

# Moving Smarter: Exploring energy and GHG reduction solutions for Canadian cities

Municipalities and regional agencies across Canada are working to reduce energy use and greenhouse gas (GHG) emissions to mitigate the impacts and risks of climate change. A toolbox of measures has been developed to help these agencies assess available options for reducing GHG emissions from the urban transportation sector. The toolbox also includes options which would be led by private enterprise or senior levels of government in order to highlight the supporting role that municipalities and regional agencies can play. A description of options and an overview of their benefits, costs, GHG reduction potentials, and considerations for implementation are presented.

## Urban Transportation and GHG Emissions

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The Canadian transportation sector is a significant contributor to Canada's total GHG emissions due to a heavy reliance on fossil fuels as the dominant energy source for propulsion. In 2011, it accounted for about one quarter of Canada's total GHG emissions<sup>1</sup>. Ground-based passenger and freight transportation, including transportation occurring in urban areas, accounted for nearly 88% of these emissions, and are projected to increase slightly by 2030<sup>2</sup>. Municipalities and regional planning and transit agencies, responsible for much of the land use, infrastructure and services which support ground-based urban transportation, will have a significant role to play in reducing the transportation sector's emissions.

Ground-based urban transportation GHG emissions are influenced by population and demographics, economic activity, travel patterns, vehicle fuel efficiency and the carbon intensity of vehicle fuels. Recent trends suggest that road passenger GHG emissions, which have stabilized since 2005, will decrease both in absolute terms and on a per capita basis by 2030 despite increasing travel demand. Reasons for this projected downward trend in road passenger transportation GHG emissions include:

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<sup>1</sup> Government of Canada. (2014). *Canada's Sixth National Report on Climate Change*, Ottawa.

<sup>2</sup> Idem.

- Population growth in urban centres where alternative forms of transportation to the automobile are more readily available;
- Demographic changes, including retiring baby boomers and the millennial generation tending to drive less;
- Gains in vehicle fuel efficiency; and,
- Adoption of national renewable fuel content regulations in 2010.

On the freight movement side, heavy duty vehicles are also seeing improvements in fuel efficiency, but the projected economic growth and increased demand for freight movement to 2030 could outweigh these gains without any additional measure. Furthermore, based on current federal and provincial policies and measures in place as of 2013, the growth of freight heavy duty vehicle GHG emissions is projected to off-set anticipated reductions in passenger GHG emissions, resulting in a net projected increase in emissions by 2030<sup>3</sup>.

## The Toolbox of Measures to Reduce GHG Emissions

There are three main approaches to reducing transportation GHG emissions in urban areas:

1. **Reduce Vehicle Kilometres Travelled:** Reducing distances travelled by passengers and goods by vehicle;
2. **Improve Transportation System and Driver Efficiency:** Improving the efficiency of the transportation system so that more passenger and freight travel with less vehicles under more optimal conditions in terms of speed and flow;
3. **Encourage Alternative Vehicle and Fuel Technologies:** Adopting and supporting vehicles that use alternative fuels and technologies which are more energy efficient or use less GHG-intensive energy sources for propulsion.

These approaches can be implemented through a variety of strategies, policies, programs, projects or actions, collectively referred to as “measures”. The toolbox presents 30 different measures across the three approaches to reduce transportation-related GHG emissions, as identified in the following table:

Reduce VKT	Improve Transportation System and Driver Efficiency	Encourage Alternative Vehicle and Fuel Technologies
<ul style="list-style-type: none"> <li>• Land Use Planning</li> <li>• Transit</li> <li>• Active Transportation</li> <li>• Carpooling and Carsharing</li> <li>• Telecommuting</li> <li>• Pricing Mechanisms</li> <li>• Parking Control Mechanisms</li> <li>• Trucking</li> </ul>	<ul style="list-style-type: none"> <li>• Roadway and Intersection Capacity Management</li> <li>• Traffic Signals</li> <li>• Speed Controls</li> <li>• Incident Management</li> <li>• Transit Priority</li> <li>• Eco-driving</li> </ul>	<ul style="list-style-type: none"> <li>• Light Duty Vehicle Tech.</li> <li>• Heavy Duty Vehicle Tech.</li> <li>• Transit Vehicle Tech.</li> <li>• Low Carbon Fuels</li> </ul>

<sup>3</sup> Government of Canada. (2014). *Canada's Sixth National Report on Climate Change*, Ottawa.

For each measure, the toolbox provides readers with various types of information to help identify which ones are most suitable to their context, including:

- A summary description of the measure and how they help to reduce transportation related energy consumption and GHG emissions. Examples and references are also provided where readers can seek further information;
- Measures that can be taken by federal, provincial, regional and local municipalities, transportation authorities and transit agencies to encourage the implementation or enhance their effectiveness;
- A list of advantages, disadvantages, and co-benefits of the measures covering physical, social, environmental, economic or financial aspects, as well as how they may affect individuals, businesses, organizations or communities;
- A review of the impacts of the measures on transportation patterns, transportation energy consumption and GHG emissions; and,
- A list of constraints and barriers to implementation, and comments on how some of these may be overcome.

Furthermore, implementation considerations and performance indicators are provided including responsibility for implementation, applicability, timing, GHG reduction potential, timeframe for emission reduction, cost, technical feasibility and social acceptability.

## **Implementation**

The toolbox lists the principal actors who are best positioned to implement the various measures. As owners and operators of infrastructure and transportation services, municipalities and transit agencies have the ability to implement many of the measures. Some of them will also typically be led by provincial and federal governments, as well as private enterprise, industry or non-governmental organizations. The roles that local or regional agencies can play in supporting these actions are identified.

## **Applicability**

The toolbox indicates the applicability of each measure by population size of a municipality. There are a large number of measures which can apply to municipalities of all sizes. However, certain measures will be more appropriate for medium and large municipalities where population densities, travel demand to specific areas, and traffic congestion are greater or pose more significant challenges.

## **Implementation Timing**

Most of the measures in the toolbox can be implemented in the immediate or short term under the assumption that political will and financial constraints (e.g. availability of funding, support from upper levels of government) have been addressed. Generally, there are few overarching knowledge gaps or technical barriers to implementing many of the transportation supportive land use planning, transit, road system, pricing and parking measures described in the toolbox. However, some measures still require further technology development and refinement, such as for distance-based fees, as well as build-out of certain fuel or energy distribution infrastructure, before wide-scale market deployment can occur.

## GHG Impacts

The potential of measures to reduce overall urban transportation GHG emissions was scored qualitatively, based on a literature review and examination of current Canadian transportation modal share and GHG contributions. They are ranked in terms of their potential to reduce overall urban transportation GHG emissions in descending order of GHG reduction potential:

- Economy wide pricing mechanisms which provide strong pricing signals for changing travel behaviour across a broad range of economic sectors;
- Regional and local pricing mechanisms which provide strong pricing signals, but apply to a more limited number of travellers;
- Light duty and heavy duty vehicle technologies that increase vehicle fuel efficiency, or eliminate fossil fuel use altogether;
- Eco-driving strategies to encourage more energy and fuel efficient driving practices;
- Comprehensive transportation-efficient land use planning;
- Employer-based commute strategies that target a large portion of urban travel;
- Transportation supply side alternatives like transit, active transportation, car pooling and car sharing;
- Transportation system improvements to promote smoother traffic flow and reduce causes of congestion; and,
- Measures to reduce freight VKT in urban areas.

The timeframe when GHG emissions reduction would be expected to occur was evaluated. Some measures such as pricing measures and transportation system optimizations can result in significant GHG emissions reduction shortly after implementation due to their ability to quickly influence travel behaviour. The full GHG reduction potential of other measures such as transportation efficient land use planning, transit, active transportation, and certain vehicle propulsion technologies are not likely to be achieved until the medium or long term since they require significant time for build out and network effects to be created, or for significant vehicle fleet turnover to occur.

Exhibit 1 presents the evaluation of GHG reduction potential, as well as the expected timeframe when significant GHG reduction could be achieved if measures were hypothetically implemented immediately.

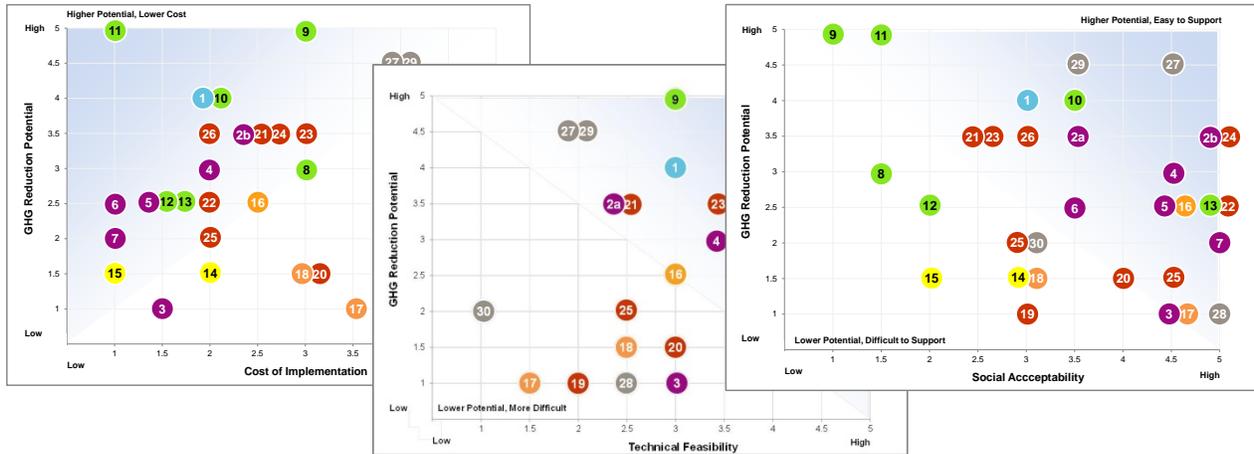
**Exhibit 1 – GHG Reduction Potential and Expected Timeframe**

Measure	GHG Reduction Potential*	Timeframe	
<b>Reduce Vehicle Kilometres Travelled</b>			
<b>Land Use</b>			
1	Land Use Planning and Smart Growth	4	Long
<b>Transportation Supply-Side Alternatives</b>			
2a	Expand Transit Service	3 – 4	Medium to Long
2b	Enhance Existing Transit Services	3 – 4	Medium to Long
3	Provide Taxibus Transit Service	1	Short
4	Encourage Active Transportation	3	Medium to Long
5	Provide Carsharing Services	2 – 3	Short
6	Encourage Carpooling	2 – 3	Short
7	Encourage Telecommuting	2	Immediate
<b>Pricing Mechanisms</b>			
8	Implement Toll Roads and Cordon/Area Pricing	3	Short
9	Implement Distance Travelled Fees	5	Short
10	Charge Distance-based Insurance Costs	3 – 5	Short
11	Implement a Fuel Sales or Carbon Tax	5	Short
12	Increase Parking Costs	2 – 3	Immediate
13	Offer Fees in Lieu of Travel, Parking	2 – 3	Immediate
<b>Parking Mechanisms</b>			
14	Optimize the Use of Existing Parking Spaces	1 – 2	Immediate
15	Reduce Minimum Parking Requirements	1 – 2	Medium to Long
<b>Trucking</b>			
16	Enhance Logistics Management	2 – 3	Short to Medium
17	Encourage Modal Shift for Freight	1	Short to Medium
18	Enhance Truck Inspection and Maintenance	1 – 2	Short
<b>Improve Transportation System and Driver Efficiency</b>			
19	Increase Infrastructure Capacity	1	Short, but Diminish over Long Term
20	Manage Roadway Capacity Dynamically	1 – 2	Short
21	Implement Speed Change Policies	3 – 4	Short
22	Optimize Traffic Signal Operation and Timing	2 – 3	Short
23	Implement Ramp Metering	3 – 4	Short
24	Improve Traffic Incident Management	3 – 4	Short
25	Provide Transit Priority Measures	2	Short
26	Encourage Eco-driving	3 – 4	Short to medium
<b>Encourage Alternative Vehicle and Fuel Technologies</b>			
27	Encourage Adoption of Efficient Vehicle Tech.	4 – 5	Medium to Long
28	Implement New Transit Vehicle Technologies	1	Medium to Long
29	Encourage New Heavy-Duty Vehicle Tech.	4 – 5	Medium to Long
30	Use Low Carbon Fuels	2	Short

\* Evaluated on a five point scale: 1 – very low, 5 – very high reduction potential

Finally, GHG reduction potential for each measure in the toolbox was compared against the cost, technical feasibility, and estimated social acceptability of implementation. These comparison charts (see Exhibit 2 below) provide readers with a further method for quickly sorting and identifying the performance and trade-offs of the various measures included in the toolbox.

**Exhibit 2 – Example of Comparison Charts between GHG Reduction Potential and Cost, Technical Feasibility and Social Acceptability**



**Concluding Remarks**

The toolbox presents an overview of measures to reduce urban transportation GHG emissions. It contains key information and evaluations to help readers identify the benefits, considerations and trade-offs of the various measures. The information in the toolbox will help to select measures or bundles of measures which are applicable to a jurisdiction. Local factors and considerations will affect the selection and evaluation of appropriate measures, such as the state of existing transportation systems and services, political contexts, budget availability, and time horizons for action, as well as funding opportunities from upper levels of government; plan, policy or infrastructure renewal cycles; or broader planning processes. The toolbox provides a starting point to select and adapt measures according to the local context, assess potential GHG emissions reduction, and identify specific planning and implementation considerations that may apply.

The evaluation of the GHG reduction potential of measures presented in this toolbox was qualitative in nature. The toolbox of measures can be enhanced through a more comprehensive, quantitative evaluation of the GHG reduction potentials. Such an exercise would require a closer examination of local conditions and opportunities across the country for the implementation of measures, and setting assumptions as to the geographical extents, timing of application, and intensity of the effort. In addition to providing a more quantitative assessment of GHG reduction potential, such an evaluation would also provide more detailed, location-specific information about economic costs, benefits, cost-effectiveness and implementation considerations for the various measures.

**References**

The methodology of the report is based on an extensive literature review of more than 190 documents and references.

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