 36% below 2005 levels [CITE]. In 2021, Canada formally announced its intention to exceed Paris Agreement commitments with reductions of 40-45% below 2005 levels by 2030 [CITE]. The 2022 Emissions Reduction Plan is first of its kind, required under the *Canadian Net Zero Emissions Accountability Act* [CITE]. The plan outlines Canada's planned actions to meet Canada's 2030 emissions target, 443 Mt CO_2e or 296 million tonnes below 2005 levels (Figure 1).

Figure 1: Historical (1990-2019) and Projected (2020-2030) Canadian Emissions

[1] The *Pan-Canadian Framework on Clean Growth and Climate Change* was released in 2016, followed by *A Healthy Environment and A Healthy Economy* in 2020. Canada's nationally determined contribution pledges to the United Nations Framework Convention on Climate Change also became increasingly aggressive between 2016 and 2021.

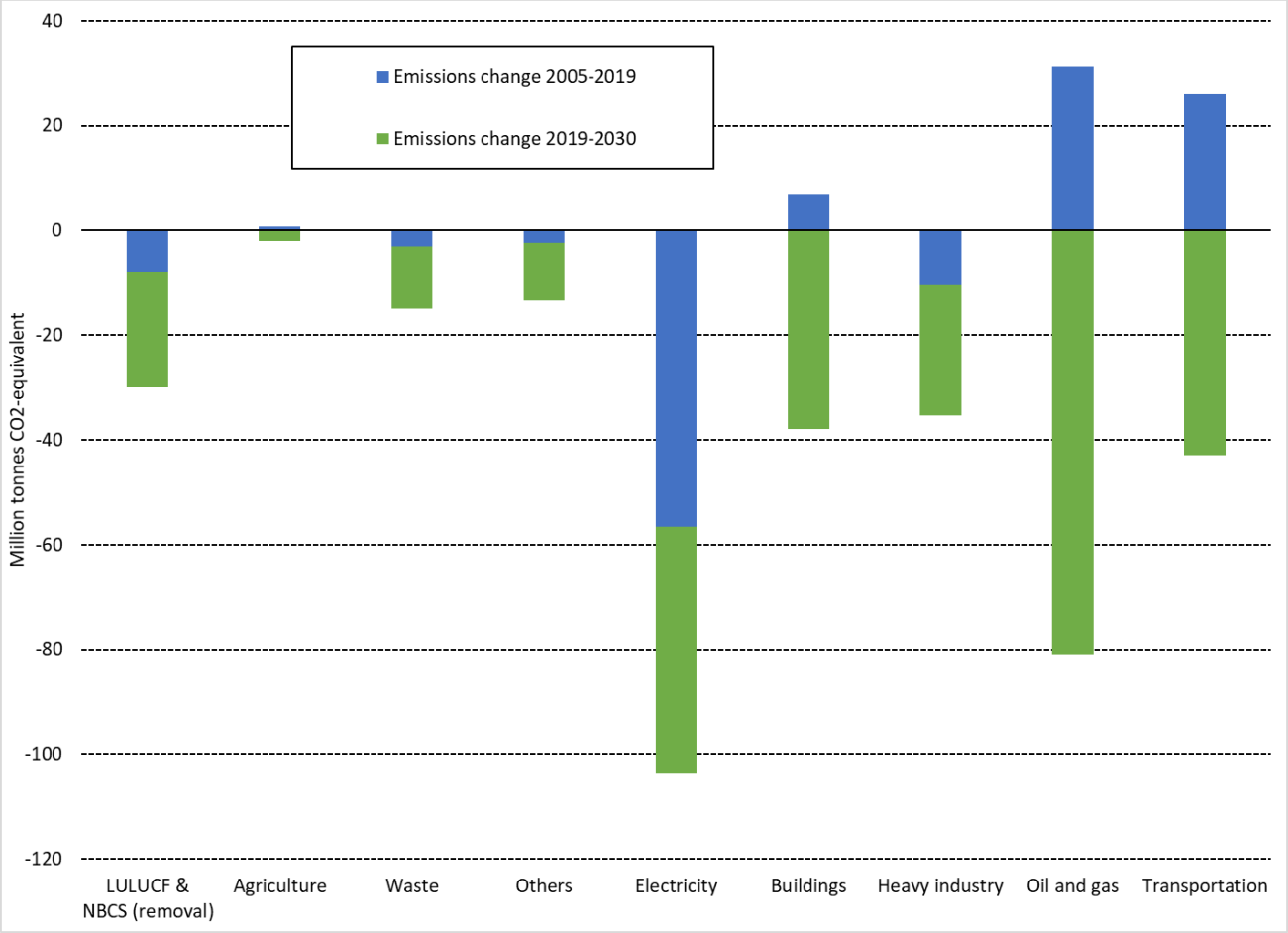


Note: LULUCF is land use, land use change and forests. NBCS is nature-based climate solutions. LULUCF emissions are not included in Canada's national inventory report total. Others includes coal production, light manufacturing, construction and forest resources. Emissions removal due to LULUCF, NBCS, and agriculture are not available prior to 2019.

Source: 2021 NIR [CITE], ERP backgrounder [CITE] and ERP [CITE].

While all sectors of the economy are expected to reduce emissions by 2030, the level of emissions reductions and distribution differ substantially across sectors (Figure 2 and Table 1). The electricity sector has already substantially reduced emissions between 2005 and 2019, and will need to reduce emissions by another 47 Mt CO_2e by 2030. This sector is particularly important as its decarbonization will underpin emissions reductions in other sectors such as buildings and transportation via increased electrification. In contrast to electricity, emissions from oil and gas, buildings, and transportation increased between 2005 and 2019, increasing the emissions-reduction challenge for those sectors. Municipalities' decisions will directly affect these emissions reductions and others along Canada's path to net zero, particularly in buildings, transportation, waste, and land use. I use these to frame my discussion.

Figure 2: Emissions Changes by Sector, 2005 to 2030



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Source: 2021 NIR [CITE], ERP backgrounder [CITE] and ERP [CITE].

Table 1: Expected Emissions Changes by Sector, 2005 to 2030

	Emissions Change 2005-2019	Emissions Change 2019-2030	Percentage Change in Emissions 2019-2030	Sectoral Share of Expected Emissions Reductions 2019-2030
LULUCF & NBCS (removal)	-8	-22	-275%	8%
Agriculture	1	-2	-3%	1%
Waste	-3	-12	-43%	4%
Others	-2	-11	-46%	4%
Electricity	-57	-47	-77%	17%
Buildings	7	-38	-42%	14%
Heavy industry	-10	-25	-32%	9%
Oil and gas	31	-81	-42%	29%
Transportation	26	-43	-23%	15%

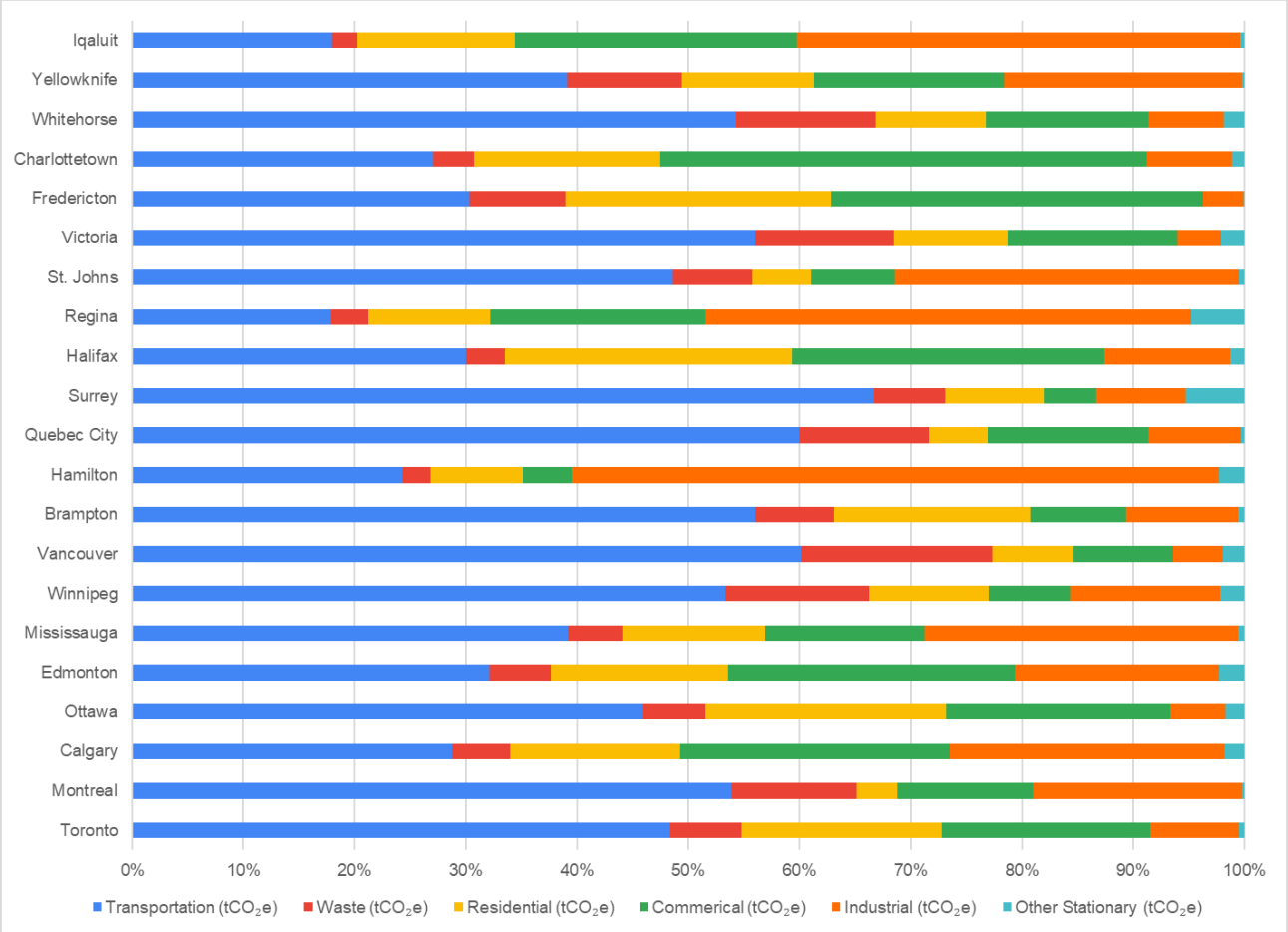
Note: LULUCF is land use, land use change and forests. NBCS is nature-based climate solutions. LULUCF emissions are not included in Canada's national inventory report total. Others includes coal production, light manufacturing, construction and forest resources.

Source: 2021 NIR [CITE], ERP backgrounder [CITE] and ERP [CITE].

Cities and Emissions

Canada's capitals and large cities (population over 500,000) accounted for 20.8% of Canada's 2018 emissions, and mid-size cities (population between 100,000 and 500,000) accounted for 12%.[2] The largest source of emissions was stationary combustion (including residential, commercial and industrial), followed by transportation (Figure 3). Even within Canada's major cities, there is substantial variation in the importance of different sources of emissions. This pattern is repeated in mid-sized cities (Figure 4).

Figure 3: Emissions from Canadian Capitals and Large Cities by Source



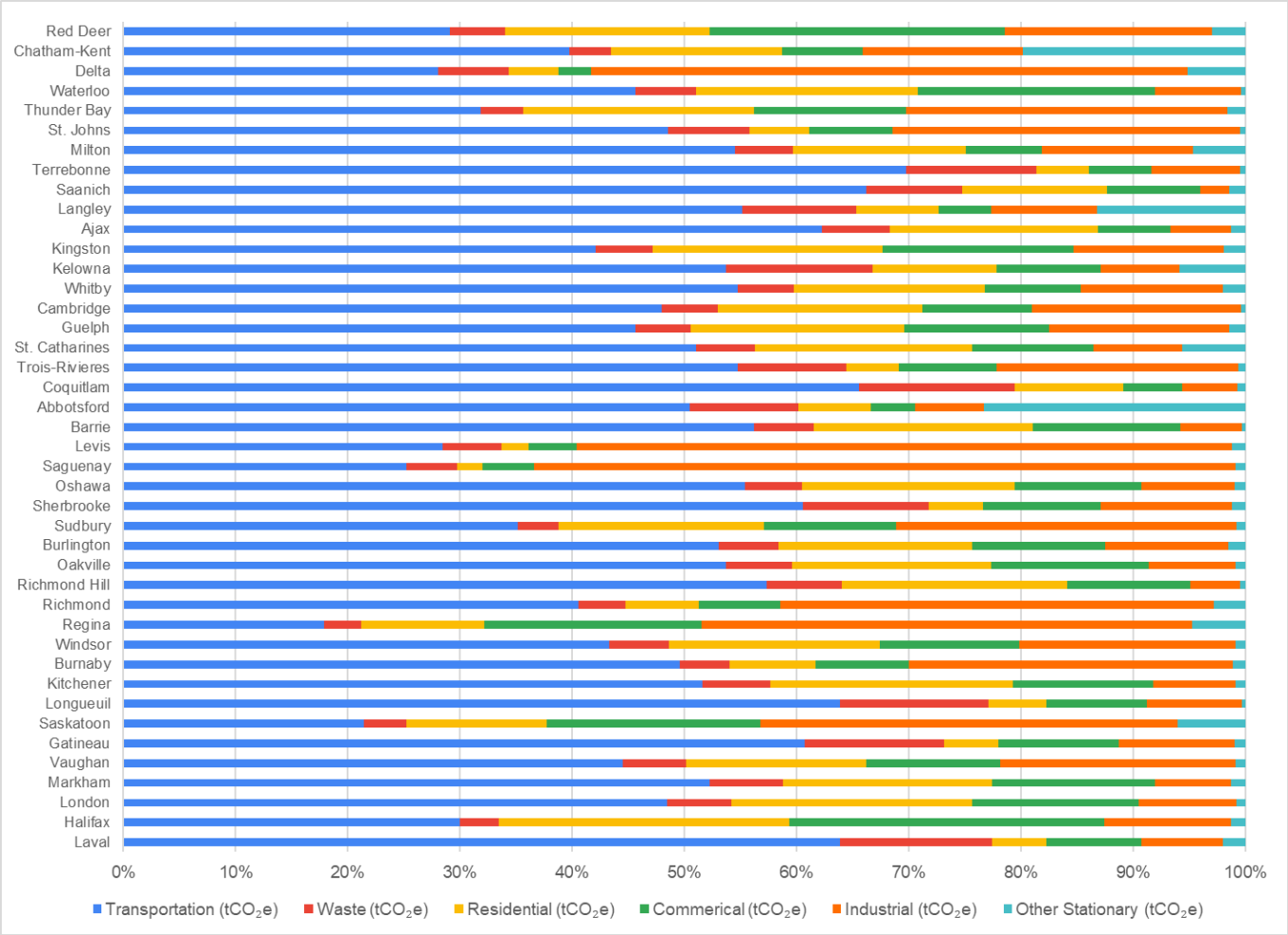
Note: Cities ordered by 2016 population. Emissions are within municipality boundaries, not emissions under direct municipal control.

Source: MEED database [CITE].

[2] This measures emissions within municipal boundaries, not emissions under their direct control.

These disparate patterns speaks to the importance of policy and actions tailored to cities' specific circumstances and industrial structures. Importantly, some cities are heavily industrialized — such as Hamilton or Regina — and will be more substantially affected by federal or provincial large-emitter policies than cities with emissions from commercial rather than industrial activity. Nevertheless, there are broad strokes of policy relevant for all cities; we turn to those in the next section.

Figure 4: Emissions from Canadian Mid-Size Cities by Source



Note: Cities ordered by 2016 population. Emissions are within municipality boundaries, not emissions under direct municipal control.

Source: MEED database [CITE].

Policy Options for Municipal Emissions Mitigation

Transportation

For most Canadian cities, the largest source of emissions are from transportation, including personal, public transit and freight transportation. Cities can support emissions reductions in personal transportation (and potentially freight transportation) by emplacing more electric vehicle charging stations. This makes the switch from combustion engine to electric vehicles more convenient for residents, complimenting federal budget initiatives incentivizing personal zero-emission vehicle uptake

[CITE]. Cities have several levers to achieve more EV stations. In issuing permits for new developments or retrofits of older properties, cities could require commercial and residential builders to include EV charging stations. Another option is partnering with other cities to build out a charging station network, such as the Peaks to Prairies network in Alberta [CITE]. A third option is taking advantage of federal and provincial funding initiatives supporting EV adoption. For example, the 2022 federal budget allocated $500 million for urban ZEV charging infrastructure [CITE]. Importantly, however, cities should avoid subsidized or free EV charging. The carbon tax is the incentive to change vehicle engine type, and the presence of EV charging stations increases the convenience of the switch. Subsidized electricity costs for EVs would likely distort driving decisions, leading to more congestion.

Cities can also disincentivize personal driving as a method of reducing emissions. Options to discourage personal vehicle and encourage public transit use include congestion charges, higher fuel taxes (such as in Metro Vancouver), and establishing a low-emissions zone (such as in London, UK). An indirect method of discouraging personal vehicle use is high parking fees, which would then require differentiating between types of vehicles.

Discouraging personal vehicle use as a method of emissions reduction subsequently requires the availability of substitutes for personal transportation. While improving walkability and installing bike lanes both have a role, an important consideration is the availability, quality and accessibility of different forms of public transit. For example, if traditional public transit service is infrequent but parking is expensive, individuals may choose to travel by taxi or transportation network company (TNC, e.g. Uber) instead of public transit. In this instance, emissions reductions depend on the type of vehicle used by the taxi service. As regulators of taxis and TNCs, cities may have a role in nudging those companies to choose low- or zero-emission vehicles through differential licensing fees based on vehicle type, or requiring that all new vehicles are low- or zero-emissions. The idea behind this is that, conditional on having a taxi on the road, it would be preferable if the taxi does not emit. However, a more direct and broader-based way to address vehicle emissions in a given region is a low-emissions zone with an accompanying vehicle emissions standard, applicable to all vehicles.

An important consideration for all levels of government is that in focusing on reducing emissions from public transportation options that quality, accessibility and affordability[3] are maintained. Federal support for transitioning public transit busses to electric is available from the Canada Infrastructure Bank [CITE]. Cities can take advantage of this to upgrade their bus fleet, but ensuring quality and accessibility will take additional investments (particularly with potential increases in ridership) which will likely rely on provincial/territorial and federal support. Moreover, with expected reductions in gasoline tax revenue from vehicle switching, new sources of revenue will be needed.

Buildings

Residential and commercial stationary combustion emissions are another major source of in-municipality emissions, and cities have several levers to encourage electrification and emissions reductions. The federal 2022 budget promised funds to develop a greener buildings strategy; municipalities have the ability to take action now.

[3] This does not mean public transit should be free; crowded public transit would likely push higher-income users that value speed, frequency of service, and quality of a trip back into personal vehicles [CITE], which could exacerbate emissions in the short-term.

One of cities' major levers is in zoning and permitting, in both new builds and retro-fits of old buildings. For example, Vancouver requires all new low-rise residential buildings to have zero-emissions heating systems [CITE]. This may not be feasible for all municipalities in Canada, depending on available energy sources and climate. In these circumstances, flexibility and cooperation with utilities is in order to accommodate potential changes in energy sources. For example, there are multiple locations in the UK piloting hydrogen as a heating fuel [CITE, CITE], which may be preferable to heat pumps or electrification. Moreover, municipalities should not focus exclusively on residential buildings here — commercial stationary combustion emissions are larger than residential for Canada's large cities, and equal for mid-sized cities.

Amending by-laws to prevent 'undesirable' energy uses is only part of the answer, however, as this approach avoids future emissions from new activity without addressing emissions from the current building stock. Retrofits of existing buildings will be an important source of emissions reductions, and one easily facilitated by municipalities. Clear and transparent processes for renovations such as heat pumps, solar panels, and adding EV charging will ease uptake. Preferential regulatory treatment in permitting may not be palatable, but municipalities do have an additional lever in property-assessed clean energy (PACE) programs. These programs allow residential and commercial property owners to finance energy efficiency improvements (e.g. insulation or appliance improvements) and energy source changes (e.g. heat pumps or solar panels) through property taxes [CITE, CITE]. This type of program can mitigate access-to-financing challenges for property owners, have more flexible financing terms than traditional bank loans, and ties the cost and benefit of improvements to the property [CITE]. These programs also avoid the additionality problem of direct subsidies, where subsidies partially offset the cost of investments that would happen anyway.

Another innovation municipalities can support is piloting and then expanding district energy systems which supply renewable-based energy to small community groups, such as microgrids or geothermal systems for heating and cooling. For example, Edmonton has piloted a district energy system with geothermal and solar energy [CITE], and Banff has a small waste-biomass district heating system [CITE]. These pilots provide information and lessons to other municipalities, and are a small-scale but expandable way to reduce emissions from buildings.

Waste

Municipally-run solid waste landfills are a major source of waste emissions in Canada, and an opportunity for municipalities as one of the few areas under full municipal control. Waste management will also become more imperative with the federal commitments to zero plastic waste [CITE] and developing methane regulations for landfills [CITE]. Mitigating emissions from waste relies primarily on avoidance (diverting waste from landfills), adjusting landfill management practices to reduce methane off-gassing, and capturing off-gasses for other use [CITE].

Waste diversion opportunities primarily rely on the presence of substitutes — expanding recycling and composting — and penalizing undesirable behaviour.[4] Options include pay-as-you-throw, using RFID chips embedded in waste, recycling, and composting receptacles to charge households and businesses for their use of collection services, including frequency and volume of waste produced [CITE]. Municipalities can also revisit the size of bins used for waste collection and recycling and composting,

[4] For a detailed review of policy options for managing municipal waste in Canada, see [CITE] and [CITE]

using smaller bins for waste to encourage diversion. Regardless, improved diversion and recycling and composting will take substantial investments; at the municipal level, re-aligning waste disposal charges to match system costs can help support these investments [CITE]. Currently there are limited federal dollars devoted to this challenge, aside from a general Low Carbon Economy Fund and the Food Waste Reduction Challenge [CITE].[5]

Landfill gas recovery is an important option for mitigating emissions from waste, estimated to account for 12 Mt CO_2e by 2030 [CITE], or the entire waste sector's emissions reductions (Table 1). As an example, Edmonton recovers landfill gas and uses the methane to generate electricity [CITE]. Expansion of these types of activities could have an important role in supporting district energy systems or displacing fossil-fuel-based natural gas use.

Other Options: Land Use and Zoning

The final tools cities have at their disposal are choices on land use and zoning, particularly related to green spaces, air quality standards, and densification. Green spaces improve quality of life for residents and are emissions sinks, and as porous ground have an important role in preventing overland flooding [CITE], making them a useful tool for cities in mitigating and adapting to climate change.

Air quality standards (AQSs) can take many forms, such as the aforementioned low-emissions zones or in response to smog problems. AQSs are likely to be of particular importance for cities with heavy industrial bases, where provincial and federal emissions-reduction policies have more direct economic effects on industrial facilities. Nevertheless, cooperation between municipalities and higher orders of government to design and enforce, and subsequently increase the stringency, of air quality standards are another method of addressing industrial emissions and improving residents' quality of life.

Finally, there are several benefits to increasing urban densification, which takes two major forms. The first (and likely to most familiar), is slowing geographic expansion by increasing housing density, moving away from large, single-family homes. Energy use and emissions per residential unit will be lower, and with appropriate zoning, commercial amenities will be nearby, mitigating residents' need to travel to access services. Relatedly, moving from a single downtown to several urban hubs can reduce residents' commute times and reduce overall traffic congestion, lowering emissions.

Conclusions

Municipalities in Canada have numerous policy levers to support wide-scale emissions reductions within their boundaries. While big-ticket federal, provincial and territorial policies like carbon pricing creates the broad framework for emissions reductions, municipal policy affects how people live and work which has crucial importance in reducing emissions in the near- and longer-term. By nudging residents and businesses via land-use, zoning and by-laws municipalities have numerous tools to affect emissions reductions in transportation, stationary combustion (residential, commercial and industrial), and waste management.

[5] This is not necessarily surprising given the federal focus on reducing methane emissions from oil and gas, a much larger source of methane emissions than waste [CITE].