Greenhouse Gas Reduction Opportunities for the Freight Transportation Sector

by J. Caceres and D. Richards

Prepared by AgriTrade and Transport
for the David Suzuki Foundation

David Suzuki Foundation
Finding solutions

2211 West 4th Ave., Suite 219
Vancouver, BC V6K 4S2
Tel: (604) 732-4228
Fax: (604) 732-0752
www.davidsuzuki.org

1. Introduction

The purpose of this report is to examine the potential to reduce greenhouse gas emissions in the freight sector in British Columbia over the period 2000-2015.

Section 2 provides a profile of the freight transportation system in B.C. Section 3 provides the baseline estimates of 1990 emissions for freight in B.C., the emissions that are forecast to occur in 2015, and the amount of emission reductions from the forecast 2015 level required to meet the Kyoto target.

Section 4 provides an analysis of the transportation sector in B.C. using the following criteria:

- Technical and economic potential for energy efficiency improvements
- Applicability of energy conservation techniques and practices, e.g. mode shifting
- Availability of concrete examples of implementation in B.C. or elsewhere

It also examines policy changes, incentives and disincentives which can facilitate the implementation of more efficient modes of freight transportation, including a discussion of market and other barriers which impede the implementation of design solutions.

Section 5 provides a high level (conceptual) economic analysis of the potential for employment and investment opportunity through the implementation of these policies and incentives. Section 6 will sum up the significant findings and conclusions.

2. Freight Transportation in B.C.

Trucking in B.C. is comprised of for-hire or common carriers, couriers, and private trucking operated by companies that haul their own freight. Independent-owner operators provide trucking service to both private and for-hire carriers. There is little data available on private trucking, and long-haul trucking is not its main activity.

In 1998, for-hire inter-city truck freight totalled 44 million tonnes. Intraprovincial (within B.C.) shipments accounted for 15.7 million tonnes, interprovincial (to or from another province) accounted for 8.2 million tonnes, and to or from the U.S. accounted for 4.8 million tonnes. The average distance of shipments loaded in B.C. is 850 kilometres and for shipments unloaded in B.C. 1,206 kilometres. The most important commodities loaded in B.C. are wood products, by tonnage and revenue. Shipments weighing over 10,000 Kgs (22,000 lbs) account for 90 per cent of tonnage loaded in B.C.

In 1997, rail traffic totalled 89.8 million tonnes. Intraprovincial (within B.C.) shipments totalled 30.6 million tonnes, of which 21.2 was loaded on marine vessels for export. Traffic to or from the U.S. totalled 4.9 million tonnes. Traffic to or from other provinces totalled 54.3 million tonnes, dominated by westbound exports of coal, grain, potash and sulphur. The CN and CPR main lines are also used to ship containers of imported goods eastbound. Forest products are the most important component of traffic on the B.C. Rail line from the interior to North Vancouver.

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In 1997, domestic marine traffic in B.C. amounted to 12 million tonnes. This is a small part of B.C. port activity. Marine shipments overseas totalled 81.8 million tonnes and from overseas 5.2 million tonnes.[1]

Trade between B.C. and other provinces grew an annual average four per cent per year between 1984 and 1995, about the rate of inflation. However, foreign trade with B.C. grew seven per cent per year. Increasingly, B.C. trade flows are growing north-south with the U.S., in line with the growing integration of the Canadian and U.S. economies. B.C. relied less on other provinces as a market than any other province. B.C. production (by value) was shipped 62 per cent to within the province, 31 per cent international and six per cent to other provinces.[2]

Canadian National and Canadian Pacific Railway maximize the mileage they ship goods on their lines before transfer to U.S. railways. Thus, B.C. is a gateway for international imports and exports to and from other parts of Canada. Because truck weight limits are higher in Canada (138,000 pounds) than in the U.S. (80,000), there is an incentive for exports by truck from Alberta to use B.C. highways. As a result, B.C. gateways handle about 16 per cent of Alberta's exports by truck to the U.S.

3. Emissions and Activity Forecast

The current forecast[3] indicates that greenhouse gas (GHG) emissions from energy consumption in the freight transportation sector will grow from 4.6 Megatonnes (millions of tonnes) in 1990 to 7.3 Megatonnes in 2015, an increase of 56 per cent. Almost all of the growth in emissions is due to increased trucking activity. The following tables illustrate trends in freight emissions and activity.

[1] Transport Canada, Transportation in Canada 1998, p.254
[2] Transport Canada, Transportation and North American Trade, 1998, Chapter 6
[3] Natural Resources Canada, Canada's Emissions Outlook, Tables BC-18,19,20

Table: B.C. Freight Emissions Kilotonnes CO_2 Equivalent[4]

	1990	1995	2000	2005	2010	2015	Mode % 1990	Mode % 2015	Change 2015-1990
Heavy Duty Gas Trucks	298	383	644	765	875	964	6.4%	13.3%	223%
Light-Med Duty Diesel Trucks	449	810	883	954	976	989	9.7%	13.6%	120%
Heavy Duty Diesel Trucks	2234	2866	3324	3334	3406	3568	48.1%	49.1%	60%
Total Trucks	2981	4059	4851	5053	5257	5521	64.2%	76.0%	85%
Rail	1476	1689	1524	1505	1516	1490	31.8%	20.5%	1%
Domestic "Marine"	1874	2463	2068	2168	2393	2566	n/a	n/a	37%
Domestic Marine Freight	186	245	206	216	238	255	4.0%	3.5%	37%
Total Freight	4643	5993	6581	6774	7011	7266	100.0%	100.0%	56%

Table: B.C. Freight Activity in tonne-kilometres[5]

	1990	1995	2015	1990	1995	2015
Rail tonne-km (billions)	61.7	73.4	82.1	70.5%	68.1%	63.6%
Truck tonne-km (billions)	16.3	21.8	33.2	18.7%	20.2%	25.7%
Marine tonne-km (billions)	9.5	12.7	13.9	10.8%	11.8%	10.8%
Freight tonne-km (billions)	87.5	107.9	129.2	100.0%	100.0%	100.0%

One tonne-kilometre is one tonne hauled one kilometre

In 1995, rail accounted for 68.0 per cent of freight activity (tonne-kilometres) and 28.2 per cent of freight emissions. Trucking accounted for 20.2 per cent of activity and 67.7 per cent of emissions. Domestic marine accounted for 11.8 per cent of activity and 4.1 per cent of emissions. Between 1990 and 2015, rail activity will increase 33 per cent with no increase in emissions. Trucking activity will increase 104 per cent with an 85 per cent increase in emissions.

About two-thirds of the trucking tonne-kilometres are handled by major for-hire carriers, with the balance handled by smaller carriers, private trucking and couriers. Inter-city trucking accounts for 56 per cent of truck emissions and urban trucking for 44 per cent.[6]

Under the Kyoto protocol, Canada would reduce its GHG emissions to a level six per cent below 1990. For freight in B.C. this would mean a reduction from the 7.3 Megatonnes forecast in 2015 to 4.3 Megatonnes, or by 41 per cent. The Kyoto target is the current objective, but may not achieve the goal of sustainability on climate change in the long-term.

[4] Natural Resources Canada

[5] Delcan and A.K. Socio-Technical Consultants, Assessment of Freight Forecasts and Greenhouse Gas Emissions, prepared for Transportation Table, June, 1999. We have taken the national emissions and freight activity from this report and allocated activity to B.C. based on share of national emissions for each mode for each year indicated.

[6] ibid, sec 5.3.1 step 3 and step 4

The forecast of 2015 emissions developed by Natural Resources Canada (NRCan) assumes a sharp decline in current rates of emissions growth. If the carbon dioxide emission trends of 1990-1997 were simply extrapolated (linear, not compounded), freight emissions in 2015 would be 12.5 Megatonnes, or 184 per cent above 1990 levels and 79 per cent above the NRCan forecast used for 2015. Almost all of the difference is in trucking. Whereas B.C. trucking emissions grew 60 per cent in seven years between 1990 and 1997, the NRCan forecast projects they will grow just 16 per cent in 18 years between 1997 and 2015. The forecast projects trucking activity will grow at about one-third the rate experienced since 1994.

We have scaled down the forecast of the total B.C. domestic marine sector to an estimate of the B.C. domestic marine freight sector, based on the national estimate by the Transportation Table portioned to B.C. domestic freight activity. Note that emission estimates of the B.C. freight sector exclude international ocean shipping.

The NRCan forecast assumes that the price of crude oil will be $U.S. 20.60 per barrel. This year the price has already increased to $30 per barrel. This should lower the forecast of emissions from transportation per se. However, this will encourage more use of Alberta oil sands which will increase emissions in oil production. The overall effect could be increased emissions.[7]

The NRCan forecast for 2015 already incorporates anticipated improvements in the fuel efficiency of freight modes. Fuel efficiency in trucking is expected to improve 0.5 per cent per year, marine 0.3 per cent per year and rail 1.0 per cent per year. The following table compares the fuel efficiency of trucking, rail and marine in terms of kilojoules of energy consumption per tonne-kilometre[8].

Freight Energy Intensity – kilojoules per tonne-kilometre[9]

Mode	1990	1995	2010	2015
Truck Avg	2670	2600	2412	2353
Truck Tractor-Trailer	1300	1268	1176	1148
Rail	302	291	243	229
Marine	258	254	243	239

[7] Centre for Sustainable Transportation, Monitor #3, March 2000, p.9

[8] measures freight workload, one tonne-kilometre is one tonne hauled one kilometre

[9] Truck average, rail and marine estimates are from Delcan Corporation and A.K. Socio-Technical Consultants, Assessment of Freight Forecasts and Greenhouse Gas Emissions, Final Report, 1999, prepared for Transportation Climate Change Table. Inter-city truck estimates are from Delcan, KPMG and A.K. Socio-Technical Consultants, Assessment of Modal Integration and Modal Shift Opportunities, 1999, prepared for Transportation Climate Change Table.

4. Potential Emission Reductions

Approach

According to the Organization for Economic Cooperation and Development (O.E.C.D.), the overall framework of analysis for sustainability must consider the inter-relation between production and transportation.[10] Trying to reduce freight emissions without analyzing the link with production and distribution would be like trying to do urban transportation planning in isolation of land use planning.

Although technical advances have been made to improve the fuel efficiency of traffic, growth in the amount of traffic has overwhelmed these savings. Future advances in technology will also be insufficient to overcome increased environmental impacts.[11] Individual and disconnected measures can work at cross purposes by shifting freight to less fuel-efficient modes. Simply improving fuel efficiency of transport supply can induce additional transport demand.

Evolution of the production and distribution system to just-in-time logistics has had the following impacts which increase emissions:[12]

- Increase in market share for trucking, the most energy inefficient inter-city mode
- Increase in shipment distances as globalization breaks down local economies
- Increase in out-sourcing of components
- Decrease in density and increase in shipment frequency
- Shift in distribution costs from private warehouses to public roads

While these trends are often viewed as a market preference, there is also an implicit subsidy involved through the road system, and the transfer of costs for pollution, global warming and collisions to society. The market does not reflect full costs.

The emerging trend toward consumers buying products over the internet will likely increase emissions in the freight sector more than anticipated. Truck manufacturers are already stepping up production of medium sized trucks for more dispersed shipping patterns. UPS is gearing up for an expected expansion in home delivery. Air freight will grow. However, consumers will create fewer emissions in driving to and from the store, except where shopping is a stop-off during a trip that will occur anyway.

[10] O.E.C.D., Sustainable Consumption and Production, web site
[11] O.E.C.D., Project on Environmentally Sustainable Transportation, web site
[12] Caceres and Richards, "Just-in-Time System and Climate Change", paper to Canadian Transportation Research Forum conference, Montreal, 1999, p.7

The national Climate Change Transportation Table Options Paper is a good source of information on technical solutions to reduce freight emissions, but its approach to freight demand issues is limited. Implementing all of its *most promising* and *promising* measures for freight modes and truck vehicles/fuels (as well as the *less promising* measures for trucking) would reduce B.C. freight emissions in 2015 by 1.83 Megatonnes. B.C. freight emissions would then be 5.35 Megatonnes, still 23 per cent above the Kyoto target. The difference is due to the strong growth in trucking activity.

This analysis will outline an alternative approach with more aggressive technical solutions to reduce emissions, as well as conservation measures, for example shifting to more efficient modes and influencing the amount and type of freight demand.

Replacing 40 per cent of freight trucks with trucks powered by fuel cells (each of which reduces emissions a net 60 per cent after including emissions required to produce the hydrogen fuel) would reduce 2015 emissions by 1.32 Megatonnes. Note, however, that the cost of the hydrogen fuel is 50-100 per cent higher than the current diesel price. Limiting truck speeds to 90 kilometre per hour would save 0.44 Megatonnes. Truck driver training and better maintenance would save 0.56 Megatonnes. Other non-engine improvements (truck tracking, load matching, tires, lower vehicle weight, electronic border clearance) would save 0.28 Megatonnes.

Implementing a marine code of practice and shore power would reduce domestic marine freight emissions by 0.017 Megatonnes. Because marine freight emissions are already very low, and there is a slow replacement rate for vessels, there is little opportunity or benefit for fuel cells by 2015.

Electrifying main rail lines in B.C. would reduce emissions by 0.66 Megatonnes, after including emissions to generate and transport electricity.[13] However, the railways would be unable to finance the $800 million cost of electrification on their own at current diesel prices. Using electric railway locomotives would save as much in emissions, at lower cost, than developing new hydrogen fuel cell locomotives. Reducing the gap in tax treatment on the purchase of rail equipment compared to trucks would save 0.06 Megatonnes.

More compact land use planning could reduce urban trucking emissions by 0.12 Megatonnes. Pooling urban delivery systems could reduce emissions by 0.12 Megatonnes by reducing circuitous routings and increasing load factors. Several firms could combine to operate their pick up and distribution, based out of an intermodal freight terminal and distribution centre.

[13] Transportation Climate Change Table, Options Paper, app 5

Increasing local production and consumption is assumed to reduce emissions by 0.24 Megatonnes (75 per cent reduction in shipping distance for 10 per cent of inter-city truck hauls). For example, currently raw milk produced in B.C. is shipped to Alberta for processing, and then shipped back to B.C. Processing the milk in B.C. would reduce emissions.

The Transportation Table examined one intermodal option for B.C., which was to shift 18 per cent of point-to-point truck traffic between Calgary and Vancouver from truck to rail. It estimated emission reductions at 0.006 Megatonnes. This paper will instead examine a more systematic approach, including the removal of current market and regulatory distortions that act as barriers to increased intermodal transport and artificially increase the growth rate of truck transport.

Table: Potential Emission Reductions from Mode Shift

	2015 truck emissions Megatonnes	2015 inter-city truck emissions Megatonnes	2015 Truck emissions avoided (Megatonnes)	2015 Additional rail or marine emissions (Megatonnes)	2015 pick up from and delivery terminals emissions (Megatonnes)	2015 Net Change emissions (Megatonnes)
Shift 10%	5.521	3.11	0.31	0.068	0.027	-0.215
Shift 20%			0.62	0.136	0.054	-0.429
Shift 30%			0.93	0.204	0.082	-0.644

Shifting 20 per cent of inter-city truck traffic in 2015 to rail (e.g. carload, container or piggyback) or marine would reduce emissions by 0.429 Megatonnes, after including emissions from a 25 kilometre truck pick up and a 25 kilometre truck delivery. About two-thirds of the shift would displace the traffic growth forecast for trucking. As a result of the shift, rail/domestic marine traffic would increase about seven per cent.

An example of intermodal opportunity is the truck traffic that crosses the mountains. About 1,100 westbound trucks a day cross the Alberta/B.C. border daily and another 1,100 eastbound. These amounts will grow by 2015. There are opportunities with new short lines serving the Okanagan and Vancouver Island. With aggressive local marketing, short line railways have proved effective at taking truck traffic off highways, even over short distances. B.C. Rail is also owned by the Government of B.C. The opportunities for greater use of the marine freight mode include coastal areas, the Fraser River in the lower mainland and north-south lakes in the interior.

Implementing all of the above measures would reduce B.C. freight emissions by 4.3 Megatonnes to 3.0 Megatonnes, compared to the target of 4.3 Megatonnes. However, there is some overlap or double counting between individual fuel efficiency measures. Subsequent measures apply to a somewhat smaller base of emissions. Assuming a 25 per cent overlap, the total emission reduction is 3.2 Megatonnes to a level of 4.1 Megatonnes.

The following table summarizes the possible measures that could be used to reduce freight greenhouse gas emissions in B.C.

Table: Possible Measures to Reduce Freight Emissions in B.C.

		BC 2015 svg Megatonnes	BC 2015 svg (for the mode)
Trucking: replace 40% of trucks with trucks powered by fuel cells	technology	1.32	23.9%
Trucking : tracking, load matching, tires, lower vehicle weight, electronic border clearance	technology	0.28	5.1%
Trucking: limit speeds to 90 kms/hr	technology	0.444	8.0%
Trucking: driver training, preventative maintenance	conservation	0.56	10.1%
Trucking		**2.604**	**47.2%**
Rail freight car capital cost allowance	technology	0.016	1.1%
Rail locomotive capital cost allowance	technology	0.046	3.1%
Rail, electrification	technology	0.663	44.5%
Rail		**0.725**	**48.7%**
Marine freight, code of practice	conservation	0.007	2.7%
Marine, shore power	technology	0.01	3.9%
Marine		**0.017**	**6.7%**
Compact land use planning	demand	0.12	
Pool urban deliveries	demand	0.12	
Shift 20% of 2015 truck freight to rail or marine	demand	0.429	
Increase local production & consumption	demand	0.24	
Measures to influence nature and amount of demand		**0.909**	
Freight, emission reduction before adjustment for overlap among measures		4.26	58.6%
Freight, eliminate 25% overlap		**3.195**	**44.0%**

Infrastructure Issues

The trucking industry uses roads and traffic controls built and maintained at public expense. Diesel taxes and license fees cover about 60 per cent of the cost imposed on the road system by the typical tractor-trailer truck.[14] However, there is one toll highway between Hope and Kamloops. The latest (1997) National Highway System study recommends spending an additional $2.9 billion for highways in B.C. in the designated national system, including $806 million to expand capacity with additional lanes.

[14] Royal Commission on National Passenger Transportation, 1991, determined that the average tractor-trailer caused 0.69 cents per tonne-kilometre in road costs. Fuel taxes and license fee revenue for a tractor-trailer in B.C. are 0.42 cents.

Research work for the Transportation Table on infrastructure issues finds that increasing highway capacity would increase emissions. Although fuel is saved by reducing congestion for a while, the additional capacity induces new traffic that increases emissions overall. The O.E.C.D. states that the provision of additional road infrastructure is rarely a solution, but rather adds to the problem.[15] Intelligent highway systems (e.g. high tech traffic control and incident management systems) could both reduce emissions caused by congestion, and also increase emissions by expanding highway capacity.

Rail track capacity is adequate for present traffic volumes, but there is congestion in the Vancouver area. Traffic ranges from one to two trains per day on branch lines to 25 to 35 trains per day on the main lines. About 35 per cent of the CPR main line is double track, with major segments between Golden and Revelstoke, Sicamous and Kamloops and Agassiz to Coquitlam. Westbound grain traffic has declined 35 per cent since 1994 as transport subsidies were cut and Canada integrates with the continental grain economy. An increase in the exchange rate or integration of railway companies could alter the routing of some bulk shipments to U.S. ports. Coal traffic could decline as the Kyoto process increases the marginal cost of carbon to customers. Any decline in bulk traffic would free up additional capacity for intermodal traffic, but it would also mean that other traffic would have to cover a bigger share of fixed costs. Mode shift to rail could require infrastructure improvements, depending on the future volumes of bulk traffic.

The most recent Transport Canada inventory of freight infrastructure and activity in B.C. has very little information about domestic marine activity which appears to be small compared to overseas traffic. The Federal Government is already implementing a user pay system for marine.

Possible Economic Instruments

Economic instruments are not a stand-alone magic bullet to reduce emissions in freight transport, but there can be a role for them to support other policies.

Research for the Transportation Table concludes that increasing diesel taxes by 50 cents per litre would still leave trucking emissions in 2010 at 35 per cent over 1990 levels. Fuel taxes have a bigger impact in passenger transport because B.C. commuters cannot drive via the U.S. Most of the rail tonnage, and much of the truck tonnage, can. Thus, increased diesel taxes in B.C. would shift some freight emissions to the U.S. unless U.S. fuel taxes were also raised.

[15] ibid, 3.3

Road pricing based on truck weight and distance driven is a better way to recover road costs because fuel taxes undercharge heavy vehicles. For sake of discussion, if the mileage toll for a tractor-trailer on the Coquihalla highway were applied to all trucks operating in B.C., and replaced the fuel tax and license fee, this would increase truck costs about 17 per cent. This would shift about eight to 19 per cent of truck traffic to other modes.[16] There are competitiveness issues.

Under a freight carbon ceiling, shippers would be required to purchase carbon quotas or credits if a shipment produced more than a certain amount of emission per tonne-kilometre. Shippers using rail or marine should be able to earn and sell credits for shipping below the threshold. The carbon ceiling would be reduced to meet targets.

Charges collected for freight transport congestion, collisions, infrastructure and pollution could be recycled through shadow tolls to more environmentally-friendly modes. This would be revenue neutral to government and minimize impacts on competitiveness.

4. Barriers to Implementation

Government assisted development of fuel cells for buses would benefit future applications in heavy trucks. However, the hydrogen fuel would cost 50-100% more than the current diesel price. Electrification of main railways in B.C. would cost $800 million, but this is not commercially viable for the railways at current diesel prices.

There are split jurisdictions across governments and across modes. Because over half the freight tonnage crosses a border, B.C. would have to work with other jurisdiction to fully implement many of the measures identified in this report. An institutional constraint is the private sector concern about competitiveness in light of B.C.'s position as a gateway.

There are both market and policy barriers to mode shift of freight from truck to rail or marine. The just-in-time logistics system places a high value on reliability and frequency, for which truck transport is well-suited. Attempting to shift freight from truck to rail or marine would be an ambitious but necessary objective. Current growth trends in trucking emissions and infrastructure demand are not sustainable.

[16] Toll for five axle truck is $40 for 115 kms or 34.8 cents/truck km. Fuel tax and license revenue is 10.4 cents/truck km. Operating cost is 147.2 cents/truck km. Cross-elasticity truck/rail is 0.5-1.1

Following are some of the policy barriers that need to be resolved if significant mode shift is to occur:

- Railways in B.C. contribute net revenues to governments of $20 million a year through fuel taxes. Trucking in B.C. receives a net subsidy of $65 million a year through the road system (after deducting fuel taxes and license fees).[17]
- The tax system encourages investment in trucks rather than trains. Trucks qualify for a 40 per cent depreciation rate for taxes, but locomotives have a 15 per cent rate.
- Truck fuel taxes and license fees for infrastructure use can be deducted 100 per cent for tax purposes, but investments in rail infrastructure can be deducted at only 10 per cent annually.
- Regulations for modes and infrastructure are split across jurisdictions.
- The costs of pollution, collisions and congestion are not factored into market prices of freight transportation. This creates excess growth for the least-efficient modes.

Possible solutions to overcome barriers to emission reductions include:

- Defining and implementing a sustainable freight transportation policy for B.C. based on intermodal principles.
- Governments cannot interfere with or micro-manage millions of decisions by individual consumers and shippers, but they can integrate their own policies across jurisdictions and between modes.[18]
- Making intermodal and transload facilities eligible for funding out of the highways budget, on the basis that this will reduce the need to expand road infrastructure.
- Eliminate distortions in the tax system that currently shift freight to road
- To minimize competitiveness issues, work for a regional solution with the State of Washington which also bears the costs of pass through trade traffic in border areas.
- Implement an eco-labelling system where transport options can be evaluated on their environmental impacts

Examples of Emission Reductions in Freight Transport

Bison Transport, a trucking company located in Winnipeg, is registered with the Voluntary Challenge Registry, has an environmental awareness program and trains its drivers to save fuel, for example to reduce idling. A number of the larger carriers also have speed restriction policies.

[17] 25 billion tonne-kilometres, 0.694 cents per tonne-kilometre road cost, 0.42 cents per tonne-kilometre fuel tax and license revenue

[18] O.E.C.D., Transportation and the Environment, Policy Measures and Their Effects, 3.4

About 80 German cities have set up "City Logistic" projects whereby shipments are consolidated outside the city limits and better organised within the city. The municipality, chamber of commerce and large hauliers set up a trans-shipment facility and a new company that provides a common service of deliveries within the city. This concept benefits municipalities (less spending on roads), citizens (less noise and pollution), railways (attract new inter-city traffic), and hauliers (reduce costs). [19]

Rail carloads of grain arriving at the Port of Vancouver are pooled in order to reduce congestion, irrespective of the originating railway and grain company terminal. Railways have created a common terminal railway in some cities. Similarly, inter-city couriers such as Purolator, FedEx, UPS and DHL could operate a common urban delivery system in the Greater Vancouver area in order to reduce vehicle kilometres.

DHL Worldwide Express has reduced the number of trucks in Amsterdam, Holland by setting up a marine distribution system, which serves as a trunk system feeding bicycle couriers. In Dublin, Ireland, a DHL bus drives around the city centre, making use of walking couriers.[20]

In 1998, Sweden introduced an eco-label for freight transport. Green procurement means that companies include environmental performance when choosing transport services. Transport chain environmental management involves life-cycle analysis of the impacts of manufacture, distribution, use and retirement of products.[21] Transporters can be evaluated in terms of their environmental impacts.[22] In 1998, Swedish State Railways launched the GreenCargo service brand which offers environmentally-labelled, door-to-door overnight transport.[23]

Austria and Switzerland offer examples of mountainous territories that are using intermodal transport to reduce the environmental impact of truck traffic. Both offer roll/on roll/off services whereby trucks use the railway to cross the mountains. In 1994, Switzerland passed a plebiscite banning trucks carrying freight through Switzerland effective 2004. Since then, the position has moderated with an agreement in 1998 to implement road pricing and quotas for heavy trucks, and to beef up the rail intermodal service. In addition to rail carload, container and piggyback service, the Swiss Federal Railway operates a "rolling highway" rail service that takes the truck and provides the truck driver with couchette sleeping accommodation on the train over the mountains.

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[19] Andreas Pastowski, Wuppertal Institute, presentation to Moving the Economy Conference, Toronto, July 1998
[20] Heidi Eichwald, presentation to Moving the Economy Conference, Toronto, July 1998
[21] Centre for Sustainable Transportation, Monitor, No. 3, March, 2000
[22] Delcan, K.P.M.G. and A.I. Socio-Technical Consultants, Assessment of Modal Integration & Modal Shift Opportunities, June, 1999, p.49
[23] Janes World Railways 1999-2000, p.315

With aggressive local marketing, short line railways have proved effective at taking truck traffic off highways. For example, RaiLink Southern Ontario has taken 3,600 trucks a year off the QEW highway near Hamilton. The short line delivers steel billets to mills in Hamilton. The traffic used to go by rail to Toronto, but then by truck to Hamilton.

5. Economic and Employment Opportunities

Reducing GHG emissions will create opportunities for investment and employment, for example to develop alternative fuels, fuel cells, more fuel-efficient vehicles, intermodal management processes and to electrify railways. Whether or not the U.S. implements the Kyoto protocol, it will have to reduce its dependence on imported oil as supplies of inexpensive conventional oil decline. B.C. would then be in a good position to export its expertise and technology to the U.S. restructuring in a sellers market.

Reducing the energy intensity of transportation in B.C. will make the B.C. economy more competitive in the long-term. Fuel prices are already escalating as the world's supply of inexpensive conventional crude oil declines. For example, the U.S. Department of Energy estimates that country is today saving $150- $200 billion annually as a result of energy efficiency measures taken during the 1970's oil embargo.

The trucking industry estimates there is a shortage of 50,000 truck drivers in Canada. Intermodal would result in a more efficient use of truck drivers picking up and delivering freight at intermodal terminals, thereby relieving the long-haul driver shortage. It would also permit a reduction in the fleet of truck tractors which could assist the program to scrap old trucks.

The benefits of mode shift go beyond reducing GHG emissions, to reducing road expansion costs, road damage, traffic collisions, and improving the quality of life. For example, a 20 per cent mode shift of B.C. inter-city freight in 2015 would reduce annual public costs by about $65 million (road costs $14 million, collision death and injury costs $17 million and congestion costs $32 million).[24] Thus, it would be economically efficient for the government to offer some shadow tolls or tax credits.

Reducing greenhouse gas emissions will reduce the cost of health care and the financial losses caused by drought, forest fires, and extreme weather such as flash floods. There should be a cost estimate of the do nothing option as a benchmark against the cost of implementing reduction measures. The cost of emission reduction measures, no matter how sophisticated, are meaningless without an estimate of the cost of business as usual.

[24] Road cost is $0.27 per tonne-kilometre after deducting 15.5 cents/litre fuel tax and license fees, difference in rail and truck collision costs is $0.34 per tonne-km. Congestion cost on inter-city highways is $0.64 per tonne-km.

6. Conclusions

Greenhouse gas emissions in the B.C. freight transportation sector will grow from 4.6 Megatonnes (millions of tonnes) in 1990 to 7.3 Megatonnes in 2015, an increase of 56 per cent. Almost all the increase is due to increased trucking activity. To reduce emissions to a level six per cent below 1990 would mean a reduction from 7.3 to 4.3 Megatonnes, or by 41 per cent. On average, inter-city trucking consumes four to five times as much fuel as rail or marine to haul a tonne of freight one kilometre. Trucking is the fastest growing freight mode.

The national Climate Change Transportation Table Options Paper provides a good source of information on potential measures to reduce freight emissions through fuel efficiency, but is limited in its examination of measures to influence freight demand. Improvements to fuel efficiency will be insufficient to stop growth of emissions.

Technology and conservation measures (e.g. hydrogen fuel cell trucks, driver training, limiting truck speeds, removing tax disincentives to the purchase of rail equipment, rail electrification and a marine code of practice) could reduce 2015 emissions by 3.3 Megatonnes, before discounting for overlaps and double counting among measures. Influencing the nature and amount of freight demand. (compact land-use planning, pooling urban delivery systems, mode shift from truck to rail or marine, increased local production and consumption) would save 0.91 Megatonnes, before discounting for overlaps. Taken together, all measures identified could reduce 2015 emissions by 3.2 Megatonnes, after discounting 25 per cent for overlaps.

It is more challenging to reduce freight emissions than passenger emissions because much of the freight crosses a border. Hydrogen fuel for trucks is more expensive than current diesel prices. The railways would be unable to finance railway electrification on their own at current diesel prices. Policies are fragmented across jurisdictions and modes. B.C. needs a sustainable intermodal freight transportation policy that removes market and regulatory distortions which currently favour the least fuel-efficient modes.

Reducing GHG emissions will create opportunities for investment and employment, for example to develop alternative fuels, more fuel-efficient vehicles, intermodal management processes and railway electrification. Technology and expertise could then be exported to the U.S. which will have to reduce its dependence on imported oil. Public transit fleets will drive the development of alternative fuels and fuel cells for heavy trucks. Increasing the use of intermodal transport would relieve the current shortage of long-distance truck drivers and reduce the annual cost of road damage, collisions and congestion in 2015 by about $65 million.