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Transportation – The Way We Move

This is part one of a two part Environment and Energy Bulletin that will explore the topic of transportation. In part one we focus on the context, statistics and some key issues that set the stage for part two, a discussion of policy options and possible directions for managing transportation and related infrastructure issues going forward.

If GM had kept up with technology like the computer industry has, we would all be driving $25 cars that got 1,000 MPG. (Bill Gates)

New motor vehicle sales up by 8.9% between 2012 and 2013. (Statscan, July 2013[1])

At the most basic level people are made to move and, if you think about it, a lot of auto-body functions are about moving. At first we were running away from being dinner; now we run for pleasure. Then we used our brains to invent easier ways of getting around on earth and eventually to explore the solar system on rockets. People have always been inventing ways to move – faster, further and with more ease – all of which requires energy.


CYCLE AND AUTOMOBILE TRADE JOURNAL

The Ford Line
for 1908

AS PER USUAL—will eclipse everything else.

AGENTS ARE ANXIOUS to learn what it is to be—we are our copyist competitors, and we are not telling.

ALL THE PRESENT MODELS will be obtained—every one is a world-beater in its class—not one, has a rival to-day; nothing others can bring out in 1908 can possibly compete in quality and price.

THE FORD SIX—the car that made the fame of sixes and compelled 27 unwilling makers to follow its lead, will still be made in the

...any,

Starting with the wheel in the 4th millennium BC, we graduated over a long period of time to the now ubiquitous personal vehicle. 1866 is the year noted as its birth; the inventor of record was Carl Benz. The first affordable option was introduced by Henry Ford in 1908 – the famous Ford Model T, priced at $825 (~$21,000 in today's dollars). In the first year of production 10,000 were sold. Four years later, prices had dropped to $545 (1912) and by 1914 Ford had 48% of the US vehicle market.[2] Now there are about 50 major manufacturers globally, who produced 84 million cars and commercial vehicles in 2012,[3] adding to a global vehicle fleet that's already in excess of 1 billion.

At the turn of the last century, the car was a luxury item for most people; now it provides an essential service for hundreds of millions of households. It's not only a practical tool of everyday life but a status symbol. Furthermore, and without exception, the transportation of goods and services is fundamental to the functioning of any modern economy – locally, nationally, and globally.Refined petroleum products are the "blood" that keeps it all running. In fact, "transport is assumed to be a key factor of the economic level achieved by a region ... [and] … it is fairly [well] established that historically, the growth of freight transport has accompanied economic growth."[4]

[1] Statistics Canada

[2] "Henry Ford Changes the World, 1908," EyeWitness to History

[3] Organisation Internationale des Constructeurs d'Automobiles, World Motor Vehicle Production

[4] Correlation between Transport Intensity and GDP in European Regions: a New Approach, Garcia, Levy, Limão, and Kupfer, 2008

What Is the Issue?

Mobility and access to goods and services are necessary to meeting human needs and satisfying the widespread desire to attain a high standard of living. Transportation systems along with energy systems have therefore become a backbone of social and economic development, so much so that the transport sector is currently the biggest global consumer of oil and oil products and is projected to account for almost all (97%) of the increase in world primary oil use by 2035.[5] This is largely a result of an ever expanding vehicle fleet, which is expected to reach 2.5 billion by 2050.[6]

While we derive significant social and economic benefits from transportation, there are also costs that must be considered. For the most part we understand the direct costs of transportation – construction of infrastructure, manufacturing costs and the retail value of vehicles sold, gasoline prices, etc. – but we are less clear on the indirect and cumulative costs to local communities, human health and the environment. This is, in part, because indirect impacts often deal with non-market goods and cannot easily be monetized. The issues are multidimensional and complex, cutting across a myriad of public policy responsibilities, including urbanization, equity, climate, energy security, taxation, health and environmental protection.

From BC's perspective, the province's legislated GHG reduction target of 33% of 2007 levels by 2020 and 80% of 2007 levels by 2050 is problematic. Industry, including the oil and gas sector, is responsible for 37% of BC's GHG emissions.[7] However, because large point sources of emissions are in the business sector, they are often the primary focus of reduction efforts and policy-makers' concerns.

In equal measure, transportation is responsible for 38% of BC's total GHGs, but given the non-point source nature of these emissions, the options for managing them are more challenging and limited. As a result, relatively little attention has been given to the sector as a whole and to the individual's role.

The climate change actions BC has taken include measures to expand transit (this is largely a Lower Mainland set of investments), support for gateway-related infrastructure, implementing low-carbon fuel standards, and some technology promotion. Fuel efficiency standards are beyond provincial jurisdiction and are being dealt with by the national government. The province does have authority over air quality standards, which can be helpful, indirectly. However, as discussed in the Business Council's September 2012 paper, "Air Quality Regulation: Canadian and BC Developments," adopting more stringent regulations, when recent indicators of air quality point to continued improvements (except for a few localized issues), could accelerate deindustrialization.

Overall, there is little scope to achieve further point-source reductions of industrial air pollutants in BC. Adding more costs may jeopardize competitiveness and/or undermine the ability to use our energy endowment to foster economic development and greater prosperity. Investment in public transit is expensive, often controversial and largely an urban and regional set of activities that require all levels of government to cooperate. Overall, looking at long-term behavioural change and shifts in urban design is a must if policy-makers want to mitigate the environmental impacts of transportation. However, alterations to habits and existing ways of doing things are difficult to engineer, especially in a sector so deeply embedded in our economic, social and cultural psyche; but it is necessary to identify and pursue opportunities in the transport sector to improve the efficiency of energy use and reduce emissions.

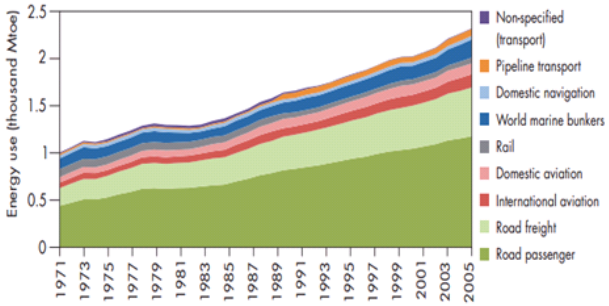
[5] World Energy Outlook, 2012
[6] OECD's International Transport Forum
[7] This figure excludes transport emissions related to industrial activity.

Statistics – What the Data Says

Global Data

Globally, transportation is a major driver of both energy consumption and greenhouse gas emissions – 19% and 23%, respectively.[8] Since the 1970s, transportation's share of worldwide energy consumption and GHG emissions has risen from roughly 1 billion tonnes of oil equivalent (Toe) to 2.5 billion Toe per year, owing largely to population growth, expanding vehicle ownership and use, economic growth, and the predominant reliance on road freight for moving goods.[9] Taken together, relative to 2010 levels, global passenger and freight travel is expected to double by 2050, with 90% of the increase occurring in non-OECD jurisdictions.[10]

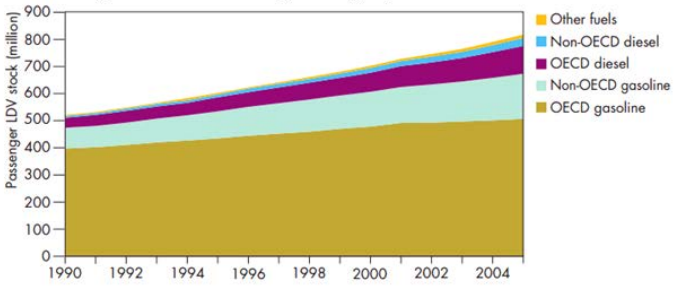
Figure 1 – World Transport Energy Use by Mode (1971-2005)



Today, personal cars, trucks, mini-vans and SUVs (collectively known as Light Duty Vehicles, or LDVs) account for about half of global transport energy use.[11] Figure 1 shows that the share of road passenger vehicles in world energy use has increased over time; and the number of passenger vehicles on the world's roads has risen by 13% since 2006.[12] As per capita income has increased in countries like China and India, so has car ownership and total kilometers driven.[13]

Following the current path will lead to a global stock of LDVs of 1.7 billion in 2035,[14] up from 800 million in 2005. In tandem with the growth of personal transportation is the continued expansion of road freight. The demand for fast, reliable, smaller, "just-in-time" and door-to-door shipments has contributed to a sharp rise in energy use for freight transport.[15]

Figure 2 – Number of Passenger LDVs by Region and Fuel



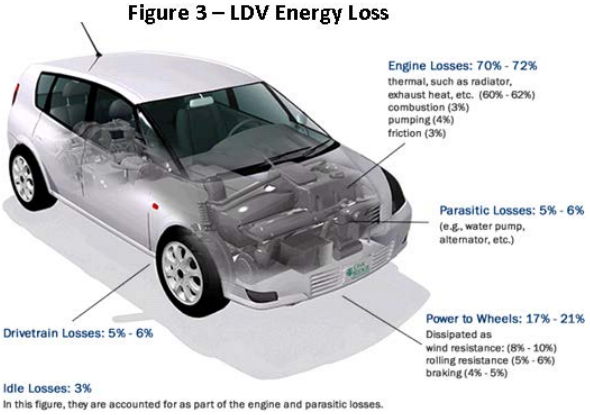
Source: IEA Mobility Model database.

Despite growing demand in developing countries, OECD countries are still the biggest consumers of energy for transportation, accounting for almost 60% of current world demand (see Figure 2). However, as non-OECD countries continue to develop and grow richer, their share of world transport-related energy demand is expected to climb steadily and eventually will surpass that of the OECD countries.

Not surprisingly, transportation-related GHG emissions are "projected to increase by nearly 50% by 2030 and by more than 80% by 2050,"[16] compared to 2006 levels. Overall, because of the small size of LDVs and the inefficiencies of internal combustion engines, road transportation has a "significantly higher environmental footprint than others modes."[17] Figure 3[18] shows the energy losses from modern-day LDVs.

[8] IEA, Transport, Energy, and CO2 , 2009
[9] See footnote #8
[10] Transportation Infrastructure Insights, IEA, 2013
[11] See footnote #8
[12] Ward's Automotive Group, 2011
[13] United Nations Statistical Yearbook, 2005
[14] See footnote #8
[15] Global Energy Assessment, Energy End-Use: Transport Chapter 9
[16] See footnote #8
[17] Transport Canada, Road Transportation 2011
[18] US Department of Energy, Office of Transportation and Air Quality

Figure 3 – LDV Energy Loss



Considering the projected increases in vehicle ownership and in kilometers travelled in non-OECD countries, and the transport sector's heavy reliance on fossil fuels, transportation will put significant quantities of carbon dioxide into the atmosphere in the foreseeable future. This is in addition to carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3) sulfur dioxide (SO_2) and particulate matter ($PM_{2.5}$) emissions, along with land use impacts from expanding infrastructure requirements (changes in land use, soil quality), water effects (run off, marine, potential for oil spills), dredging, and noise.

Canadian Data

Canada's vast geography and relatively small and scattered population make transportation a vital part of our everyday lives—it connects family, friends, and businesses, and moves goods and services that are central to our economic well-being. In terms of GDP, transportation accounts for 10.2% of Canadian economic output ($175 billion in 2011).[19] Personal expenditures on transportation represent three-quarters of this total, and grew by 5.2% between 2010 and 2011.[20]

The transport sector is the single largest user of energy in Canada; in 2010, it accounted for one-third of total energy use.[21] Transportation also produces about one quarter (24%) of Canada's greenhouse gas emissions.[22] Interestingly, the transport sector's share of energy use in Canada is roughly 14 percentage points higher than the international average.[23]

In 2008, on-road passenger travel accounted for 55% of the energy used in Canadian transportation and for 45% of the transport sector's GHG emissions. Conversely on-road freight accounted for 41% of transport-related energy use and for 37% of the sector's emissions.[24] Together, these two modes thus generate more than four-fifths of Canada's transport-related GHGs.[25]

Canadian transport-related GHG emissions grew significantly from 1990 to 2005, rising by 33% (42 Mt Co_2e), but since 2005 emissions have edged down by 2.3% (4 Mt of CO_2e),[26] largely due to the effects of the 2008/09 recession and increasing fuel efficiency in LDVs. The recent decrease in

More Roads, Please

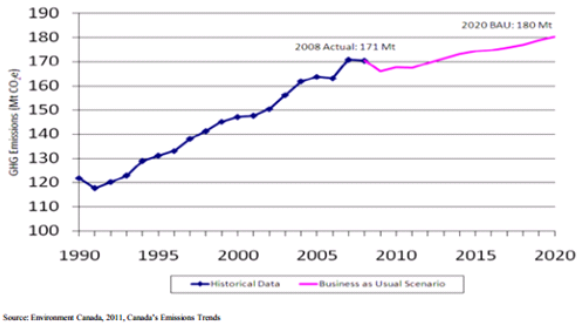
As demand for transportation continues to rise, it will place an increasing strain on global infrastructure. Road infrastructure in particular will play an important role in meeting demand:

- Total paved roads in the world (2009): 42 million km (two-lane equivalent)
- Total paved roads in Canada (2011): 416,000km (two-lane equivalent)
- Estimated number of roads required to meet demand by 2050 (under the current trajectory): 25 million.
- By 2050, infrastructure for roads, rail, and parking is expected to account for between 250,000 km^2 and 350 000 km^2 of built surface area—about the size of the United Kingdom and Germany, respectively (IEA, 2013).

[19] Transportation in Canada 2011 Statistical Addendum
[20] Ibid
[21] Ibid
[22] Canada's Emissions Trends 2012
[23] This is likely due to Canada's high per capita use of energy in the transport sector compared to the global average.
[24] Canadian Energy Demand: Passenger Transportation
[25] See footnote #19
[26] See footnote #22

emissions, however, is likely to be short-lived. Transport Canada estimates that under a business as usual scenario, transport sector GHG emissions will increase by 9 Mt (CO_2e) to reach 180 Mt (CO_2e) by 2020.[27]

Figure 4 – Total Transportation Emissions All Modes, 1990 to 2020



The National Energy Board predicts that on-road freight will be the main contributor to future increases in transportation energy demand, and that the related emissions will grow at an average annual rate of 1.9% through 2035.[28] At the same time, on-road passenger travel is projected to grow at only half the rate of on-road freight, despite more motor vehicles in use and more vehicle-kilometers travelled.

The environmental impact of passenger vehicles will be reduced with the implementation of the federal *Passenger Automobile and Light Truck Greenhouse Gas Emission*[29] *Regulations*, which are slated to come into effect for the 2017 model year (see Figure 5).[30]

On a per capita basis, the typical Canadian devotes 15% of her/his personal expenditures to transportation (2010), which adds up to roughly $4,100 each year.[31] On average, 86% of these costs are incurred to buy and operate vehicles, while the remaining 14% is used to pay for commercial transportation (public transport, rail, air travel, water transport, taxis, etc.).[32] These trends move in parallel with the number of vehicle-kilometers travelled (see Figure 6) and with increases in vehicle purchases. Between 2012 and 2013, new motor vehicle sales in Canada jumped by almost 9%.[33]

Figure 5 – Transportation Sector Energy Demand by Mode, Reference Case (NEB)

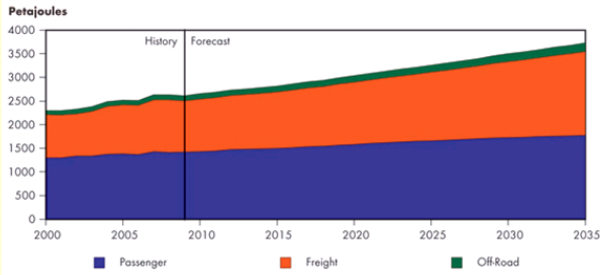
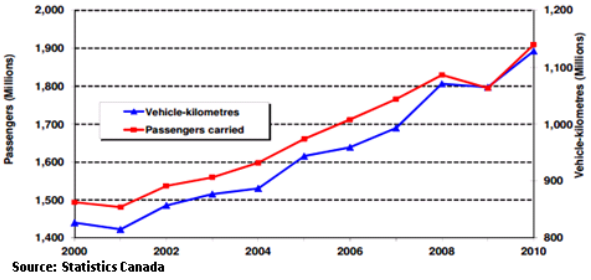


Figure 6 – Passengers versus Vehicle kilometers driven 2000 to 2010



The transportation sector is a major employer in the Canadian economy. Including both private and public sectors, 924,600 people were employed in the transport sector in 2010, up from 800,700 in 2001.[34] Those working in the trucking industry comprise 44% of the overall transport sector workforce.[35]

Trucking has been and remains the primary mode of transport for trading with the US, Canada's largest trading partner. Although trucking has decreased in mode share over the past decade, road transport still accounts for

[27] See footnote #22
[28] Canada's Energy Future: Energy Supply and Demand Projections to 2035
[29] Regulating Greenhouse Gas Emissions from Light-Duty Vehicles (2017-2025)
[30] See footnote #19
[31] It should be noted that this figure does not include external costs, such as air pollution, GHG emissions, congestion, obesity, noise pollution, time, or land use.
[32] See footnote #19
[33] StatsCan (to 2012) and Jan to May 2013
[34] See footnote #19
[35] See footnote #19

56% of all US-Canada trade (2011).[36] Seventeen percent of cross-border trade is conducted by rail; 6% by marine; and 5% by air.[37]

Canada 2009 by the Numbers
- 20 million vehicles in Canada
- 304 billion vehicle kilometers driven
- 32 billion liters of fuel purchased

British Columbia

Like other provinces, transportation occupies a large place in the BC economy. But there are several noteworthy trends which set BC apart from other provinces. For one, transportation in BC consumes a smaller share of energy (27%) than the national average (33%). While transportation is the biggest consumer of energy in Canada as a whole, the industrial sector is the largest user of energy in BC.[38] The BC transportation sector's GHGs, however, are 1.5 times the Canadian average.[39] Where transportation generates 24% of total Canadian emissions, in BC its share is 38%.

The discrepancy between energy use and GHG emissions is due, in part, to the unique energy portfolio in BC, as the majority of residential and commercial energy use is sourced from GHG-free hydroelectricity.[40] Further, GHGs from the transport sector also include off-road industrial activity related to forestry, mining, and oil and gas production – all important industries in BC.[41]

From 1990 to 2010, emissions from the transport sector stemming from growth in population, industrial activity, vehicle ownership and kilometers travelled increased by 28% in BC, compared to the national average of 30%. During these two decades, total economy-wide GHG emissions increased by 12% in BC, while intensity (emissions per unit of GDP) for the province decreased by 10%.[42] The decrease in intensity is likely attributable to improvements in energy efficiency across most sectors and to rising urbanization.

As a small open economy, exports and trade are vital to BC's economic prosperity. Thus, BC's role as Canada's Pacific Gateway depends on a clear vision and the physical infrastructure to support it, which includes an integrated network of roads, ports, railroads, and airports to enable the efficient movement of goods and people. BC's gateway infrastructure, which includes the Vancouver and Prince Rupert ports, contributes over 82,000 jobs and over $6.5 billion in GDP annually to the province's economy.[43] Some 37% of Canadian merchandise exports to non-US markets moves through and out of BC, while 7% of national goods exports to the US use BC infrastructure.[44]

BC's Automotive Profile (2009)
- Number of vehicles: 2.6 million (13% of Canadian total)
- BC had the 3rd lowest per capita expenditures on transportation
- The average British Columbian spent 12.5% of their personal expenditures ($3,684) on transportation.
- BC residents, on average, drove less than any other province.
- 22% of all Canadian medium sized trucks are in BC
- 5% of all Canadian heavy sized trucks are in BC
- BC has the highest level of hybrid car ownership in the country (per capita).

[36] See footnote #19
[37] See footnote #19
[38] Review of Energy Supply, Consumption and GHG Emissions in British Columbia, 1990 to 2009, Canadian Industrial Energy End-use Data and Analysis Centre, 2011
[39] British Columbia Greenhouse Gas Inventory Report 2010
[40] Canada's Emission Trends 2012, Environment Canada
[41] Personal communication, BC Ministry of Environment Climate Action Secretariat
[42] See footnote #39
[43] The Economic Role of the Gateway Transportation System in the Greater Vancouver Region , Economic Development Research Group, 2008
[44] See footnote #19

Over the past decade or so, the growth of BC's gateway economy has occurred through the expansion of marine ports and the trucking industry, plus significant new investments in the rail sector. BC now leads the country in rail-to-marine traffic, being home to 35% of such Canadian activity. Container traffic at Port Metro Vancouver and the Port of Prince Rupert is expected to increase by 300% by 2020, moving from 2.86 million TEUs[45] in 2010 to 9 million TEUs in 2020.[46] Over the long-term, BC's transport network will be instrumental for continued trade with the United States, as two-thirds of all US-BC trade involves the trucking of goods and services.[47] The Pacific Highway crossing in South Surrey is the 6th busiest in Canada.[48] Access to fast-growing offshore markets in Asia and elsewhere will depend on the ability to maintain and enhance BC's ports and the transportation infrastructure assets and services that are linked to port activity.

Metro Vancouver as a region is home to over half of BC's population and it ranks as the biggest urban center west of Toronto. As such, it plays an important role in how transportation policy is conceived and implemented in the province. While the region is not a global leader in transportation systems, it has made progress at accommodating a mix of modes and alternatives, and it has established ambitious targets which, if achieved, would see 50% of all trips made by foot, bike, or transit by 2020, rising to two-thirds by 2040.[49] Of interest is that since 1996, the population of the downtown core has grown by 75% but the number of vehicles entering the core has decreased by 25% in peak periods.[50] Overall in Metro Vancouver the population has increased by 18%, but this has been accompanied by a 5% reduction in vehicle use.[51]

Residents and businesses in the region will have a significant influence on both future energy use and GHG emissions in BC.

BC Trucking Industry

Operates about 13,000 to 14,000 vehicles, employs over 26,000 people and generates approximately $2 billion annually in revenues in British Columbia

Source: BC Trucking Association

Conclusion

Efficient transportation services are essential to any well-functioning economy and society. Good transportation connects communities and people, enables access to external markets, and facilitates intra- and interregional trade and tourism – allowing small economies to specialize and reap the benefits that stem from the process of comparative advantage. However, the transportation sector is a big energy consumer as well as the world's largest user of oil and refined petroleum products. It is responsible for one quarter of world-wide greenhouse gas emissions, and it contributes to local air quality concerns in most large urban centers. If we are serious about changing how we use energy and about reducing emissions, the transportation system will have to be part of the equation.

In the next issue of Environment and Energy Bulletin, we will explore policy alternatives for managing the environmental impacts of transportation, including reducing fuel subsidies, setting low carbon fuels standards, reforming urban planning, deploying new technology, and using fiscal instruments to drive improved efficiency and lower emissions.

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[45] TEU = Twenty-foot equivalent unit, a measure used for capacity in container transportation.
[46] Canada's Pacific Gateway
[47] See footnote #43
[48] See footnote #19
[49] Transportation 2040
[50] Carbon Talks
[51] Ibid