# MEASURES TO REDUCE GREENHOUSE GAS EMISSIONS FROM URBAN GOODS MOVEMENT – A REVIEW OF CURRENT INITIATIVES

Brian Hollingworth, IBI Group
Lee Sims, IBI Group

## Introduction

The movement of goods, particularly in urban areas, represents a growing and significant portion of Canada's overall greenhouse gas (GHG) emissions. In addition to environmental consequences, the growing number of commercial vehicles in urban areas results in increasing levels of congestion, which negatively affects Canada's competitiveness and overall quality of life.

Until recently, there has been limited attention on reducing GHG emissions from the movement of goods in Canadian cities through changes in transportation patterns and distribution systems. Rather, the emphasis has been on implementation of fuel saving technologies and on measures to improve driving practices. While there have been some initial efforts to understand the extent, patterns and impact of urban goods movement in a number of jurisdictions, there remains significant work to be done to fully understand the extent to which various measures might reduce GHG emissions.

Recognizing this gap in research, the Surface Policy Directorate of Transport Canada commissioned a review of measures to reduce GHG emissions resulting from the movement of goods in urban areas. The objectives of this review were to:

- Improve the understanding of recent policy and program approaches to reduce urban goods movement GHG

emissions through changes or improvements in goods movement systems and practices in Canada, the U.S. and other comparable jurisdictions; and,

- Gather general information that may be used for more detailed analysis of various efficiency measures.

The remainder of this paper presents the results of this review which is composed of two components: a general literature review and a more detailed examination of case studies which may be relevant to the Canadian context.

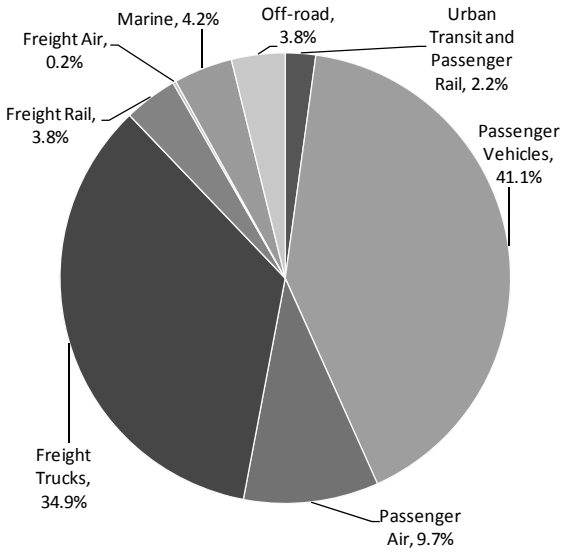
**Context on Energy Use and GHG Emissions from Urban Goods Mo vement**

In 2008, the transportation sector produced approximately 180 megatonnes (MT) of GHG emissions representing 37% of Canada's GHG output from all sources (Natural Resources Canada, 2011). Of this, approximately 77.5 MT or 43% is attributable to freight movement. As shown on Figure 1, trucks account for the largest percentage of GHG emissions from freight movement.

Although it is difficult to estimate the magnitude of freight GHG emissions that are attributable to "urban" goods movement, it is reasonable to assume that a large portion takes place within urban areas, or is generated by activities within urban areas.

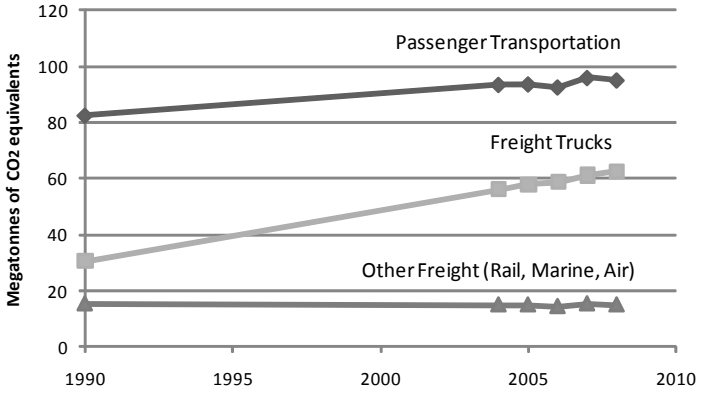
One trend that is certain is that GHG emissions from freight have been increasing rapidly. Between 1990 and 2008, GHG emissions from freight movement increased by 70% whereas emissions from passenger transportation increased by 15%. As shown on Figure 2, the fastest rate of growth occurred in the trucking sector, which is the primary means of moving goods in urban areas.

**Figure 1: GHG Emissions by Mode of Transportation (2008)**




Source: Based on data from Natural Resources Canada, Office for Energy Efficiency

**Figure 2: Change in GHG Emissions by Mode (1990-2008)**




Source: Based on data from Natural Resources Canada, Office for Energy Efficiency

**Overview of Current Activities Relating to GHG Emissions and Goods Movement**

***Canada***

In the late 1990's the Climate Change Collaborative Initiative undertaken by the Federal government generated a significant body of research on transportation and GHGs. Several studies were prepared on freight modes but most of these focused on intercity movements or technology.

Since the 1990's most work has focused on gateways and specific regions including:

- Pacific Gateway (Greater Vancouver)
- Continental Gateway (Greater Toronto, Greater Montreal)
- Atlantic Gateway (Halifax)

In general, efforts have focused on congestion mitigation, data collection and economic considerations.

One of the reasons why research and related actions on GHG reduction from goods movement has been hindered is due to a lack of data. In particular, the challenge with describing goods movement in urban areas is that they are heterogeneous and are the manifestation of many diverse influences of market forces responding to different needs. In the analysis of goods movement there is a considerable amount of reference to logistic chain, however, in looking at urban goods movement it is also important to look at the consumption chains, the linkage between consumers purchasing a good, using it and, if necessary, disposing of it at the end of the life cycle.

***United States***

Goods movement planning activities in the United States are similar to Canada. The primary focus has been on optimizing goods

movement infrastructure (e.g. eliminating bottlenecks), reducing public health and environmental impacts and addressing air quality, as governed by federal legislation.

Until recently, greenhouse gas emissions reduction was not a motivating consideration. Much of the research around reducing GHG's from urban goods movement has occurred at the state, NGO, or "think-tank" levels.

***International***

In many European countries, urban goods movement is featured to a greater extent in overall GHG reduction strategies than in North America. Even as far back as the late 1990's in the OECD Environmentally Sustainable Transportation Study involving seven countries, Germany and the Netherlands showed a far greater willingness to tackle GHG emissions from freight movements than North American counterparts (OECD, 1998). Land use may explain some of the differences; North America is much less compact, however, based on the literature, there seems to be a greater willingness to experiment with innovative options. In addition, goods movement data in Europe is more robust, providing greater opportunities to analyze potential solutions.

**Review of Initiatives to Reduce Urban Goods GHG Emissions**

The primary motivation of this research was to identify recent national, provincial/state and municipal policies, programs and initiatives that have been developed to reduce urban goods GHG emissions. To accomplish this, three main types of developments were examined:

- Policies that have been suggested or put in place under various jurisdictions;
- Specific measures such as regulations, taxes or subsidies which have been applied; and

- Demonstration projects that have been introduced with respect to urban goods movement.

In general, most policies, programs and initiatives can be grouped around the following themes:

- Support and coordination
- Policies and regulations
- Land use and urban design
- Mode shift and demand management
- Technology and logistics

***Support and coordination***

Urban goods movement is primarily a function of private sector transactions. While data collection and research provide the basis for GHG reductions, one has to know what is being emitted and by whom before effective mitigation can take place. The literature reveals there is a significant role to be played by government and industry in leading, coordinating and in some cases financing improvements in urban goods movement. Support and coordination projects are not usually tied to achieving measurable specific GHG reduction targets, rather they recognize the importance of creating an atmosphere where change can take place. In particular, providing case studies and trial projects allows companies to understand the potential costs and benefits to their enterprises.

In Europe, the premier program and resource for support, coordination and information sharing on urban goods movement is the BEST Urban Freight Solutions (BESTUFS) program. Started in 2000 for a period of four years, the project is still ongoing in 2010. The aim of the project is to identify and disseminate best practices with respect to urban freight transport. As a thematic network, BESTUFS does not aim to start new projects but rather collect and analyze new and emerging projects to provide case studies and data for further work. Much of the work has been focused on projects shifting freight from roads to water. Quantifying urban freight deliveries and their associated environmental impacts is also a focus.

Within Canada, the Greening Retail Program initiated by the Toronto and Region Conservation Authority and other stakeholders is a private sector focused best practices sharing network. Greening Retail undertakes research, develops resources and programs, and facilitates demonstration projects to help retailers implement environmental best practices.

Case Study: Smartway Freight Transportation Partnership

The Smartway Freight Transportation Partnership by the US Environmental Protection Agency was launched in 2004. The SmartWay brand essentially identifies products and services that reduce transportation-related emissions. The Smartway Partnership brings key freight shippers, trucking companies, railroads, logistics companies and trade/professional associations together to implement practices that will create mutually beneficial energy savings and reductions in emissions. The program also offers tools and resources to help shippers and carriers reduce emissions and improve fuel efficiency. Strategies range from improved logistics to idling reduction strategies.

The Program estimates that by 2012 ground freight transportation in the United States will consume over 45 billion gallons of diesel fuel and produce over 450 MT of carbon dioxide—a 25% increase over 2004 levels. Ultimate goal of the Smartway program is to reduce between 33 and 66 MT of $CO_2$ emissions per year (EPA, 2010).

***Policies and Regulations***

Urban goods movement is primarily driven by commercial sector supply and demand, but it is subject to a wide range of government rules and regulations. The regulatory structure is primarily a municipal framework of local bylaws and programs under the umbrella of regional, provincial and national plans and policies. The Federation of Canadian Municipalities (FCM) estimates that Canadian local governments have direct or indirect control (influence) over 44 % of the country's GHG emissions (FCM, 2009).

US based research confirms that GHG reductions can only be successful with local government participation (Cut & Carter, 2010).

All Canadian provinces require local governments to undertake various land use and development planning exercises including transportation planning however there are often no specific requirements that these plans address urban goods movement. A recent review of transportation plans in Canada's largest cities indicates that there is an explicit planning focus on decreasing traffic congestion in cities (especially the downtown core), shortening commuter and delivery trip distances, and reducing pollution. In particular, policies are generally being designed to reduce delays in traffic flows on both arterial and major throughways, especially in and near residential areas. The two most widely cited reasons for this policy direction are the needs to improve neighbourhood vitality and to reduce carbon emissions (Haider, 2009).

One European approach to addressing emissoins from urban goods movement is to implement Low Emission Zones (LEZs). LEZs are areas in urban cores where the most polluting vehicles are restricted from entering an area. This means that vehicles are banned, or in some cases charged, if they enter the LEZ when their emission rates are over a set level. The bans generally apply to vehicles over 3.5 tonnes though some, such as the London City Centre Congestion Zone, also apply to most cars. These types of regulations have a larger impact on improving air quality than reducing GHG emissions. However, since these schemes usually result in fewer vehicles and better traffic flows, there would be some reduction in GHG emissions.

Case Study: Port of Los Angeles

The Port of Los Angeles has established a number of regulations and policies aimed at reducing GHGs including a clean truck program involving a progressive ban on older trucks, and an electric truck program involving the use of 25 electric trucks for drayage operations.

The Port of Los Angeles Harbor Department has also developed a strategy to reduce GHG emissions from internal activities, although this does not extend beyond the activities within the site. In other words, there is no acknowledgement of the GHG impacts of global shipping activities.

***Land Use and Urban Design***

Land use patterns and urban design, or the built form of a city, can have an impact on reducing GHG emissions from urban goods movement by supporting the efficient delivery of goods. The literature includes projects such as provision of loading docks and drop off zones and the implementation of freight consolidation centres under this theme. Haider's recent study (2009) of express or courier package deliveries in downtown Toronto revealed little consideration for the infrastructure needed to support this type of delivery. Building owners did not seem to have a high level of interest in offering loading zones or docks that could support express deliveries. This is of considerable importance given that Haider's study revealed there are approximately 80,000 express packages delivered in a one square kilometre traffic analysis zone of downtown Toronto on any given day.

Carter and Culp (2010), in their study of local government projects and policies that can reduce GHG emissions, estimate that state climate action plans for western US states typically contain 30 to 60 quantified policy options for reducing greenhouse gas emissions. Of these, approximately a dozen relate to land use planning and local government action, typically accounting for about one-fifth of total greenhouse gas reductions. These policies could include changes to transportation networks and land use for more efficient goods movement.

Just as with policies and regulations, there is no one answer for urban design solutions that will support the efficient delivery of goods. In general, the literature shows a lack of consideration for land use and urban design tools aimed at urban goods movement. Converesly, many communities have invested considerable effort using zoning

and urban design tools to create more sustainable residential communities. These typically include higher density housing, pedestrian and bicycle facilities, and mixed residential-commercial uses to encourage shopping and living in the same neighbourhood. While these programs have underlying motivations to reducing GHG emissions, most are silent on goods movement.

Case Study: DHL Packstation

Packstation is a service run by DHL Parcel Germany providing automated booths for self-service collection of parcels and oversize letters as well as self-service dispatch of parcels 24 hours a day, seven days a week. Booths are located within shopping areas and near residential communities. The idea is that GHG savings result from fewer deliveries to individual homes, and fewer missed drop-offs. The service also offers users to purchase carbon off-sets.

Although the GHG savings have not been quantified, DHL has approximately 1 million customers in Germany suggesting the impacts could be measureable (DHL, 2010).

***Mode Shift and Demand Management***

In Canada, the United States and Europe there are several studies examining mode shift from road to rail or water as a way of improving the efficiency of the transportation chain and in some cases mitigating GHG emissions. For example, Transport Canada commissioned a major modelling study in 2007 examining the factors that influence shippers' mode choice in the Quebec-Windsor Corridor.

In general, mode shift studies involve transportation hubs such as ports and generally cover long distances. While intermodal goods movement offers options for long distance trips, receivers are often distributed throughout the urban area and are only connected by road. In other words, the last-mile nature of urban goods movement means that it is almost exclusively limited to trucks. The only broad based exception would be bicycle couriers. Even if goods are moved long-

haul on rail or via waterways, the truck linkage to a local urban distribution centre is an urban issue.

Given the dominance of trucks for urban goods movement, the literature is largely silent on alternative mode options. However, there are some examples from Europe that demonstrate innovation:

- A tramway in Dresden, Germany supplies parts for an urban assembly plant from a factory just outside of the city.
- The Paris France based La Petite Reine bicycle courier service utilizes cargo bikes with a 1,500 litre capacity. It is reported to make some 2,500 deliveries every day for clients including DHL, ColiPoste and Monoprix.

Case Study: Monoprix Urban Rail

Monoprix is a privately owned company that operates 300 stores in France. In 2004, a partnership was established to develop a rail to CNG fueled truck distribution system. From Monday to Friday, a railroad shuttle uses the regional express rail tracks to transport goods from the warehouses at Combs la Ville and Lieusaint to the Gabriel Lamé Hall where goods are unloaded, sorted out by stores and transferred to trucks that use natural gas for final delivery to Paris locations.

The CNG trucks used by Monoprix produce 33% fewer GHG emissions than those they replaced (Jacobs and Smits, 2009).

***Technology and Logistics***

A survey by the Supply Chain and Logistics Association of Canada and Industry Canada (2008) examining green supply chain management strategies for logistics and transportation services from a Canadian perspective concluded that, for green technology initiatives to be successful, environmental benefits and a positive financial result for the service provider must both be achieved at the same time. While the study was not strictly focused on urban goods movement, it still provides some background on the drivers behind technology

adoption and the types of tools being used to achieve GHG emission reductions. Best-in-class Canadian transportation businesses look towards anti-idling programs, energy efficient vehicles and green dashboards that monitor the vehicle and driver performance to support the reduction of GHGs.

The literature also reveals a range of tests projects on the applicability of alternative fuels. Test projects include hybrid-electric, complete electric, compressed natural gas (CNG), biodiesel and ethanol to list some of the most common. Fleet based transportation companies are usually in the best position to test alternative fuels because they can hold some of their vehicles as test cases while switching others and still keep the vehicles operating on comparable routes. Fleets with a large range of vehicle types on set routes – such as couriers – are very well placed to test and in the end benefit from new fuels. A large percentage of their operating costs are fuel, so reducing these costs is paramount to their long-term success. Courier companies also operate in many different settings and climates so their can test fuels where is appears there is the most to be gained. Both UPS and FedEx, two of the largest courier companies, have several tests on-going tests in various markets. They are also constantly testing routing technology to improve their operations.

Ryder Trucking, a large US based carrier, utilizes RydeSmart, a GPS fleet location, tracking and vehicle performance management system. The system allows Ryder to refine route design, detect engine inefficiencies and measure driver performance and vehicle efficiency by monitoring speed, hard breaking and idling. RydeSmart uses Teletrac software and PanaStream's instructional service. This system has reduced fuel consumption and the associated GHG emissions between 10% and 15% per truck per day (Denning & Kustin, 2010).

Case Study: UPS Alternative Fuels Fleet

UPS is a major LTL delivery company with a fleet that includes more than 1,900 alternative fuel vehicles including: hydraulic hybrid, hybrid electric vehicles, fuel cell vehicles, liquefied natural gas (LNG), compressed natural gas (CNG), electric vehicles, and propane

powered engines. They approach the introduction of new technologies by using their fleet as a rolling laboratory. Technologies are introduced in large enough groupings in specific geographic areas where the delivery patterns, geography and climate will likely provide the best return on investment.

Emission reduction numbers are not available for all projects but there are two examples illustrate the potential. In 2007, UPS deployed 50 third-generation hybrid electric vehicles in Atlanta, Dallas, Houston and Phoenix. These vehicles promise a 40 % improvement in fuel economy over the vehicles they are replacing. resulting in a reduction in $CO_2$ by 457 tonnes annually. In spring of 2008, UPS announced an order for 200 hybrid electric vehicles - the largest commercial order of such trucks by any company. The new HEVs will be deployed in 2009 and are expected to $CO_2$ emissions by 1,786 metric tonnes each year (UPS, 2010).

**Conclusion and Future Research**

This paper has presented a high level review of recent literature and case studies aimed at reducing greenhouse gas emissions from urban goods movement. This review revealed a number of initiatives ranging from broad policy studies to localized technology and modal shift options. However, what appears to be lacking is the reporting of quantitative information on the GHG outcomes of any initiative, particularly in terms of the "net" impacts. For example, do improvements in efficiency result in absolute reductions in GHG emissions or do they simply off-set growth? Very few studies or examples were found that acknowledged the need to de-couple freight movement from economic growth, and the associated GHG impacts.

Looking ahead, it is reasonable to expect that the number of pilot projects that have been started in North America in the past few years will result in improved data on GHG reduction potential so as to inform future decision making processes.

In the Canadian context, and from the themes and lessons presented, this review also raises several areas for additional research:

- Methods to increase cooperation and coordination between levels of government to achieve reductions in GHG emissions from urban goods movement;
- Collection of data and development of tools to support the evaluation of different measures in terms of the short and long term potential for GHG reduction; and,
- Better understanding of the key stakeholders that are best able to tackle reducing GHGs from goods movement;

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