Greening the Goods

Opportunities for low-carbon goods movement in Toronto

Kathryn Grond, Eli Angen

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Kathryn Grond, Eli Angen
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The Pembina Institute
219 19 Street NW
Calgary, AB
Canada T2N 2H9
Phone: 403-269-3344

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About the Pembina Institute

The Pembina Institute is a national non-partisan think tank that advances clean energy solutions through research, education, consulting and advocacy. We have spent close to three decades working to reduce the environmental impacts of Canada's energy production and use in several key areas:

- driving down energy demand by encouraging energy efficiency and transportation powered with cleaner energy sources;
- promoting pragmatic policy approaches for governments to avoid dangerous climate change, such as increasing the amount of renewable energy plugged into our electricity grids;
- and — recognizing that the transition to clean energy will include fossil fuels for some time — advocating for responsible development of Canada's oilsands and shale gas resources.

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The City of Toronto established Toronto Atmospheric Fund in 1991 to focus on reducing local greenhouse gas and air pollution emissions. Working with a $23-million endowment from the sale of the long-closed Langstaff Jail Farm, TAF operates as an arms-length agency at no cost to the City. TAF helps the City achieve the targets set out in the Council-approved climate plan and supports energy cost savings through energy efficiency. TAF-supported projects such as a street lighting retrofit, traffic light LED conversion, and building retrofits have generated $55 million in savings for the city to date.

TAF deploys three programs — Incubating Climate Solutions, Mobilizing Financial Capital, and Mobilizing Social Capital — to address Toronto's major emissions sources: buildings and transportation. Based on a careful study of Toronto's emissions profile, TAF has a strong interest in energy efficiency retrofits in buildings, electric vehicles for fleets, efficient transportation of goods, natural gas alternatives like geothermal, and social innovation to support emission reduction strategies.

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Executive summary

Freight trucks are one of the fastest growing sources of greenhouse gas (GHG) emissions in Ontario. In the City of Toronto, trucks are the largest emitter of nitrogen oxides (NO_x), which contribute to smog and respiratory diseases such as asthma. Growing population and employment in Toronto means more pressure to transport goods quickly and reliably, which increases the number of trucks on municipal roads.

Greening the Goods presents policy options and innovative ideas that government and businesses can implement to improve goods movement in Toronto. These ideas will help companies cut both costs and emissions of their operations, and reduce congestion on our streets, saving us all time and money.

How to green the goods

These six initiatives to improve goods movement represent the top recommendations from our research and stakeholder engagement on urban freight strategies. They have been successfully implemented in other cities and urban areas across the world and have great potential to be implemented in Toronto.

1. Off-peak deliveries

Working with local businesses to shift delivery scheduling away from peak congestion times

Off-peak delivery encourages freight operators and receivers to schedule deliveries outside of peak congestion periods, opting instead for early morning, evening or overnight deliveries. Off-peak delivery reduces delays caused by congestion and lack of parking during the day. Pilots in New York City and the United Kingdom have resulted in faster and more reliable delivery times, with few disruption complaints.

The Ontario Ministry of Transportation (MTO) is currently piloting off-peak deliveries in preparation for the Pan Am/Parapan Am Games in 2015. If successful, the program should be continued after the games, with support of the City of Toronto, to improve traffic operations in congested areas and to reduce exposure to emissions during the day.

2. Local delivery plans

Bringing together neighbouring businesses to discuss local delivery challenges and develop strategies to coordinate deliveries

Local delivery plans are developed by businesses, property managers and tenants to collect information about deliveries of goods. This information can then be used to create strategies that make deliveries more reliable, efficient and cost effective. These plans have been shown to reduce the overall number of trips and disruptions in the area.

Large office and retail buildings in Toronto could consolidate tenant deliveries to minimize the number of repetitive deliveries and improve the use of their loading facilities. Local business improvement associations (BIAs) that face issues with congestion and truck parking could use delivery plans to coordinate and better plan delivery times and locations.

3. Delivery truck parking

Combining better parking enforcement with better options for on-street loading

A lack of adequate parking and accessible loading space makes the timely delivery of goods in urban areas challenging. Reducing the number of vehicles that circulate while looking for a place to make their deliveries can help reduce congestion and emissions, as well as reducing traffic disruption from illegally parked vehicles.

The City of Toronto's Downtown Traffic Operation Study (DTOS) recommends the creation of 13 courier delivery zones in the downtown area during off-peak periods to reduce illegal parking. The City should review other neighbourhoods that lack adequate loading spaces and select appropriate strategies for truck parking and loading.

4. Open data for freight ITS applications

Using real-time traffic data to improving truck routing and reduce empty or partially loaded truck trips

Intelligent transportation systems (ITS) utilize traffic management software, sensor information and wireless technology to improve the efficiency of traffic networks and optimize routing decisions. These systems send real-time information to road users to help them dynamically adapt to road conditions and make better logistic and trip-routing decisions. Other freight ITS applications can help pair packages to be delivered with underutilized trucks in the area.

The City of Toronto should consider sharing real-time traffic network data to support improved travel decision-making of truck drivers and fleet operators. The MTO iCorridor is one way of disseminating ITS information from roads in the GTHA. The city could also consider working with Peel region to develop a Smart Freight Association and online portal that would help match trucks with extra capacity to companies that need packages delivered.

5. Incentives programs for low-emission vehicles

Provide rebates for low-emissions retrofits and the purchase of newer high-efficiency vehicles

A 2007 emission inventory of the City of Toronto showed that heavy trucks contribute more total NO_x pollution than cars, even though there are many more cars on the road. An effective way to improve air quality and public health would focus on retrofitting or removing the oldest and most polluting trucks used in urban areas.

The Province of Ontario should consider reintroducing a low-emissions vehicle program such as the Green Commercial Vehicle Program (GCVP) that was offered from 2009 to 2011. Funding for a rebate program could be provided by emission pricing policies, outlined in option 6 below.

6. Emissions fees

Charge a fee for emissions to accelerate the adoption of fuel-efficient and low-carbon vehicle technology

Putting a price on emissions through various fees and pricing schemes can support the acceleration of emissions intensity reduction in the commercial vehicle fleet sector. There are various options for pricing GHG emissions. National and regional carbon price schemes apply to all sources of carbon emissions, whereas low-emissions zones, tolled lanes and gas taxes target emissions generated by the transportation sector.

The Province of Ontario should consider adding an emission fee on fuels, or apply an annual emission fee to commercial vehicle registration based on vehicle age and type. The City of Toronto could also explore emissions-based road tolls on the Gardiner and Don Valley Parkway or a low-emission zone and regulations for vehicles entering the city.

Next steps for low-carbon goods movement in Toronto

The City of Toronto, neighbourhood BIAs, the Province of Ontario and the freight industry can begin working together to make Toronto a "smart freight city", where goods are moved more efficiently and with less pollution. Here are three actions that can begin today to support low-carbon freight options for Toronto:

1. Urban freight strategy

The City of Toronto should develop an urban freight strategy to prioritize policies and programs that can reduce environmental impacts and improve the efficiency of deliveries in the city. Priority policies the City could include are: off-peak deliveries, better on-street parking for truck loading, and sharing traffic data to support freight ITS applications.

2. Neighbourhood freight forums

Bringing together fragmented and independent businesses and clients to review and improve their transportation practices is an important first step in implementing strategies such as consolidation and off-peak deliveries. Neighbourhood freight forums can help kick off local delivery plans in areas where congestion, road space management, and air quality issues are of concern.

3. GHG impact and cost-benefit analysis of freight policies

The Province of Ontario and Metrolinx should consider supporting GHG modelling and cost-benefit analysis, including health impacts, of low-carbon urban freight strategies to help build the case for freight ITS applications, clean vehicle incentive programs and emissions fees policies.

1. Introduction

Reliable and cost-effective delivery and movement of goods and services are vital to the economy and functioning of the Greater Toronto and Hamilton Area (GTHA). However as the number of freight deliveries grows, so does the level of congestion, which contributes to increasing GHG emissions and air pollution. GHG emissions from the freight sector are predicted to surpass emissions from passenger vehicles Canada-wide in 2030 (see Figure 1), and similar growth of emissions will occur in Toronto.

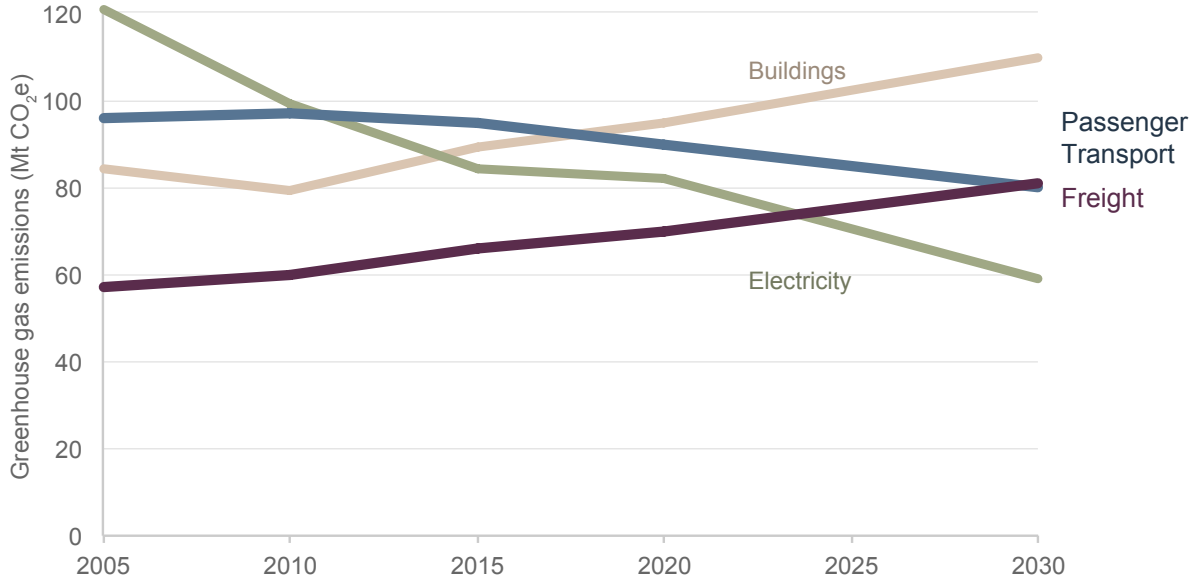

Figure 1 GHG emissions by sector, in Canada

Data source: Government of Canada[1]

Businesses and residents of the GTHA have simply learned to cope with this situation: companies internalize the cost of congestion delays and illegal parking tickets on downtown streets, while citizens deal with congestion and the health impacts of poor air quality.

Despite its importance for our regional economy and quality of life, the freight sector does not have a comprehensive and supportive set of policies and programs that would help it tackle congestion and growing emissions. The City of Toronto will need to play an important role in addressing the challenges faced by the freight sector by developing and implementing best practices, and encouraging business solutions that will improve the movement of goods and reduce emissions.

Rather than focusing regional freight policy and regulation at the provincial and national levels, this report features best practices for local movement of services and goods in Toronto, and

[1] Canada, *Canada's Sixth National Report on Climate Change 2014* (2014). http://unfccc.int/files/national_reports/non-annex_i_natcom/submitted_natcom/application/pdf/final_nc_br_dec20,_2013[1].pdf

recommends options that will help create a stronger, cleaner and smarter freight sector. Recommended options build upon existing freight initiatives and research in the region to accelerate emissions reduction, and focus on ideas that can be tested in the next one to three years.

Some solutions may have relatively small impacts but may be easier to implement in the short term. Other strategies will help transform the market over the longer term, but may be more challenging to implement; they may require more research and supportive best practices before they can be advanced.

Section 1 reviews the greenhouse gas and air pollution contributions from the freight sector, and describes the industry and government stakeholders. It also includes insights offered by experts about the best options for low-carbon delivery in Toronto.

Section 2 is an overview of the benefits and implementation strategies for low-carbon delivery options that have the best chance to reduce emissions. Criteria for selecting those options are reviewed, and successful national and international examples are presented.

Section 3 suggests three key actions that are needed to advance freight best practices in Toronto in the next few years.

1.1 Freight emissions in Toronto

The City of Toronto's goal is to reduce its GHG emissions to 30% below 1990 levels by 2020. The city is already halfway to its 2020 target, with another 4 million tonnes of emissions to go.[2] Meeting the 2020 target will require major new investments, best practices and programs. Emissions from the freight sector, in particular commercial vehicles and trucks, will play a part in achieving this goal.

A detailed inventory and analysis of the City of Toronto's emissions sources in 2007[3] provided an estimate of community source of GHG emissions, including the contribution from trucks and commercial vehicles. The study found that heavy trucks contributed 9% of Toronto's GHG emissions in 2004[4], about 5.5 million tonnes (megatonnes; Mt) of carbon dioxide equivalent (CO_2e). This represents one-quarter of all transportation-related emissions, shown in Figure 2. The City of Toronto's model of emissions sources estimates that the contribution of GHG emissions from trucks has increased slightly from 2001 to 2008; however, the lack of detailed data on the truck fleet and distances travelled in Toronto make it difficult to get an accurate estimate of emissions.[5]

[2] Bryan Purcell, "Nailed it! Toronto exceeds Kyoto target", *eighty by fifty blog*, Toronto Atmospheric Fund, April 24, 2013. http://www.toatmosphericfund.ca/2013/04/24/toronto-exceeds-kyoto-target/

[3] The 2011 Toronto GHG emissions will be released by the City of Toronto in 2014.

[4] ICF International, *Greenhouse Gases and Air Pollutants in the City of Toronto: Toward a Harmonized Strategy for Reducing Emissions* (2007), iii.
http://www1.toronto.ca/city_of_toronto/toronto_atmospheric_fund/files/pdf/ghginventory_jun07.pdf

[5] City of Toronto, *Summary of Toronto's 2011 Greenhouse Gas and Air Quality Pollutant Emissions Inventory,* Staff Report, March 27, 2013, 8-9,14. www.toronto.ca/legdocs/mmis/2013/pe/bgrd/backgroundfile-57187.pdf

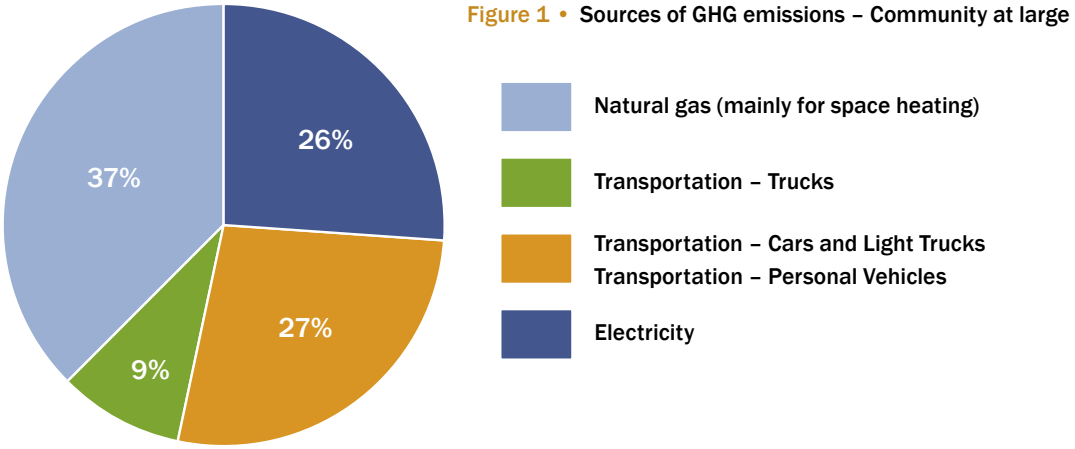

Figure 2 Sources of GHG emissions in Toronto

Source: ICF International[6]

Despite significant reductions in emissions intensity of substances such as sulfur oxides (SO_x) and carbon monoxide, trucks contribute to air quality issues in the city.[7] Commercial vehicles accounted for 36% of all NO_x emissions in Toronto in the 2007 emission inventory.[8]

Air quality studies, like the recent South Etobicoke and South Riverdale studies, show cars and trucks are the most significant source of NO_x pollution, which contributes to smog and respiratory diseases such as asthma.[9] A city-wide model shows that NO_x emissions concentration is highest along every major highway (Figure 3).[10]

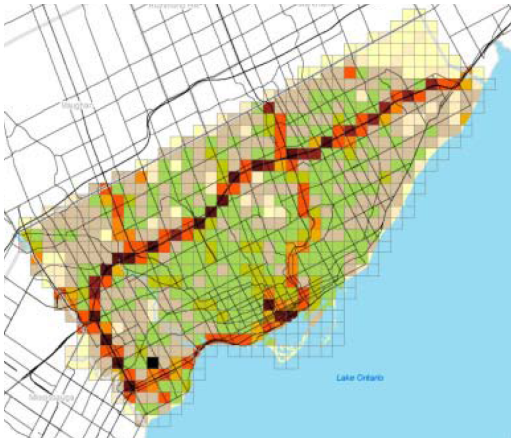

Figure 3 Patterns of NO_x emissions in Toronto

Source: Ciccone[11]

[6] ICF, *Greenhouse Gases and Air Pollutants in the City of Toronto,* iii.

[7] David Thompson, "Putting Transportation on Track in the GTHA A survey of road and rail emissions comparisons", Sustainable Prosperity and the Pembina Institute, (2011), 3. http://www.pembina.org/pub/2155

[8] ICF, *Greenhouse Gases and Air Pollutants in the City of Toronto, iv.*

[9] City of Toronto, "Nitrogen Oxides" *Local Air Quality Studies: Etobicoke-Lakeshore (Wards 5 & 6)* (2014). http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=68a79e5f01543410VgnVCM10000071d60f89RCRD&vgnextchannel=44a0e211597a1410VgnVCM10000071d60f89RCRD

[10] Anthony Ciccone, *All Sources and Cumulative Air Quality Study – City of Toronto*. Presentation, October 15, 2011. http://www1.toronto.ca/city_of_toronto/environment_and_energy/key_priorities/files/pdf/2011-10-18_golder_associates.pdf

[11] *All Sources and Cumulative Air Quality Study,* 25.

New federal fuel standards and clean technology will improve future emissions intensity of trucks, continuing the downward trend shown in Figure 4. Despite the reduction in emissions intensity, net emissions will continue to rise. The National Emissions Inventory provides an analysis of Canadian emission trends for the freight sector until 2030. Yet, Figure 1 shows that the total freight sector emissions are growing while passenger vehicle emissions are decreasing — and the trend lines will cross in 2030. More is needed to accelerate the reduction of GHG emissions from the freight sector.

While these studies, models and data collection have provided a good start on estimating the emissions contribution of freight, there is not enough comprehensive data on truck movements in the GTHA to calculate the baseline and source of emissions, and what information is available is out of date. Investments in better data collection and research are needed to measure and forecast the emissions of commercial vehicles operating in Toronto, and to understand the potential of best practices and solutions in reducing truck emissions.

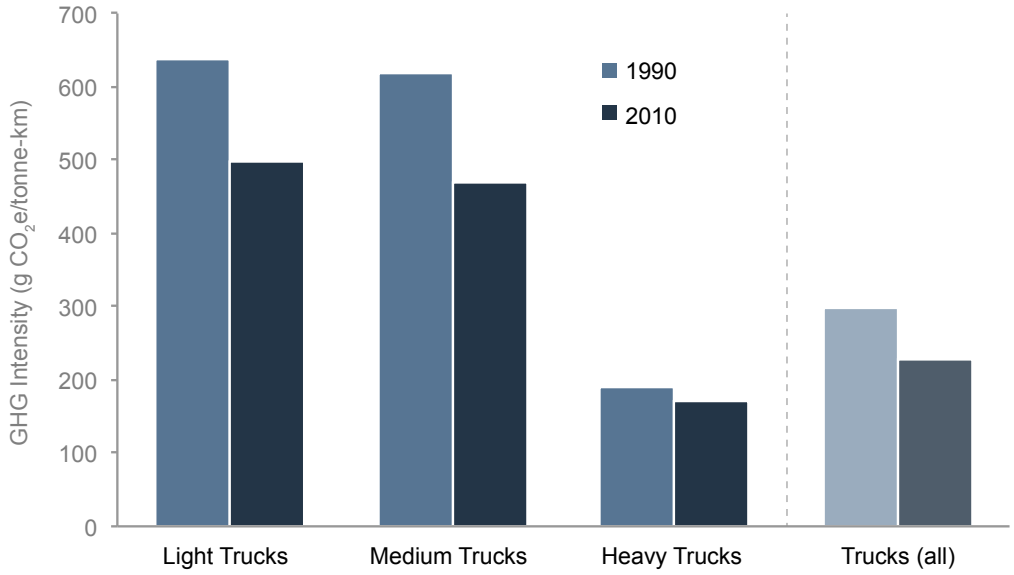

Figure 4 GHG intensity of goods moved by trucks

Data source: Natural Resources Canada[12]

1.2 The freight sector in the GTHA

The goods movement sector is a crucial component of our local economy. The transportation and warehousing sector contributed $21.2 billion to Ontario's gross domestic product in 2010.[13] In 2013, the sector accounted for 5% of all employment in Ontario.[14] The City of Toronto is part of the Continental Gateway and Trade corridor, the most important Canadian trade corridor in terms

[12] Natural Resources Canada, *Emissions from the Freight Transportation Sector 1990-2010 (Canada)*. "Energy Use Data Handbook Tables – Transportation Sector". oee.nrcan.gc.ca/publications/statistics/handbook2010/handbook2013.pdf

[13] Ontario Ministry of Finance, *Ontario Economic Accounts* (2013), Table 14, 37 http://www.fin.gov.on.ca/en/economy/ecaccts/eca.pdf

[14] Statistics Canada, "Employment by major industry group, seasonally adjusted, by province (monthly) (Ontario)" CANSIM table 282-0088. http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/labr67g-eng.htm

of volumes moved, and the GTHA is also a significant generator and consumer of goods.[15] This will only increase over time as the population and economy grow and evolve.

Trucks are the most frequently used mode of transportation for both short- and long-haul trips[16], and account for about 90% of urban freight operations in the GTHA.[17] The road network and congestion greatly affect the movement of goods in our region. Different groups and areas of the city face different issues: congested 400-series highways create pinch points for deliveries moving across the region and province, whereas lack of parking and loading space and congestion on arterial roads are issues in the downtown core of Toronto.

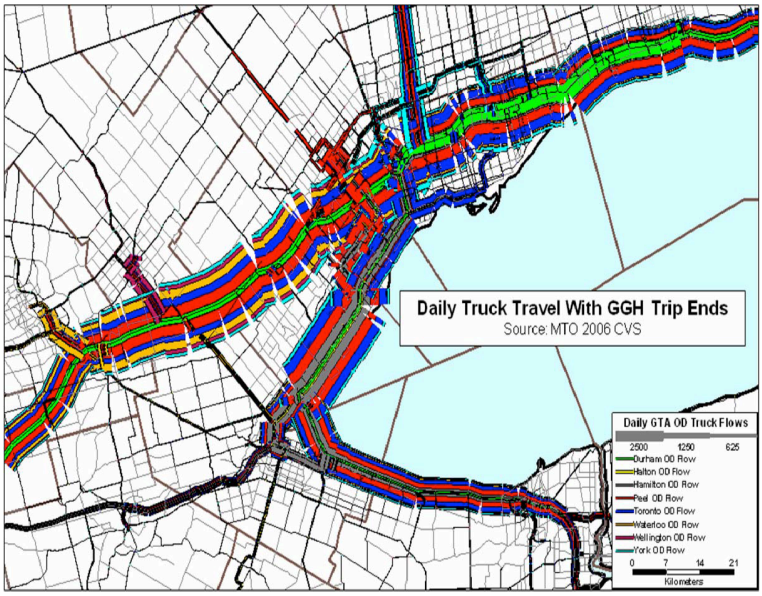

Figure 5 Daily truck trips destined for the Greater Golden Horseshoe, 2006
Source: HDR | iTRANS[18]

While there is limited data on exactly how many trucks travel across the city, there are a few provincial surveys that can help understand what goods move through the city. The 2006 commercial vehicle survey captured freight activity on the highway approaches to the GTHA. According to the survey, the commodities most frequently transported by truck are manufactured goods (15%), food (11%), and wood and paper products (6%). Empty trucks represented a full 37% of trips surveyed (see Figure 6).[19]

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[15] Metrolinx, *GTHA Urban Freight Study* (2011), 3. http://www.metrolinx.com/en/regionalplanning/goodsmovement/GTHA_Urban_Freight_Strategy.pdf

[16] Short-haul trips are less than 160 km from the home terminal, and long-haul trips are longer than 160 km. British Columbia Employment Standards Act and Regulations. https://www.labour.gov.bc.ca/esb/igm/esr-part-1/esr-s1-short-haul-truck-driver.htm

[17] Ontario Commercial Vehicle Survey (2006). Presented in HDR | iTRANS, *GTHA Urban Freight Study: Technical Backgrounder*, prepared for Metrolinx (2011), 49. http://www.metrolinx.com/en/regionalplanning/goodsmovement/GTHA_UFS_Technical_Backgrounder_Feb2011_Part1.pdf.

[18] *GTHA Urban Freight Study: Technical Backgrounder*, 49.

[19] Ontario Commercial Vehicle Survey (2006). Presented in HDR | iTRANS, *GTHA Urban Freight Study: Technical Backgrounder*, prepared for Metrolinx (2011), 54-55.

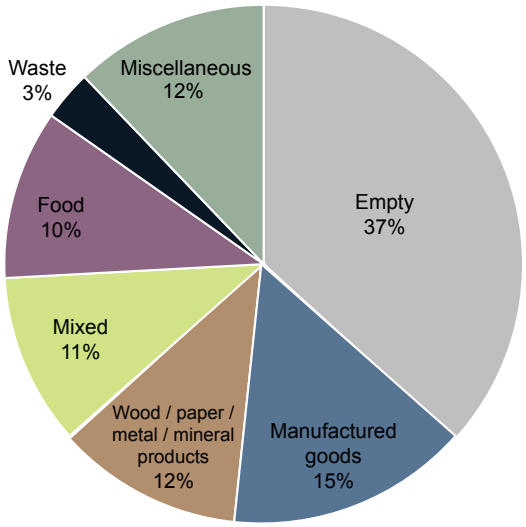

Figure 6 Types of commodities moved by trucks, 2006

Miscellaneous includes plastics, chemicals, stone, fuels, textiles, minerals and dangerous goods.
Data source: Ontario Ministry of Transportation[20]

1.3 Freight actors

In order to understand which best practices are most effective, it's important to note that the freight sector is heterogeneous — the types of companies providing freight services and their customers vary tremendously in terms of size and operation arrangements depending on the types of goods moved. Not only is the freight industry quite varied, there are also many companies that operate in the sector who are often in direct competition with each other. While each individual company is quite efficient, the nature of the sector has led to system-wide inefficiencies such as the large number of trucks travelling only partially loaded or empty.[21]

From a policy perspective, the heterogeneity of the sector means there isn't a one-size-fits-all approach to making improvements. It will take many small efforts and collaborative initiatives on the part of various freight actors to create change.

Below is a short summary of the main types of freight service providers and government actors, and some of the strategies and policies that have been implemented to reduce emissions from freight.

Key insights about the freight sector in Toronto from experts and stakeholders consulted are also included to help understand which options and best practices could be implemented in Toronto.

[20] Ontario Commercial Vehicle Survey (2006). Presented in HDR | iTRANS, *GTHA Urban Freight Study: Technical Backgrounder*, prepared for Metrolinx (2011), 54-55.
[21] Commission for Environmental Cooperation, *Destination Sustainability: Reducing Greenhouse Gas Emissions from Freight Transportation in North America*, (2011). http://www.cec.org/Storage/99/9783_CEC-FreightTransport-finalweb_en.pdf

Freight service providers

Within the freight industry, there are four major categories of freight service provider. Each type of provider has different types of customers, scales of operation, and challenges. Therefore they will benefit differently from best practices, and will require tailored strategies and partnerships.

Courier and logistics companies

These are major multi-national organizations that provide courier or logistics services as their main service for clients. Some well-known logistics companies are UPS, FedEx, DHL, Purolator and Canpar.

FedEx has developed a fleet of hybrid-electric delivery vehicles by investing in new vehicles and converting existing ones. Their goal is a 20% increase in vehicle efficiency by the year 2020.[22]

Large 'for-hire' freight operators

Colloquially known as trucking companies, these companies move goods through trucks and trailers. Most of these trucking companies operate at a regional scale and will sometimes partner with local owner-operators to move goods.

Werner Enterprises participates in the U.S. EPA SmartWay Program, and has implemented multiple energy efficiency devices, such as auxiliary power units, side skirts, and computerized onboard anti-idling systems.[23]

Small 'owner-operated' freight operators

Owner-operators are often self-employed drivers who own their trucks, or are part of a small company. They provide transportation services for general freight, liquid and dry bulk, forestry products and other specialized freight.[24]

100km Foods Inc provides clients in the GTHA with agricultural products grown and produced in the Toronto Greenbelt and surrounding farms. The company is looking to switch their diesel fuel with either a bio-diesel or a hybrid refrigeration system.[25]

Vocational trucks

Vocational trucks are designed for a specific function or industry. They are often used to perform a specialized task or to transport a specific kind of goods, such as cement, garbage, fuel and livestock.

The City of Toronto has purchased a hybrid Class 8 garbage truck, which has some electric auxiliary systems. This particular model of truck — the Peterbilt 320 — is also available with a natural gas engine if higher power density is required.[26]

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[22] Article13, "FedEx - EarthSmart - sustainability strategy". http://www.environmental-expert.com/articles/fedex-earthsmart-sustainability-strategy-240940

[23] Werner Enterprise, "Green Fleet Info". http://www.werner.com/content/drivers/werner_advantages/our_fleet/green_fleet_info/

[24] Statistics Canada. *Annual Survey of Small For-Hire Carriers of Freight and Owner-Operators.* http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=2800

[25] Interview with Paul Sawtell, Co-Founder of 100km Foods.

[26] City of Toronto, "Information on our Green Vehicles." http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=1e61a1438014f310VgnVCM10000071d60f89RCRD&vgnextchannel=bab82ea35be3f310VgnVCM10000071d60f89RCRD

Private trucking

Many large retailers control the transportation and distribution of their goods from suppliers to retail stores. Examples of such companies include Wal-Mart, Loblaws and Canadian Tire. Product manufacturer, such as Nestle or Coca-Cola, or franchise restaurants, such as McDonalds and Tim Horton, transport goods from central warehouses directly to customers and franchise locations.

Coca-Cola owns and operates a fleet of hybrid electric delivery trucks across North America.[27]

Public agencies

Federal policies

The federal government sets standards on emissions of new vehicles produced and purchased in Canada. Federal agencies also administer freight education and benchmarking programs such as SmartWay Canada and smarter driver training. The government also supports technological innovation with research and innovation incentive programs.

Provincial policies

The Ontario Ministry of Transportation regulates truck traffic on provincially-owned roads. This includes vehicle registration, and monitoring and collecting data on provincial highways, which can be accessed through iCorridor. The province also administers education and retrofit incentives programs. Recently, the province drafted a Multi-Modal Goods Movement Strategy and Freight-Supportive Guidelines[28] which give engineers and planners tools to better incorporate freight into policies and plans.

Metrolinx

Metrolinx is the GTHA's regional transportation planning agency. Goods movement is one of the transportation priorities of The Big Move, the GTHA's 25-year regional transportation plan. Metrolinx released the GTHA Urban Freight Study in 2011, which provides a comprehensive review of the freight sector, as well as 17 priority actions for urban freight. Metrolinx convenes industry and government representatives at the bi-annual GTHA Urban Freight Forum. They also support research on freight policies such as consolidation, moving freight on transit, truck lanes, and are working on developing an urban freight data collection framework.

City of Toronto

The City of Toronto has municipal bylaws that regulate truck access time and location, as well as noise limits on deliveries. Freight spans a series of jurisdictions of concern at the City: air quality and pollution (Energy and Environment, Toronto Public Health), congestion and traffic

[27] "Coca-Cola reinforces commitment to environment with unveiling of Olympic Torch Relay sustainability plan and expansion of hybrid-electric fleet," CNW, September 30, 2009. http://www.newswire.ca/en/story/464565/coca-cola-reinforces-commitment-to-environment-with-unveiling-of-olympic-torch-relay-sustainability-plan-and-expansion-of-hybrid-electric-fleet

[28] MTO, *Draft Freight-Supportive Guildelines,* (2013). http://www.mto.gov.on.ca/english/sustainability/Freight-Supportive-Guideline-EN.pdf

management (Transportation Services, City Planning), and reducing barriers to freight business and helping freight customers save on transportation costs (Economic Development).

1.4 Feedback from experts

The recommendations for urban freight best practices in this report were developed through extensive research, several rounds of consultations, and workshops with freight sector experts, academics and stakeholders. These activities provided insight onto the challenges faced by companies and actors in the field, as well as ideas from case studies across the world.

The workshop participants provided feedback on the benefits, risks and feasibility of urban freight best practices and pilots, as well as the best ways to implement these practices in Toronto. A full list of experts consulted and workshop notes can be found in Appendix A. Highlights from the most salient comments that have helped guide the selection of best practices and policies are found below.

- These strategies need to be enabling business, not disabling it. Strategies such as higher fees for parking infractions or consolidation will especially affect smaller truck operators.
- A client-driven approach will be most successful for best practices such as off-peak deliveries and delivery consolidation. Clients stand to benefit more from the savings of delivery consolidation, but they also undertake more of the burden and cost of changing delivery practices. A successful pilot will need to work with receivers and operators to address any added costs and find ways to maximize the efficiencies and cost savings.
- Most freight operators and couriers have very efficient operations, but they seldom collaborate with other companies to improve the overall efficiency of their combined deliveries. This results in the inefficient and redundant use of the road network. Local governments can hold freight forums and develop plans that help find cross-company efficiencies.
- Systematic freight data is missing in many jurisdictions across Canada. This makes it difficult to assess the impacts and benefits of implementing freight best practices. The University of Toronto and Metrolinx recently completed a freight data collection framework study for the GTHA, and are now working with MTO and regional municipalities to begin implementation.
- Freight issues and solutions need to be better researched and communicated to the public, businesses and decision makers. There is an opportunity to bring together city staff to understand how freight issues affect each of their areas, and then relay the opportunities to councillors.

2. Options for low-carbon delivery in Toronto

2.1 Criteria for selection of options

During the research and consultation, innovative ideas were sought that have been successfully implemented in other cities and had positive impacts in addition to reducing emissions. While each option was reviewed and discussed in detail, the final selection of options is based on their emissions reduction potential and ease of implementation in Toronto. Information relating to the criteria came from consultations with freight experts as well as from freight literature and stakeholder workshops.

The options presented below are not intended to be a comprehensive list of urban freight policies and strategies — there are many other green logistics strategies implemented around the world. A longer list of strategies reviewed and considered is included in Appendix C.

2.1.1 Feasibility of implementation criteria

- Are there **multiple benefits** in addition to reduced GHG emissions, such as cost savings, increased reliability of deliveries, congestion reduction, and improvements in air quality?
- Are there **successful case studies** in other jurisdictions?
- Are there **potential champions and partners in the GTHA** who are willing to implement the options?

Goods movement in the GTHA is complex and faces a variety of constraints and requirements depending on the nature of the business and supply chain. Therefore, policies and strategies were chosen to address a variety of challenges and opportunities. The options often apply to a specific geographic area or a particular freight sector. Furthermore, some options can be quickly implemented as pilots, and have the potential to be adopted on a wider scale. Other options will require changes to regulation and policies, and may require several years to implement.

2.1.2 Emission reduction criteria

The 2007 GHG inventory estimated that trucks contributed 2.2 Mt CO_2e in 2004. However, due to the lack of comprehensive data on truck movements and fleets, it is quite difficult to provide a quantitative estimate of the emissions reduction potential of each option across the whole city. This report has attempted to provide a qualitative assessment of the relative impacts on emissions based on the outcomes from case studies and GHG emissions modelling and research.

The option descriptions in the next section provide measured emissions reduction from case studies where possible. For options where data or case studies on emissions savings are not available, emissions reduction potential is based on a qualitative assessment of the changes to delivery practices and potential scale of policy implementation and adoption. We've categorized all best practices using a small/medium/large emissions reduction ranking, defined as follows:

Small impact – the option would result in a minor reduction in emissions (less than 0.02 $MtCO_2e$ per year by 2020) and would help slow the growth of emissions at the city.

Medium impact – the option would result in a more significant reduction in emissions (0.02 to 0.2 $MtCO_2e$ per year by 2020), and if implemented more broadly, it could slow or stop the growth of freight emissions in the City. This would represent a 1-10% reduction of current freight road emissions in Toronto.

Large impact – the option would result in a significant reduction in emissions (at least 0.2 Mt CO_2e per year by 2020) and might reverse the growth of freight emissions in the city. This would represent a 10% or greater reduction of current freight road emissions in Toronto.

2.2 Summary of low-carbon delivery options

This section will explore the benefits of the top six urban freight options for the City of Toronto. We outline possible paths of implementation and the roles of major stakeholders to move them forward or to support these changes. Table 1 summarizes the criteria for each option, and Table 2 highlights the implementation and challenges of each option. Section 2.3 provides a detailed description of each option.

Table 1 Low-carbon delivery options for Toronto

Option	Criteria for selection		
	Benefits	Case studies	Emission impact
Trip reduction and optimized operations This category of options focuses on reducing the number of trips and distances travelled, optimizing the use of trucks and increasing reliability. The consolidation and coordination of deliveries is most effective when led by clients.			
Off-peak deliveries	Reduce travel time and costs, increase reliability and ease of delivery, avoid illegal parking tickets	New York City, London (U.K.)	Small – Emissions are reduced because of improved travel speeds and optimal routes
Local delivery plans	Reduce total trips, better utilize truck capacity, increase reliability, significant cost savings for clients	Toronto, London (U.K.)	Medium – Avoided trips could result in significant emissions reductions if implemented across the city
Delivery truck parking	Reduce idling and circulation when looking for space, improve accessibility for loading and unloading	Ottawa, Washington D.C.	Small – Reduced emissions from unnecessary circulation and idling, both directly from delivery trucks and indirectly from other traffic that benefits from reduced congestion
Green vehicle policies This category of options seeks to accelerate the reduction of GHG and emissions above the federal emission standards, through better information and education, as well as incentives and fees on emissions. While there is a greater potential for emissions reduction, these options are more challenging to implement.			
Open data for freight ITS applications	Real-time data to improve truck route decisions, reduce empty or partially loaded truck trips, and change driving behavior (acceleration and travel speeds)	Kansas City, Dallas	Medium – Pilot projects have shown a 5–15% reduction in emissions per fleet from more optimal routing and driving behavior
Incentives programs for low-emission vehicles	Support businesses to choose newer, cleaner vehicles, especially helpful for smaller businesses	Chicago, Boston	Large – Significant potential to reduce emissions, especially if targeting the least efficient vehicles
Emissions fees	Increased fuel cost encourages conversion to cleaner fleets; fees can also provide funding for incentive program	Vancouver, Berlin	Large – Fees in other jurisdictions have accelerated the turnover of commercial fleet to newer, cleaner trucks.

Table 2 Implementation of low-carbon delivery best options

Option	How to do it here	Challenges
Off-peak delivery	Extend the Pan Am/Parapan Am Games off-peak pilot as a legacy program in the GTHA	Noise bylaws can prohibit deliveries outright; cost of staffing a receiving area at off-peak hours
Local delivery plans	If led by city, integrate with existing environmental and planning community consultations or traffic and planning studies If led by businesses, could be coordinated by BIA, office tenants and property managers	Competition amongst freight carriers; reluctance to share proprietary information; cost of developing and managing a freight coordination plan
Delivery truck parking	Replicate downtown traffic operation study (DTOS) in other parts of the city, with a focus on local parking demand and availability, as well as safety issues and conflicts with other road users	Competition with other road users for road space, such as for car parking and bicycles lane and pedestrian sidewalks
Open data for freight ITS applications	City to review and include real time traffic data in open data agreements; will need to work with MTO to share and develop data	Data privacy concerns; cost to maintain and collect data
Incentives programs for low-emission vehicles	Reinstate Ontario Green Commercial Vehicle Program, and update cost-benefit analysis	Need resources and political support to implement
Emissions fees	Small increase in gas tax or a registration fee that would exclusively go to funding truck retrofits and other green logistics programs	Not politically popular; impacts on industry are not well understood; need more research on best way to administer

2.3 Description of options for low-carbon delivery

2.3.1 Off-peak deliveries

Off-peak delivery encourages freight operators and receivers to schedule deliveries outside of peak congestion periods, opting instead for early morning, evening or overnight deliveries. This reduces delays due to congestion and parking scarcity at the delivery locations. This strategy not only improves delivery travel times for operators, but will also ease the level of congestion for other road users during peak times. Off-peak deliveries are made in Toronto where possible, such as long commercial arterials and at the Eaton Centre.


Photo: Kathryn Grond, Pembina Institute

In practice

Sainsbury's supermarket in Wandsworth, England, ran a three-month pilot project of off-peak deliveries. It resulted in a 60-minute reduction in travel time between the store and the warehouse, $25,000 of annual savings in driver's wages and a 68-tonne annual reduction in CO_2 emissions.[29]

The Off-Hour Deliveries NYC pilot project ran from 2009 to 2010 in New York. The project engaged both delivery companies and their customers, and found that most businesses supported off-hours deliveries. Travel speeds for deliveries improved by as much as 75%. There was also a sharp reduction in parking tickets and fines: more than $1,000 per month for each truck. The city is continuing to support and expand participants in the off-peak delivery program, and has included this strategy in its sustainability plan, PLANYC.[30]

Potential impact

Off-peak delivery pilots have produced dramatic improvements in travel times, improved the ease and speed of loading and receiving, and reduced parking tickets. Deliveries scheduled outside of peak congestion times are much more reliable, since they are not subject to traffic- and congestion-related delays. The emissions reduction potential from better travel speed has yet to be quantified, but could be significant if there was a large increase in off-peak deliveries.

[29] Freight Transport Association, *Night-time Deliveries- Wandsworth Trial*, (2009), 2. www.fta.co.uk/export/sites/fta/_galleries/downloads/night_time_deliveries/nighttime_deliver_wandsworth.pdf

[30] NYC Department of Transportation, "NYC DOT Pilot Program Finds Economic Savings, Efficiencies For Truck Deliveries Made During Off-hours", press release July 1, 2010.

How to implement in Toronto

The implementation of off-peak deliveries in Toronto would require policy changes and industry champions to pilot and implement new delivery schedules and practices. The first barrier to this option is that it may require additional staff time to receive deliveries after hours, although not all deliveries would require receiving staff. The second barrier is noise disruptions to local residences during the evening and overnight. The New York City off-peak deliveries pilot included monitoring noise complaints and testing various strategies to reduce disturbances. To date, the authorities have not received any noise complaints from local residents.

MTO is developing a pilot of off-peak deliveries in preparation for the Pan Am/Parapan Am Games in 2015. The games are expected to cause significant disruptions to the transportation network in the City of Toronto. Several host cities for major sporting events have successfully implemented off-peak delivery strategies to manage deliveries. If the pilot proves successful, the City of Toronto and MTO should continue administering an off-peak delivery program after the games.

2.3.2 Local delivery plans

Local delivery plans aim to help tenants and businesses within a particular area to record and coordinate deliveries to better manage them. This reduces disruptions and improves safety for the area. The plans can help reduce costs by ensuring higher truck loading factors and reducing the overall number of trips. Delivery plans can identify and direct truck deliveries to safe and legal locations.

In practice

Delivery service plans (DSPs) are a key strategy in the freight plan for the City of London, U.K., which aims to improve the sustainability and safety of goods movement, including reducing overall emissions. The DSPs help by finding opportunities to reduce the number of deliveries to a building, and by identifying safe and legal times for deliveries.[31]

Transport for London implemented a delivery service plan for their new building in Southwark, London. A key achievement of the plan's implementation has been the reduction of deliveries by 20%.[32] This was achieved in part by centralizing the building's facilities and collecting data on the supplies ordered and delivered (see Figure 7). Close collaboration with the property facilities group, Transport for London's procurement office and suppliers was integral to the successful development of the plan.

[31] Transport for London, *Delivery Service Plan Guidance Manual*. http://www.tfl.gov.uk/microsites/freight/documents/Delivery-and-Servicing-Plans.pdf

[32] Transport for London, *A Pilot Delivery Servicing Plan for TfL's Palestra Offices in Southwark: A Case Study* (2009), 2. http://www.tfl.gov.uk/microsites/freight/documents/20090921-DSP-Palestra-Case-Study.pdf

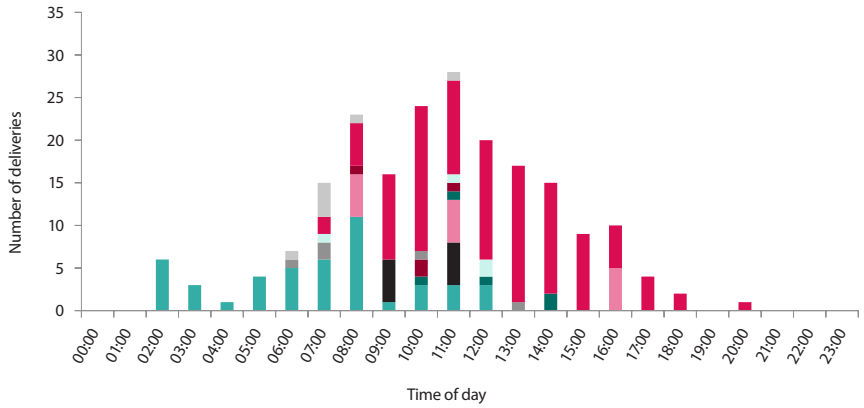

Figure 7 Schedule of deliveries in Southwark building, U.K.

Source: Adapted from Transport for London[33]

Potential impact

Local delivery plans can help reduce emissions in a variety of ways. Firstly, the data on the number of deliveries can provide an estimate of the emissions and cost of transportation. Secondly, various strategies to manage deliveries, such as reducing the overall frequency of deliveries though coordinating amongst tenants, will lead to a reduction of trips and emissions.

Delivery plans provide a way for freight customers to examine the emissions of their logistics. They also encourage the freight service providers to demonstrate how green their operations are, such as by participating in the NRCan SmartWay program. This option could lead to a moderate level of emissions reduction if adopted widely in Toronto.

How to implement in Toronto

There are several opportunities to implement local delivery plans in Toronto. Large office and retail buildings in Toronto could consolidate tenant deliveries to minimize the number of repetitive deliveries and improve the use of their loading facilities.

Furthermore, BIAs that face issues with congestion and truck parking could use delivery plans to coordinate and better plan delivery times and locations. Local delivery plans could recommend strategies that focus on consolidating deliveries (reducing multiple deliveries from the same suppliers) or manage the time and location of deliveries by restricting deliveries to a certain time of day, creating designated freight parking areas, or sharing an off-hours delivery location.

[33] *Delivery Service Plan Guidance Manual*, 19.

2.3.3 Delivery truck parking

A lack of adequate parking and accessible loading space makes the timely delivery of goods in urban areas challenging. It can also lead to illegal parking of delivery trucks. This contributes to congestion and increases emissions by blocking the flow of traffic, and by increasing the circulation of vehicles looking for a place to make their deliveries.

In many urban centres, parking tickets do not eliminate illegal curb-side parking of commercial vehicles because operators who have few parking options have factored the tickets into the cost of business.

Photo: Lucius Kwok, CC-BY-SA 2.0

In practice

New York City's muni-meter program has paired increased enforcement of parking infractions with better parking and loading zones. It has been successful in reducing the incidence of illegal double-parking while decreasing delivery times.[34]

Other options for increasing freight parking and loading opportunities include:

- Time-of-day restrictions: New York City grants freight vehicles exclusive access to parking before 12 p.m., when 65% of deliveries occur.[35]
- Space management: Designate some curb-side space for delivery loading. New York City encourages reserving some space for freight, and Washington, D.C. has extended loading zones along K Street, a major thoroughfare.[36]
- Pricing: New York City's muni-meters increase fees for freight parking over time to encourage higher turnover of spaces (US$2 for one hour, US$5 for two hours and US$9 for three hours).[37]
- New technologies: SFpark is a mobile app that provides information on the availability of parking spaces in busy neighbourhoods of San Francisco; the rate for parking is regularly adjusted to help ensure that a few spaces are available in each area.[38]

[34] Mehdi Nourinejad, Adam Wenneman, Khandker Nurul Habib, and Matthew J. Roorda, *Truck Parking in Urban Areas: application of choice modelling within traffic microsimulation*, presented at the Canadian Transportation Research Forum Annual conference, Halifax, June10-12, 2013, 4.

[35] Ibid, 4.

[36] Ibid,4.

[37] U.S. Department of Transportation, *Urban Freight Case Study: New York* (2009), 7. http://ops.fhwa.dot.gov/publications/fhwahop10019/fhwahop10019.pdf

[38] *Truck Parking in Urban Areas,*6.

Potential impact

This option will greatly help companies making and receiving deliveries in the central area of the city, where on-street loading is necessary. Better availability of parking for commercial vehicles will reduce the incidents of parking tickets.

Preliminary modelling at U of T suggests a slight reduction in emissions from extra circulation and idling, which also reduces local congestion. Clearer on-street loading zones will reduce conflicts with other road users and should help improve safety.

How to implement in Toronto

Municipal governments determine and enforce the use of local roads, including parking. The City of Toronto has specific on-street loading areas in the post-amalgamation bylaw harmonization.[39] In November 2013, the City released the Downtown Traffic Operation Study (DTOS), which recommended the creation of 13 courier delivery zones in the downtown area during off-peak periods to reduce illegal parking. This approach to truck parking could be recommend for other neighbourhoods in Toronto, and should be offered to other delivery trucks. Consultations with local BIAs and freight industry would be required.

The DTOS also recommends a traffic pattern study of the entertainment district. We would recommend that this study be extended to include delivery patterns in order to determine the need, location and timing for delivery-only loading spaces.

Sections 3.7 and 3.8 of the MTO's draft freight-supportive guidelines include recommendations and considerations for accommodating truck deliveries in existing urban areas. Section 3.9 discusses strategies for reducing conflict and improving safety for all road users, especially cyclist and pedestrians. These should be consulted and implemented by the City of Toronto as part of new road projects.

2.3.4 Open data for freight ITS applications

Intelligent transportation systems (ITS) utilize traffic management software, sensor information and wireless technology to improve the efficiency of traffic networks and optimize routing. These systems send real-time information about road conditions to road users to help them dynamically adapt to conditions.

Traffic cameras, GPS vehicle tracking and Wi-Fi communication devices can be used to collect and relay real-time data about traffic volume, network conditions and road disruptions. Real-time data could be communicated back to truck drivers and fleet managers to help them make logistic and trip-routing decisions.

[39] City of Toronto, *Toronto Municipal Code: CHAPTER 950, TRAFFIC AND PARKING.* 950-402. Commercial, passenger, bus and delivery vehicles loading and parking zones., Schedule IX in § 950-1308.

In practice

In 2010 and 2011, the U.S. Department of Transportation (USDOT) piloted two projects in Chicago and Kansas that used mobile apps and wireless technology to implement dynamic routing and logistic optimization. During the pilots, empty trips for short distances were reduced by 13% in Kansas City and 52% in Chicago. Moreover, emissions were reduced by 8% in the Kansas City pilot. Another pilot in Kansas City used dynamic route optimization, which resulted in a 21% time improvement and 10% emissions reduction.[40]

Potential impact

ITS applications use data about the road network to better plan delivery routes and avoid congestion. They can also be used to optimize the deployment of trucks and to reduce the number of empty trucks (backhaul). Based on the emissions savings from the USDOT pilots, there is significant emissions reduction potential if applied to Toronto, but further studies are needed.

How to implement in Toronto

The City of Toronto should consider supporting industry-led pilots of freight ITS applications, such as on-board vehicle or mobile apps that provide data about real-time network conditions. This data can be used both for dynamic route planning by dispatchers or in helping adjust driving behaviour, such as accelerating or decelerating at traffic lights, in an efficient manner.

Furthermore, the technology and systems used in such a pilot could be used to implement other emission reduction strategies such as dynamic low-emission zones or time-of-day congestion charges.

The Region of Peel is currently seeking proposals to study the feasibility of establishing a Smart Freight Association[41], which would help increase collaboration of freight service providers, including better use of technology to reduce backhaul. The City of Toronto should consider partnering with the region of Peel on this initiative.

The City is already investing in smarter traffic signalling and timing, and should consider how this will impact freight operations. In addition to this, the City should consider developing an open data agreement for necessary real-time traffic and road network data. This data is essential for vehicle-to-infrastructure applications, such as the smarter driving applications. It would be helpful for the City to meet with interested industry partners to determine which data is needed for freight ITS applications.

[40] Roger Schiller, Cambridge Systematics Inc, "C-TIP Evaluation: Results and Lessons Learned", presentation to the Talking Freight:Freight Advanced Traveler Information System (FRATIS) workshop, January 18, 2012.

[41] *Feasibility Study For The Establishment Of A Smart Freight Association Within The Regional Municipality Of Peel,* Document 2014-095p. Available at https://www.peelregion.ca/scripts/finance/biddocs.pl

2.3.5 Incentive programs for low-emissions vehicles

A GHG inventory of the City of Toronto showed that heavy trucks contribute a disproportionate amount of NO_x pollution compared to other vehicles.[42] A report by the Natural Resources Defense Council argues that the most effective air quality improvement program would focus on retrofitting the oldest trucks used in urban areas, since they have the greatest impact on public health.[43]

Programs that couple education with incentives have proven successful in British Columbia and Chicago. They help smaller companies with fewer resources deal with higher fuel costs and emissions charges. However, the experience from these programs shows that most companies will not adopt cleaner technologies unless there is an opportunity to significantly reduce fuel costs, or a regulation compelling them to do so.

In practice

The City of Chicago announced an incentive program for electric commercial vehicles that will provide about 250 vouchers discounting the purchase of electric commercial vehicles. The voucher, applied to the purchase price at the point of sale, will cover roughly 60% of the incremental cost of an electric vehicle compared to a diesel equivalent. The Chicago Metropolitan Agency for Planning and the Congestion Mitigation and Air Quality Improvement Program selection committee provided the city with US$15 million for the program.[44]

The EnviroTruck program in B.C. offers up to $10,000 per vehicle for the installation of new engines, aerodynamic devices and anti-idling devices. EnviroTrucks are 10–15% more fuel-efficient than older trucks, resulting in significant savings.[45] Two B.C. fleets piloting after-market fuel efficiency technologies — including low-rolling-resistance dual and single wide-base tires, trailer sideskirts and speed limiters — showed a 5% average increase in fuel efficiency and payback periods of less than 21 months.[46]

[42] ICF, *Greenhouse Gases and Air Pollutants in the City of Toronto*.

[43] Richard Kassel and Diane Bailey, *Cleaning Up Today's Dirty Diesel* (Natural Resources Defense Council, 2004).

[44] City of Chicago, "Mayor Emanuel Announces Nation's Leading Incentive Program To Encourage Private and Public Fleets To Convert Trucks To Electric Power" press release, November 27, 2012.

[45] LiveSmart BC, "Truckers: Other BC Government Incentives and Programs." http://www.livesmartbc.ca/road/truckers.html

[46] Fraser Basin Council, "Green Fleets: Today's Innovations: Trucking Technologies." http://www.e3fleet.com/trucking_technologies.html

How to implement in Toronto

Several programs provide information and suggestions for retrofits to companies in the GTHA. However, the freight sector has very low profit margins and most small- and medium-sized companies will need financial support to invest in cleaner technology. An education and incentive program for retrofits could be capitalized through a combination of government funds and fees from a low-emission zone or emissions fee program.

The Ontario Ministry of Transportation provided grants for retrofits through their Green Commercial Vehicle Program (GCVP) from 2009 to 2011.[47] This program encouraged Ontario-based businesses to switch to environmentally friendly technologies that reduce GHG emissions and fuel consumption. The GCVP helped enterprises acquire alternative fuel vehicles or add anti-idling devices to existing vehicles by reimbursing them for a portion of the costs.

Several experts consulted by Pembina said that the GCVP was worthwhile and should be revived. They believed that participation in the program may have been hampered by the timing of its launch in 2009, which coincided with a recession. At the time, the freight industry was facing a steep decline in business. With the freight sector picking up again, there is renewed interest in the program.

2.3.6 Emissions fees

New federal emissions regulations, higher fuel costs and substantial research and development on vehicle technologies are encouraging more innovation in the sector[48], but more supportive policies and incentives are needed to address the unique challenges of urban freight. Putting a price on emissions through various fees and pricing schemes can support the acceleration of emissions intensity reduction in the commercial vehicle fleet sector.

There are various options for pricing GHG emissions. National and regional carbon price schemes apply to all sources of carbon emissions, whereas low-emissions zones, tolled lanes and gas taxes specifically target emissions generated by the transportation sector.

Carbon pricing is generally recommended because it can incentivize a reduction in emissions in a non-prescriptive way — it is up to the market to find the best technology or strategy to reduce emissions. Investments in low-carbon vehicle technology require substantial capital investments, which limit the adoption rate in the freight sector; the monetization of emissions helps improve the return on investment for low-emissions vehicles as well as operational strategies that reduce fuel use, which is correlated with GHG emissions.

Low-emissions zones are a type of road pricing that charge higher-emitting vehicles; zones can be enforced in a number of ways. Vehicle classes that exceed a determined pollution-per-kilometre limit can be directly prohibited from entering the zone, or they can be granted access during specific times, or for a fee. User charges are typically based on the class and rating of

[47] Ontario Ministry of Transportation, *Ontario Green Commercial Vehicle Program Guide* (2010). http://www.forms.ssb.gov.on.ca/mbs/ssb/forms/ssbforms.nsf/GetAttachDocs/023-05002E~3/$File/05001-2E_ProgramGuide.pdf

[48] Sustainable Development Technology Canada, *Sustainable Development Business Case Report: Transportation — Industrial Freight Transportation* (2009), 122. http://www.sdtc.ca/uploads/documents/en/BC_TRANS.pdf

vehicle as a proxy for the emissions rate, and these fees are most simply collected as part of the licensing process, but can also be tracked and collected using electronic devices.

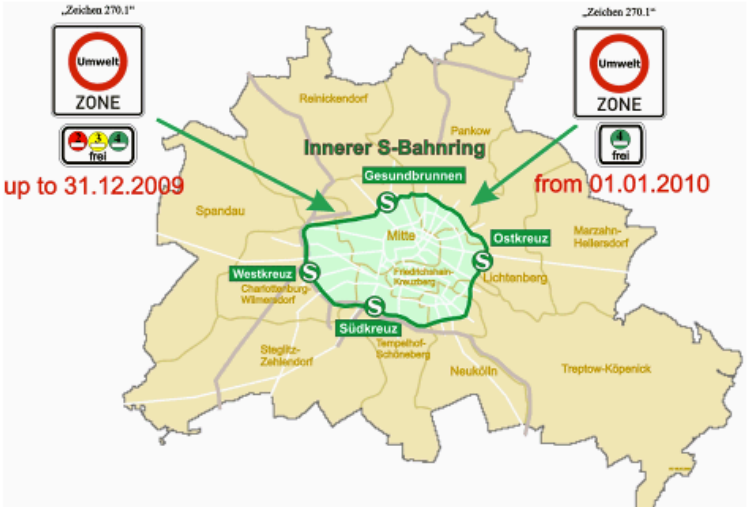

Figure 8 Berlin's low-emissions zone

Source: European Union[49]

Emission fees are generally found to have significant GHG reduction potential, as the monetization of emissions provides a very tangible driver for operational and technology change. Experience in Europe has shown positive trends in emissions reduction resulting from road pricing, either on all traffic or just freight traffic.[50] However, more research is needed to understand the economic impacts on the sector as well as the environmental benefits and potential for reducing emission.

In practice

The Distance Related Heavy Vehicle Fee in Switzerland charges a network use fee to all trucks over 3.5 tons, based on emissions, weight and distance travelled. The fee has resulted in a reduction in distance travelled by 6.5% despite an increase in both the average cargo weight (11%) and in total goods shipped (16.4%).[51]

Germany's Toll Collect is a GPS-based truck tolling system that has precipitated significant reductions in emissions. The system uses on-board devices to calculate tolls based on the vehicle's emission class, distance travelled and time of day. The cleanest engine class (Euro V)

[49] European Union, *Low Emission Zone in Europe: Berlin.* http://www.lowemissionzones.eu/countries-mainmenu-147/germany-mainmenu-61/berlin

[50] Genevieve Giuliano, Thomas O'Brien, Laetitia Dablanc,Kevin Holliday, *NCFRP Report 23: Synthesis of Freight Research in Urban Transportation Planning*, Transportation Research Board of the National Academies, (2013), 80-81.

[51] Nathaly Dasburg and Jarl Schoemaker, *BESTUFS II D5.2 Quantification of Urban Freight Transport Effects II.* (n.d.) http://www.bestufs.net/download/BESTUFS_II/key_issuesII/BESTUFS_Quantification_of_Urban_Feight_Transport_Effects_II.pdf

is charged 14.0–15.4 eurocents per kilometre, while the worst class pays 27.3–28.7 eurocents per kilometre.[52] The mileage travelled by Euro V trucks and EEVs has risen to 78%, while hardly any of the worst-rated vehicles remain on the road.[53] Revenues for the toll are redirected to improvements in various transportation sectors: 50% of revenues go to roads; 38% to rail; and 12% to waterway improvements.

How to implement in Toronto

Securing political and public support for pricing or user fees for road infrastructure in the GTHA remains difficult. Schemes such as carbon pricing, congestion charges and vehicle registration fees are politically and publicly unpopular.

However, there is a need for sustainable, long-term funding for transportation infrastructure in Ontario. There is also currently a public discussion about various funding tools for investing in transportation expansion. The public is being engaged through a variety of campaigns about revenue tools to fund transit solutions, and road tolls and taxes are part of that discussion. This may provide an opportunity in the near future to start a discussion about emissions pricing for commercial vehicles.

The Metrolinx GTHA Urban Freight Study does not include incentives and emissions fees as part of the 17 actions or strategic directions. Any fee that is put in place should be implemented across the province in order to avoid penalizing Toronto-area businesses, possibly by integrating it with vehicle registration. The City of Toronto could also explore road tolls on the Gardiner and Don Valley Parkway, or congestion charging or distance tolls within city boundaries. This would require significant investment and will be very challenging to implement, based on the recent debates for road pricing and transit funding tools.

[52] KFZ-Auskunft, "LKW Autobahnmaut - Mautberechnung." http://www.kfz-auskunft.de/info/lkw_maut4.html

[53] Toll Collect, "Truck Toll in Germany operating reliably," news release January 3, 2013. http://www.toll-collect.de/en/press/press-releases/truck-toll-in-germany-operating-reliably.html

3. Next steps for low-carbon delivery in Toronto

During the course of the project, stakeholders and experts have provided insights on how best practices for low-carbon urban freight could be put into action in Toronto. Developing comprehensive municipal policies that are more supportive of the freight sector was frequently mentioned, as well as the need for better freight data and analysis to support policies. There was also interest in innovative policies and new partnerships within the freight industry.

To encourage collaborations and to develop effective action on urban freight, the City of Toronto, local business, freight industry associations and the Province of Ontario can each lead one of the following three activities.

1. Toronto urban freight strategy

Why is it important to do? How will it help advance the six freight options in Toronto?

This report recommends a few priority actions that the City of Toronto can champion to improve freight deliveries in Toronto. Several of our consultations provided feedback on what the City of Toronto can do to demonstrate leadership and participate in discussions about urban freight, and include freight objectives in its planning and transportation policy mandates. Top best practices and priority actions that could be implemented in the next few years include:

- Collaborate with MTO on their Pan Am/Parapan Am Games off-peak delivery pilot, and if successful, continue the program after the games. A citywide off-peak deliveries strategy needs to include incentives for receivers and revisions to noise and truck route bylaws;
- Partner with Metrolinx, Peel Region and other GTHA regional municipalities to coordinate freight policies or develop a Smart Freight Association;
- Improve and enforce truck parking regulations, and increase the number of delivery zones in areas of high demand and where there are conflicts with other road users, such as along bike routes;
- Update land use planning and building standard requirements for deliveries and loading space, so that there is adequate space for home deliveries in condos;
- Dedicate resources and staff for better freight data collection and analysis, and develop data sharing agreements to support better ITS applications.

What's the timeline and path of implementation? Challenges?

In recent years, the City of Toronto has participated in a few regional and provincial level discussions about freight policy and regional planning. While the 2013 Downtown Traffic Operation Study is a step in the right direction, the City currently does not have a comprehensive set of policies to support urban freight. There are several opportunities to review and update the city's mandate surrounding freight, such as the current official plan review and Pan Am/Parapan Am Games to test and refine best practices, such as off-peak deliveries and consolidation.

Local businesses and the freight industry need to provide strong support to Toronto City Council to develop a clear strategy for supporting urban freight in Toronto. It took Peel Region — a North American leader in municipal freight policy and planning — close to 10 years to study, develop and implement a goods movement action plan, which required continuous support from city councillors and local businesses.

A first step to developing an urban freight plan is a council motion requesting a detailed study of the costs and benefits of implementing low-carbon goods movement policies in Toronto. It will require the collaboration of several departments including Energy and Environment, Transportation Services, City Planning, Public Health, Economic Development, Traffic Management Centre, Bylaw Enforcement and the Toronto Parking Authority.

2. Neighbourhood freight forums

Why is it important to do? How will it help advance the six freight options in Toronto?

In order to implement consolidation, off-peak deliveries and improvements in loading spaces, a forum is needed to bring together fragmented and independent businesses and clients to review and innovate their transportation practices. These forums could be organized by area, such as a BIA or ward, or by sector, such as the delivery of construction materials or local food.

Freight forums are a crucial low-carbon freight strategy because clients and freight receivers drive the majority of decisions about the time windows and frequency of deliveries, which then impacts where and when trucks travel in the City. Receivers and companies who have their own trucking fleets stand to gain significant cost and time savings from consolidating and reducing the number of deliveries.

What's the timeline and path of implementation? Challenges?

There are several ways of organizing and implementing this strategy. The first would be for a BIA or property manager to organize a freight forum for tenants and businesses to develop a delivery plan. A second option would be including discussions about freight strategies during existing city consultation as part of transportation studies or environmental planning, such as the planned consultations regarding local air quality studies in Etobicoke.

In each case a forum would facilitate a discussion about delivery schedules, identify local issues and challenges, and consider strategies that could reduce the number and frequency of deliveries. These forums could be organized on an ongoing basis with interested parties to develop and pilot freight improvements.

3. GHG impact and cost-benefit analysis of freight policies

Why is it important to do? How will it help advance the six freight options in Toronto?

The government of Ontario and Metrolinx should consider supporting GHG modelling and cost-benefit analysis of low-carbon urban freight strategies to help build the case for freight ITS applications, clean vehicle incentive programs and emissions fees policies. The visualization of urban freight movements and potential emissions reductions are another important component of urban freight plans, since they can help communicate and build support for urban freight policies. This analysis will also support the local freight policies implemented by the City.

Future research projects on the cost and GHG impact of freight policies could include:

- Modelling of GHG reduction potential of best practices, such as off-peak delivery and freight ITS;
- Cost-benefit impact analysis of emissions fees and incentive programs, as well as operational efficiency strategies;
- Mapping truck flows within Toronto including freight generation and demand hot spots (replicate the Peel Truck Maps, using MTO's iCorridor visualization tool);
- Infographic of the contribution of the freight sector to air quality issues and GHG emissions trends in Toronto.

What's the timeline and path of implementation? Challenges?

A framework for freight data collection was recently completed by the University of Toronto on behalf of Metrolinx. Data collected using this framework in the future will provide useful information for an impact analysis of urban freight policies. Furthermore, Metrolinx and MTO are trying to work with GTHA municipalities to collect better data on truck flows across the GTHA.

The City of Toronto or TAF could also work with NRCan to further encourage participation in the SmartWay program — a benchmarking and education program for reducing emissions of trucking fleets — to encourage more operators to green their fleets and share lessons learned. SmartWay has technical expertise that would be helpful in building the business case for incentive programs.

Appendix A. Stakeholder insights

Feedback and comments from consultations and workshops

The following insights were collected during our consultations with local and international freight experts:

- Clients drive the best approaches for strategies such as consolidation. These strategies will not succeed at the freight operator level because of higher warehousing costs.
- Most freight companies have efficient operations, but seldom collaborate with other companies to improve the overall operations. This leads to inefficiencies and redundancies in the goods movement sector.
- There are several new technologies and strategies available to improve transportation network efficiency, such as connected vehicles and intelligent traffic management systems. These same technologies can also reduce emissions.
- There is a need for improved infrastructure for freight. This does not necessarily mean more roads, but better intersections, geometries, parking and access to loading docks.
- Systematic freight data is missing in many jurisdictions in North America, which makes it hard to ascertain the impacts and benefits of best practices. A freight data collection framework for the GTHA was recently completed, and it has made recommendations to improve the quality of information about urban goods movement.
- Greater coordination of government regulations is needed, along with a stronger freight governance system to support companies, especially at the municipal level. These need to be implemented in a fair manner to ensure that those who comply are not disadvantaged.
- High volumes of truck travel can impact local air quality and health. It is important to address local concerns about increased pollution from truck routes when designing best practices.
- These strategies need to be enabling business, not disabling it.
- Road space management is an issue, and not just in the downtown. Land use planning and building design changes are needed.
- Clarify the uses for freight data to bolster support and investment in its collection and dissemination.
- Freight issues and solutions need to be better researched and communicated to the public, businesses and decision makers.
- Partnerships between government and industry are essential for any freight strategy. For example, the City of Toronto should work with Peel Region to expand some of their initiatives to Toronto.
- Partnership is the key model for any strategy.
- The city and province must provide a plan and leadership, then businesses will be able to respond.
- Freight clients make most decisions about freight deliveries. Some strategies will save clients money, and others will add costs — a successful pilot will need to address this.

- Bring together city staff to understand how freight issues affect each of their areas, and then relay the opportunities to councillors.
- A public campaign to help understand the issues of trucking is also needed.
- Talk about market transformation potential as well as strategies that have the biggest bang for the buck.
- Be mindful of business improvement areas and smaller companies — don't disrupt or undermine local businesses.

Appendix B. List of experts

Consultation Round 1	Organization
Anthony Caruso, Becky Upfold	Metrolinx
James Perttula, Toni Memme	Ministry of Transportation
José Holguin-Veras	Rensselaer Polytechnic Institute
Matthew Roorda	U of T, Civil Engineering Department
Murray McLeod	
Andrew Craig	Royal Bank of Canada
Paul Sawtell	100km Foods
Don Moore	Canadian Trucking Equipment Association
Mehdi Nourinejad	MASc student, U of T
Fang Su	MASc student, U of T

Consultation Round 2	Organization
John Kiru	TABIA
Stephen Laskowski	Ontario Trucking Association
Bob Burrows	G4 Apps
Stacey Hodge	Director, New York Office of Freight Mobility
Henry Orlowski	Eaton Centre - Cadillac Fairview
David Hunter	City of Toronto Transportation Planning
Paul Sabo	City of Toronto Transportation Services
Julie Sommerfreund	Toronto Public Health
Cecilia Fernandez	Energy and Environment Office
Manjit Kerr-Upal	Natural Resources Canada - Smart Way

Workshop Participant	Organization
Paul Sawtell	100km Foods
Henry Orlowski	Cadillac Fairview
Cecilia Fernandez	City of Toronto
Leslie Domenico	CivicAction
Janice Solomon	Downtown Business Improvement Area
Bob Burrows	G4 Apps

Michael Holland	IKEA
Mark Hayward	
Tom AppaRao	
Richard Koroscil	Korlon Strategic Services Inc.
Anthony Caruso	Metrolinx
Kitty Chiu	Metrolinx
Maheen Memon	Nulogy
Julius Gorys	Ontario Ministry of Transportation
Matthew Verrall	Ontario Ministry of Transportation
Jonathan Blackham	Ontario Trucking Association
Eli Angen	Pembina Institute
Alexandra Goldstein	Region of Peel
Kathryn Dewar	Region of Peel
Bob Dale	Royal Bank of Canada
John Kiru	Toronto Association of Business Improvement Areas
Julia Langer	Toronto Atmospheric Fund
Mary Pickering	Toronto Atmospheric Fund
Rebecca Mallinson	Toronto Atmospheric Fund
Julie Sommerfreund	Toronto Public Health
Murray McLeod	Transportation Performance Solutions
Jay Sarwar	Urban Express
Andrew Kornel	Walmart

Appendix C. Alternative options

Options reviewed at stakeholder workshop

Strategy	Total Votes
Update parking policies for deliveries	14
Delivery coordination plans	14
Off-peak deliveries	12
Transportation information systems for urban freight	10
Consolidation centres by sector	7
Recognition of low-emissions freight operators	6
Rebate for low-emissions retrofits	3
Low-emission zones	2

Full list of freight options researched

Low-carbon freight options	Potential GHG emissions reduction	Applicable in City of Toronto
Traffic management and infrastructure		
Publish a comprehensive truck routing map for Toronto	Low	Yes
Manage traffic congestion through strategic road pricing	High	Yes
Implement intelligent truck traffic management	Low – Medium	Yes
Develop ITS systems for dynamic routing or to reduce backhaul	Low – Medium	Yes
Develop intelligent lane utilization programs	Low	Yes
Install truck lanes on highways or existing utility rights-of-way	Low	Maybe
Optimize operations and trip reduction		
Increase flexibility in business operating hours	Low	Unsure
Create incentives for off-peak deliveries	Low	Yes
Create delivery service plans	Low	Yes
Designate short-term curbside parking and delivery lanes	Low	Yes
Identify opportunities to establish package drop-off stations	Medium	Yes

Replicate hospital system of “just-in-time” deliveries with off-site receiving	Low	Maybe
Consolidate deliveries by sector	Low	Maybe
Establish GTHA or Toronto freight villages	Low	Limited
Emission regulations and policy		
Provide information on GHG and energy savings technology, including fuels and lubricants and operations (driving, maintenance etc)	Medium	Yes
Offer green fleet recognition program	Low – Medium	Yes
Set maximum GHG/km (or GHG/tonne km) to be allowed in city	Medium – High	Yes
Set tolls that reflect GHG emissions	Medium – High	Yes
Regulate specific technology	Variable	No
Low-carbon technologies		
Move freight on rapid transit	Medium – High	Limited
Encourage EV bike delivery	Low	Yes
Establish a Vehicle Technology Assurance Group to provide rapid technology verification	Low – Medium	No