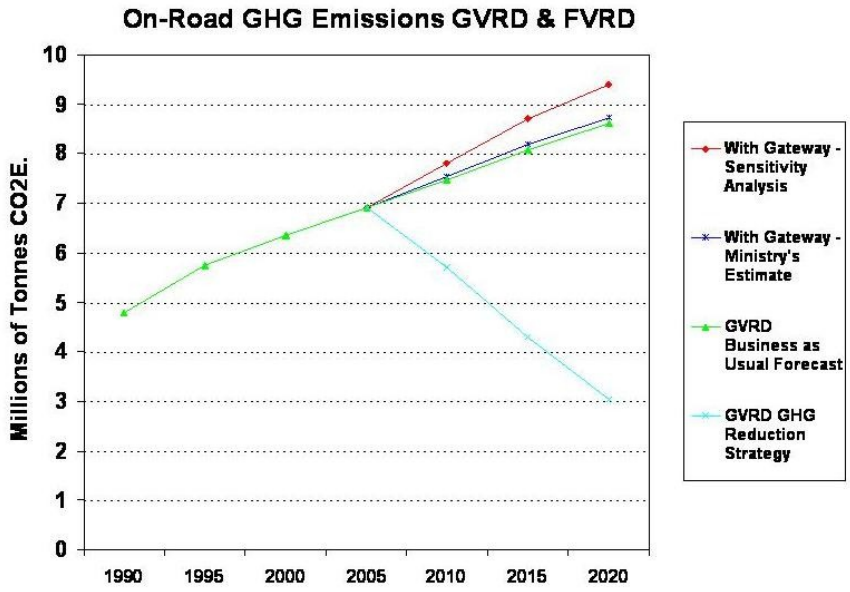
Cooking the Books, Cooking the Planet:
An analysis of Gateway greenhouse gas emissions estimates



In June 2006, it was publicly reported that Premier Gordon Campbell was confident building a better network of highways and bridges in the Lower Mainland will help cut greenhouse gas emissions.

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for

SPEC (Society Promoting Environmental Conservation)

www.spec.bc.ca

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Executive Summary

We are at a pivotal moment in the history of our region and planet. We are challenged by the latest science to take effective action to dramatically reduce the greenhouse gas emissions that are causing the global climate change crisis.

So far the provincial government has been headed in the opposite direction, devoting public resources to pushing the Gateway highway expansion program in the Lower Mainland. The Gateway program includes three components:

- Expanding Highway 1 from the 2nd Narrows Bridge between Vancouver and the North Shore to 216 St, which requires building a new freeway bridge beside the existing Port Mann Bridge.
- Building a new highway called the South Fraser Perimeter Road
- Joining and expanding a series of existing roads to form the North Fraser Perimeter Road.

Premier Gordon Campbell has claimed publicly that the Gateway Program will reduce greenhouse gas (GHG) emissions; however, the province's own study projects an *increase of 124,000 tonnes per year.*

As required under environmental assessment legislation, the BC Government has published a report on the greenhouse gas impacts of the entire proposed Gateway highway expansion program.

This report documents how the Ministry's Gateway greenhouse gas study significantly underestimates the likely increase of emissions due to the Gateway highway expansion program.

Key Findings:

- The Ministry's claim that Gateway highway expansion will only cause a "net increase in total regional GHG emissions of 0.3%" is very misleading on a number of counts. For example, it was derived by comparing emissions in the Greater Vancouver Regional District (GVRD) and Fraser Valley Regional District (FVRD) to emissions from Whatcom County USA, the GVRD and FVRD.
- The Ministry left GHG emissions from highway bridge and overpass construction out of their calculations completely. This is likely a significant factor given that 58% of industrial emissions in Greater Vancouver originate from cement plants[1].
- The traffic modeling in the Ministry's report lacks the necessary feedback loop to model land use changes induced by transportation infrastructure. As the Ministry's traffic model does not accurately reflect the induced traffic due to land use changes the resulting increase of GHG emissions estimated due to highway expansion is likely low. And since the model does not adequately recognize the self-limiting character of congestion, the emissions forecast for 2021 without Gateway are likely highly exaggerated.
- Environmental assessment legislation requires consideration of a variety of solutions, such as public transit, to ensure that the proponent has shown due diligence in planning the project. Instead the Ministry's report only compares two scenarios, a no-build scenario and a with-Gateway scenario.
- The Ministry's damage cost estimate of $37 per tonne of GHG emissions does not reflect the recommendations in the report the figure is supposedly based on, or current science. The Ministry has previously used estimates as high as $700 per tonne.

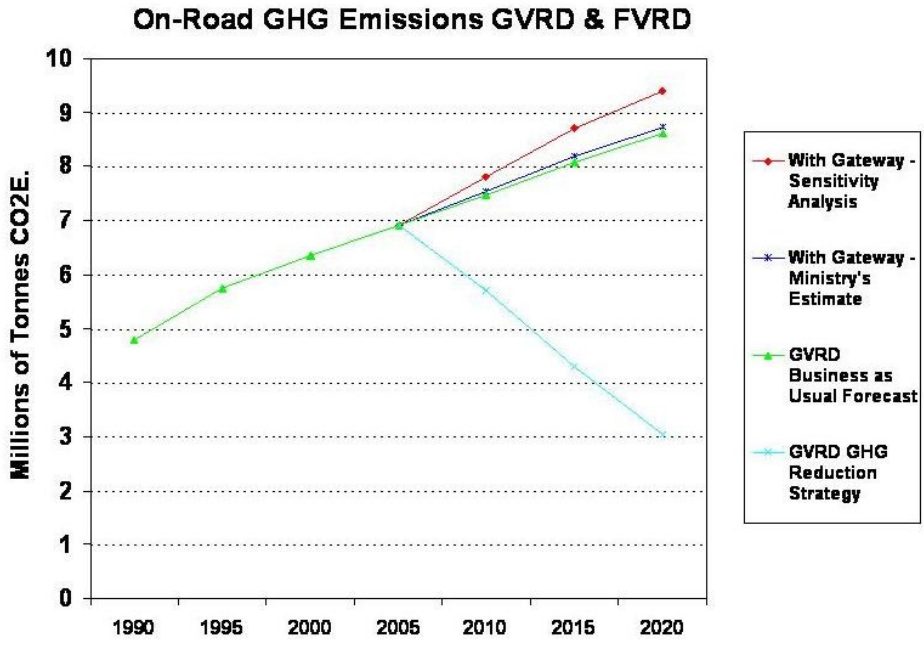
[1] 2000 Emission Inventory for the Lower Fraser Valley Airshed. http://www.gvrd.bc.ca/air/inventory_reports.htm.

This report draws on a GVRD strategy paper for an estimate of the emissions reductions a transit replacement for Gateway could achieve. A "very comprehensive and rapidly-deployed set of investments, bylaws and incentives" could *reduce on-road emissions in the GVRD by 3.87million tonnes /yr by 2020*, about a 45% reduction.

The difference between the with-Gateway scenario and the GVRD transit strategy is about *5.3 million tonnes / yr, over forty two times the 124, 000 tonnes estimated in the Ministry's report as the difference between Gateway and a no-build scenario.* This dwarfs the difference between a business as usual scenario and either estimation of Gateway emissions, as shown below in Figure A.

Using the Ministry's $700 per tonne estimate, the difference in emissions between a with-Gateway scenario and the GVRD transit scenario is up to $3.7 billion per year.

Figure A: Transit Scenario Produces Radically Different Emissions Trend; Modeling Distortion Much Less Significant.



Many measures proposed in the GVRD report would be self-funding, or result in increased revenue or reduced expenses. Therefore it is reasonable to expect that a re-allocation of the $3 to 4.5 billion cost of the Gateway Program would cover a considerable portion of the capital costs of implementing a transit strategy on the scale envisioned by the GVRD, if the most cost-effective technologies were used.

The Livable Region Coalition report *Transportation for a Sustainable Region*[2], lays out a suite of cost effective transit investments to supplant the proposed Highway 1 expansion portion of the Gateway highway expansion program. A region-wide program to replace the Gateway Program could be modeled on Zürich, Switzerland which sets the gold standard for cost-effective public transit.

[2] http://www.livableregion.ca/pdf/Transport_for_a_Sustainable_Region.pdf

1.0 Introduction - The Gateway Program Environmental Assessment

As required under environmental assessment legislation, the BC Government has published a report on the pollution impacts (including greenhouse gases) of the entire proposed Gateway highway expansion program.[3]

The Gateway program includes three components:

- Expanding Highway 1 from the 2nd Narrows Bridge between Vancouver and the North Shore to 216 St, which requires building a new freeway bridge beside the existing Port Mann Bridge.
- Building a new highway called the South Fraser Perimeter Road
- Joining and expanding a series of existing roads to form the North Fraser Perimeter Road.

Combined, these three projects have the potential to distort transportation and land use in the region, and greatly increase greenhouse gas (GHG) emissions for decades to come.

This report analyses the Ministry's report and identifies a number of distortions that must be addressed in order to have a meaningful environmental assessment.

1.1 Climate Crisis and GHG Pollution

The greenhouse gas (GHG) emissions that are causing global warming are perhaps the greatest challenge facing human society. The recent report by the economist Sir Nicholas Stern calls attention to the threat of "major disruption to economic and social activity, later in this century and in the next, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century"[4].

Recent studies have shocked the scientific and planning fields; for example a "rise of three to six meters in sea levels by 2100" is now considered a serious possibility by our regional government[5]. The outcomes which informed observers consider likely with business-as-usual emissions levels include crossing a threshold (or tipping point) beyond which the environmental consequences would lead to a permanent societal collapse and the deaths of the majority of humanity[6].

A 2006 GVRD report reports that transportation "sources now contribute half of the region's total GHG emissions and are increasing twice as fast as other sources".[7] The rapid increase projected under business as usual assumptions is shown below in figure 1.

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[3] RWDI Inc. (2006) South Fraser Perimeter Road Regional Air Quality Impact Assessment: Technical Volume 16 of the Environmental Assessment Application. http://www.eao.gov.bc.ca/epic/output/documents/p196/d22440/1160695783733_8472cae2a0154601bf12ab205e7b4d0f.pdf

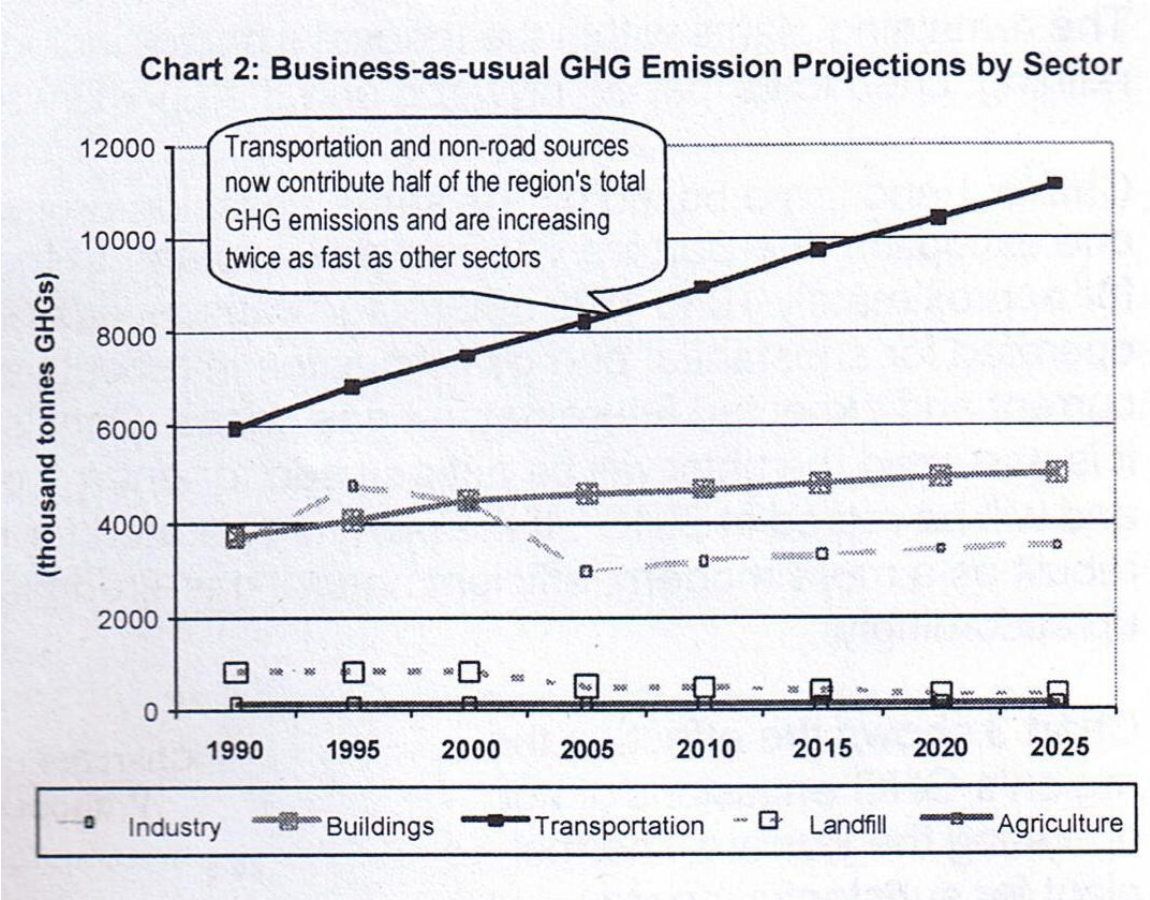
[4] STERN REVIEW: The Economics of Climate Change http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm

[5] Developing a greenhouse gas reduction strategy for Greater Vancouver. GVRD Air Quality and Management Division. http://www.gvrd.bc.ca/pdfs/GreenhouseGasReductionStrategy.pdf.

[6] e.g. *The weather makers:How we are changing the climate and what it means for life on earth.* Tim Flannery 2005. *Collapse: How societies choose to fail or suceeed*. Jared Diamond 2005.

[7] *Developing a greenhouse gas reduction strategy for Greater Vancouver.* GVRD Air Quality and Management Division. (Includes non-road sources such as construction equipment and aviation) http://www.gvrd.bc.ca/pdfs/GreenhouseGasReductionStrategy.pdf

Figure 1: Transportation emissions rise rapidly in business-as-usual scenario



Source: *Developing a greenhouse gas reduction strategy for Greater Vancouver.* GVRD Air Quality and Management Division April 2006.
http://www.gvrd.bc.ca/pdfs/GreenhouseGasReductionStrategy.pdf

2.0 Ministry of Transportation Estimation of GHG Emissions

2.1 Political Announcement of Reduced Emissions

In June 2006, CBC radio reported that Premier Gordon Campbell was "***confident building a better network of highways and bridges in the Lower Mainland will help cut greenhouse gas emissions***"

> Environment Minister Barry Penner also argued that improving roads and bridges will eliminate congestion that causes pollution.
>
> "Currently you have trucks, buses and other large vehicles sitting there idling, and the exhaust coming out of those tailpipes contribute to greenhouse gas emissions," the minister said.
>
> Penner said provincial government studies show that the gateway plan will mean a net decrease in emissions once the expansion is completed. [8]

[8] Better roads will reduce greenhouse gas emissions: premier - June 6, 2006 http://www.cbc.ca/canada/british-columbia/story/2006/06/06/bc_emissions20060606.html

In contrast, the study finally released reports that the Gateway program is expected to cause an increase of 124,000 tonnes CO2e emissions per year. In the Ministry's report this is described as a "net increase in total regional GHG emissions of 0.3%" although the report *predicts an increase of on-road emissions from 4.3 to 5.7 million tonnes per year with Gateway, a 31% increase*. However, even these figures are a distortion of the likely impacts of the Gateway highway expansion as outlined below.

One interpretation of this is that the political announcement of GHG emissions reductions may have put pressure on Ministry staff and consultants to minimize their emissions projections, even at the expense of sound technical procedures.

2.2 Distortions in Emissions Assigned to On-road Sources

2.21 Distortion of Geographical Scope

Table 5-2 in the Ministry's report compares Canadian traffic-related GHG emissions to the total emissions in the Lower Fraser Valley (LFV) including Whatcom County in the USA (Table 1 below). While there may be some rationale for this with regional air contaminants, there is no apparent reason to do so for GHGs other than to disguise the true proportion of Gateway emissions. Whatcom County accounted for 22% of LFV GHG emissions in 2000[9]; therefore, this is a very significant distortion. The report did include Whatcom County on-road emissions for some parts of their analysis, but not for GHG emissions.

This is apparently where the Ministry came up with a "net increase in total regional GHG emissions of 0.3%" due to Gateway; by comparing predicted on-road emissions in the Greater Vancouver Regional District (GVRD) and Fraser Valley Regional District (FVRD) to the total projected emissions from Whatcom County USA, the GVRD and FVRD (20.1% - 20.4% in Table 1 below).

Table 1: Ministry's Table Compares Canadian Fraser Valley Vehicle Emissions to Total Emissions from Canadian Fraser Valley and Whatcom County.

Table 5-2 Proportion of GHG emissions from regional traffic with and without the proposed Gateway Program compared to total LFV emissions

Scenario	Traffic-related Emissions in the Canadian LFV (kt/y)	Total Emissions from All Sources in the LFV[1]	Traffic-related Emissions % of Total LFV Emissions
Existing Situation 2003	4,365	23,358	18.4
Projected 2021 Without Gateway	5,618	27,972	20.1
Projected 2021 With Gateway	5,742	28,095	20.4

Source: *South Fraser Perimeter Road Regional Air Quality Impact Assessment: Technical Volume 16 of the Environmental Assessment Application* (p 47)

[9] 2000 Emission Inventory for the Lower Fraser Valley Airshed. http://www.gvrd.bc.ca/air/inventory_reports.htm p S-6

2.22 Inconsistency in On-Road Emissions

The 'Traffic-related' emissions for 2003 reported in Table 5-2 are also suspect, even beyond the geographical distortion in the Ministry's report. The *2000 Emission Inventory for the Canadian Portion of the Lower Fraser Valley Airshed*[10] prepared by the Greater Vancouver Regional District (GVRD) used data on the fuel actually purchased in the area to estimate GHG emissions, and is therefore likely quite accurate. Data on fuel purchases is tracked for tax purposes and misreporting would be a serious offence. In contrast, the Ministry's report seems to have relied on estimates of traffic volumes and estimated fuel consumption, a very weak methodology compared to calculations based on the tax records of fuel sold.

2.23 Cumulative Distortion of Base Year Emissions Estimates

The GVRD Inventory reports that on-road vehicles (light and heavy duty vehicles) were responsible for 6,357 kt/y of CO2E. This is 46% higher than the figure for 2003 (4,365 kt/yr) estimated by the Ministry. The Inventory also reports that on-road vehicles account for 32% of GHG emissions, as opposed to the 18.4% reported in Table 5-2 as shown in Table 2 below.

Table 2: Ministry Data Compared to 2000 GVRD / FVRD Data (Millions of Tonnes CO2E/year)

	On-road Emissions	Total Emissions	% On-road Emissions
RWDI Table 5-2	4.37	23.36	18.4%
GVRD & FVRD	6.36	19.71	32.3%

Source: *South Fraser Perimeter Road Regional Air Quality Impact Assessment: Technical Volume 16 of the Environmental Assessment Application*; *2000 Emission Inventory for the Canadian Portion of the Lower Fraser Valley Airshed*

The Ministry's report gives no satisfactory explanation for the huge discrepancy between their emissions estimates and those prepared by regional government using more robust methodology. The Ministry's claim of a "net increase in total regional GHG emissions of 0.3%"[11] due to Gateway should be considered a deliberate distortion as the possibility of such a series of distortions due to chance or incompetence seems very remote.

2.3 GHG from Construction and Infrastructure Maintenance

The Ministry's report seems to have left GHG emissions from construction and maintenance of new and expanded bridges, overpasses and highways out of their calculations completely. This is likely not an insignificant factor given that 58% of the industrial GHG emissions in Greater Vancouver originate from the two cement plants in the region[12].

2.4 Traffic Modeling Without Land Use Feedback

The traffic modeling in the Ministry's report uses a version of the four-step computer program EMME/2 without the necessary feedback loop to model land use changes induced by transportation infrastructure. Modern traffic modeling programs, including more advanced versions of EMME/2, use land use feedback features which significantly improve their accuracy[13].

[10] http://www.gvrd.bc.ca/air/inventory_reports.htm

[11] Page iii http://www.eao.gov.bc.ca/epic/output/documents/p196/d22440/1160695783733_8472cae2a0154601bf12ab205e7b4d0f.pdf

[12] 2000 Emission Inventory for the Lower Fraser Valley Airshed. http://www.gvrd.bc.ca/air/inventory_reports.htm.

[13] e.g. *Urban transportation planning: A decision oriented approach*. M. Meyer & E. Miller 2001.

Misleading results from these basic 'black box' models has been called “The biggest force still driving the Auto City to … accommodate the automobile rather than providing other options”[14] An article in the Journal of the Institute of Transportation Engineers documents modeling of an expansion of Highway 1 similar to the expansion proposed under the Gateway Program under different land use scenarios. The author asserts that the "origin-destination patterns indicate that the primary effect of [freeway building] has been to foster low-density sprawl in the outlying parts of the region". Therefore the author concludes that "traditional modeling approaches [that ignore induced land use] are so misleading that, in some cases, we would be better off without them"[15].

Four-Step Traffic Models

Standard four step models were developed during the 1950s and 60s freeway building boom with funding from the US Bureau of public roads (which later became the Federal Highway Administration). These models "make no claim of representing individual trip making behaviour. Rather, it represents a pragmatic approach to reducing the the extremely complex phenomena of trip making behavior into analytically manageable components that can be dealt with using relatively simple techniques and reasonable amounts of data."
(*Urban transportation planning: A decision oriented approach*. M. Meyer & E. Miller 2001)

The four basic steps are:
1 *trip generation* - a prediction of the number of daily household trips
2 *trip distribution* - a prediction of where each trip goes
3 *mode choice* - a prediction which travel mode will be chosen
4 *route assignment* - a predicts of which route will be used

Residents of low-density automobile dependant areas drive more kilometers per year which leads to higher GHG emissions, as well as enduring higher per-capita congestion costs than people in higher density areas[16]

The Ministry of Transportation has admitted the limitations of traditional four-step modeling in other circumstances. For example, a report on transit options notes that "forecasts based solely on models have been viewed with increasing skepticism by academics, transport planners and the financial community"[17]. What they have not admitted is that the modeling they use gives a false sense of certainty based on demonstrably faulty assumptions. As Dr. Mees of the University of Melbourne explains, "a model is only a set of assumptions translated into equations, and if the assumptions are debatable then so is the result"[18]

2.41 Improved Traffic Modeling

Even basic four-step modeling can be a very useful tool if it is used in an ethical and competent fashion. Skilled modelers are very careful to account for the distortions the modeling produces,

[14] Newman, P. and J. Kenworthy. *Sustainabilityand Cities: Overcoming Automobile Dependence*. Washington, DC, USA: IslandPress, 1999.
[15] Ramsey, Stuart 'Of Mice and Elephants' *ITE Journal* September 2005. pp 38-41. http://www.livableregion.ca/pdf/2005-09-ITE-Journal-Ramsey-OfMiceandElephants.pdf
[16] e.g. Land Use Impacts on Transport: How Land Use Factors Affect Travel Behavior By Todd Litman
Victoria Transport Policy Institute April 27, 2006 p. 32 http://www.vtpi.org/landtravel.pdf, A very public solution: Transport for the dispirsed city. Paul Mees 2000.
[17] Krajczar, Karoly (2006) Assessment of Transit-only Option for Port Mann Bridge. Halcrow Consulting.
http://www.th.gov.bc.ca/gateway/reports/pm-h1/Halcrow_technl_rpt_trnstonlyopt_31_3_2006.pdf p 1.
[18] Taming transport. Paul Mees. Issues Magazine. #68 September 2004.

and manually introduce factors such as multiple land-use scenarios. For example, the GVRD has used multiple land use scenarios to examine the consequences of sprawl compared to compact development.

Todd Litman of the Victoria Transportation Policy Institute notes that there are two ways to overcome some of the distortions of traditional modeling, making incremental changes or starting over with a completely different kind of model:

> Conventional, four-step traffic models . . . can be improved incrementally by integrating more land use factors, such as mix, connectivity, and design, and by incorporating feedback loops between steps to recognize reciprocal impacts. . . Another new approach, called *activity-based modeling*, predicts travel based on information about people's demand to participate in activities such as work, education, shopping, and recreation, and the spatial and temporal distribution of those activities.[19]

Regardless of how sophisticated modeling becomes, it always depends on sound assumptions and good data. Garbage in will always equal garbage out.

2.5 Congestion Prediction

The Ministry's report predicts dire increases in congestion *if nothing is done,* apparently on the basis of four-step modeling, and suggests that this congestion would contribute to increased emissions.

> "If nothing is done to ease congestion, by 2021 the number of kilometers of road at congestion levels E and F (very high to severe congestion) increase 1.6 times and 2.7 times, respectively . . . A without Gateway scenario could include increasing congestion, longer and longer "rush hours", increased costs to the economy, delayed goods movement, and unreliable transit connections throughout the region" (p.52).

The assertion that congestion will increase greatly without roadway expansion and won't with the Gateway program is misleading on three main counts:

1) Freeway expansion has been shown to *increase congestion due to induced traffic,* a phenomena that four step models are very poor at predicting. Experience shows that freeway expansions are often counterproductive; in large US cities the trend is that "congestion increases with road supply"[20]. The City of Burnaby's analysis predicts significant congestion increases in Burnaby, Vancouver and on the Second Narrows Bridge, as well as a loss of transit ridership on both SkyTrain lines and the West Coast Express commuter train.[21]

The description in the Ministry's report suggests that they have not included emissions increases from increased traffic and congestion on municipal roads: "This modeling considers changes in traffic patterns (i.e., reductions in congestion) on secondary roads as a result of the implementation of the Gateway Program projects (p.33).

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[19] Land Use Impacts on Transport: How Land Use Factors Affect Travel Behavior By Todd Litman Victoria Transport Policy Institute April 27, 2006 p. 32 http://www.vtpi.org/landtravel.pdf

[20] Litman, Todd (2006) *Smart Transportation Investments: Reevaluating The Role Of Highway Expansion For Improving Urban Transportation*. http://www.vtpi.org/cong_relief.pdf p 9.

[21] *Council response to the Gateway Program's "Program Definition Report"* City of Burnaby June 14, 2006.

2) Federal Environmental Assessment legislation requires that the Ministry consider alternatives ways of reducing congestion and providing mobility. Therefore, a package of alternatives measures with a similar budget to the Gateway project should be the basis of comparison, not doing nothing.

Transit improvements have been shown to reduce roadway congestion if transit attracts a significant ridership share. Induced traffic is a reality for both roadways and transit; if travel becomes quicker people tend to travel more. With freeway expansions this can lead to the return of congested conditions and the related travel delays in a very short time span[22]. However, improving transit may lead to a long term reduction in roadway congestion, if the transit system does not become too overcrowded. Todd Litman of the Victoria Transport Policy Institute asserts that:

> If congestion increases, people change destinations, routes, travel time and modes to avoid delays . . . Reducing this point of equilibrium is the only way to reduce congestion over the long run . . . If alternatives are inferior, few motorists will shift mode and the level of equilibrium will be relatively high. If travel alternatives are relatively attractive, motorists are more likely to shift modes, resulting in a lower equilibrium (Litman 2005).

The GHG pollution reduction potential of public transit improvement is discussed below in section 2.7.

3) Congestion is self limiting even without transit improvements, it tends to get worse up to a point and then stabilize. "Older traffic models ignore the tendency of congestion to be self-limiting: congestion tends to limit peak period traffic growth, as consumers respond by shifting travel time, route, mode and destination." [23]

2.6 Sensitivity Analysis of Modeling

Sensitivity analysis is a technique used to determine the most productive direction for more involved (costly and time consuming) studies. The practice involves making initial estimates based on available information and reasonable assumptions. The point is not to come to any final conclusions but to decide if the factors in question have significant enough impact of the results to warrant more in-depth research.

These estimates should be considered in the context of sensitivity analysis, and should not be considered precise estimates or a replacement for more in-depth research.

Table 2 above shows the RWDI estimate of traffic related emissions in the GVRD and FVRD, the quantity attributed to Gateway in 2021 is 124 kt/yr. The increase without Gateway is projected to be 1253kt/yr [24] and the increase with Gateway is projected to be 1,377 kt/yr[25], for a difference of 124 kt/yr.

As the Ministry's traffic model does not accurately reflect the induced traffic due to land use changes the resulting increase of GHG emissions estimated due to highway expansion is likely low. And since the model does not adequately recognize the self-limiting character of congestion, the emissions forecast for 2021 without Gateway are likely highly exaggerated.

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[22] Mees, P., (2000) *A Very Public Solution: Transport in the Dispersed City*. Melbourne University Press.

[23] Litman, Todd (2006) *Smart Transportation Investments: Reevaluating The Role Of Highway Expansion For Improving Urban Transportation*. http://www.vtpi.org/cong_relief.pdf p.6.

[24] (5618- 4365 = 1253)

[25] (5742- 4365 = 1377)

A simple sensitivity analysis shows the significant effect of such a distortion. If the ***GHG emissions with Gateway are increased by 25% and the no-build scenario increase is reduced by 25% the emissions attributed to Gateway increase to 781 kt/yr[26], over six times as high as the Ministry's estimate.*** Note that this should not be considered an accurate assessment of likely emissions under these scenarios, but rather an indication that emissions are very sensitive to modeling error.

A 25% sensitivity analysis was also applied to the EMME/2 ridership projections for rapid transit ridership projections 10 years into the future as part of BC Transit's 10 Year Development Plan[27], whereas the Ministry's projections are for 15 years into the future and are therefore entail a higher degree of uncertainty. These adjustment factors may be conservative given that traffic models sometimes give extremely exaggerated predictions of traffic and congestion.[28]

2.7 Transit Alternative Missing

Under joint federal - provincial environmental assessment, serious consideration is supposed to be given to a variety of solutions to the problem and goals any project is aimed to address. In the case of the Gateway program, the goals identified are to "reduce congestion, improve people and goods movement, and improve safety and reliability".

> "As responsible authority under CEAA, Transport Canada is requiring a consideration of alternatives to ensure that the proponent of this large infrastructure project has shown due diligence in planning the project." "Transport Canada requires that the proponent consider . . . functionally different ways . . . to reduce congestion, improve people and goods movement, and improve safety and reliability."[29]

Instead the Ministry's report only compares two scenarios, a no-build scenario and a with-Gateway scenario. Any serious examination of alternative solutions would include at least one option where the resources that would otherwise go to highway expansion are devoted to 'functionally different ways' to meet the stated objectives with reduced adverse environmental impacts.

The Ministry of Transportation has not seriously examined the possibility of transit, and measures such as goods movement by barge and rail, replacing the Gateway Program. The City of Burnaby states that "a balanced and comprehensive comparison of a broad range of alternative has not yet been presented, either in the Gateway Program Definition Report, or any of the studies that preceded it"[30].The potential for transit in much of the Highway 1 catchment area is very good as outlined in ***Transportation for a Sustainable Region***[31]. The Ministry's unpublished analysis confirms the potential ridership on routes in the LRSP Growth Concentration and to Regional Town Centres such as the King George Highway and Fraser Highway. However, the Gateway Program affects the whole region and therefore any alternative measure will likewise need to be region wide.

2.71 Emissions Reductions with a Transit Scenario

[26] (1377 X 1.25 - 1253 X 0.75) / 124 = 6.3

[27] *Multiple accounts evaluation of rapid transit options for Greater Vancouver*. Crown Corporations Secretariat May 1995.

[28] e.g. Disappearing traffic: The story so far by S. Cairns, S. Atkins and P.Goodwin Municipal Engineer 151 March 2002

[29] http://www.eao.gov.bc.ca/epic/output/documents/p247/1168968063558_bc82c8d4899e4ddb8583889852ad2745.pdf

[30] City of Burnaby, *Council Response to the Gateway Program's "Program Definition Report" June 14, 2006.*

[31] http://www.livableregion.ca/pdf/Transport_for_a_Sustainable_Region.pdf

The Greater Vancouver Regional District provides an estimate of the reductions in emissions such a region-wide package could achieve; *Developing a Greenhouse Gas Reduction Strategy for Greater Vancouver*[32] estimates that a "very comprehensive and rapidly-deployed set of investments, bylaws and incentives" (including public transit improvements and fare reductions) combined with a $ 0.20 per liter fuel tax could ***reduce on-road emissions in the GVRD by 3.87 Mt/yr by 2020***, about a 45% reduction. This does not include any emissions reductions possible through fuel economy improvements or shifting to alternative fuels. This reduction is illustrated below in Figure 2.

Cost Effective Public Transit

The Livable Region Coalition report *Transportation for a Sustainable Region*, lays out a suite of cost effective transit investments to supplant the proposed Highway 1 expansion portion of the Gateway highway expansion program. Some of the measures identified are:

- Transit priority measures- includes bus lanes, High Priority Vehicle (HPV) lanes and traffic signal priority.
- Accelerated purchase of skytrain cars- 44 new Skytrain cars, up from TransLink's plan to purchase 34
- Increased frequent service coverage- A 20% increase in TransLink's bus fleet, improved to a 10 minute or better frequency bus service.

The full report is available from
http://www.livableregion.ca/pdf/Transport_for_a_Sustainable_Region.pdf

A region-wide program could be modeled on Zürich, Switzerland which sets the gold standard for cost-effective public transit. Zürich has one of the highest rates of transit usage today, almost twice as many as Europe's largest cities. Establishing a network of exclusive transit lanes with traffic signal priority created Europe's best transit system more quickly and for less money than constructing just one subway line.

The Zürich model increases the capacity of existing roads by re-allocating road space to transit from single occupant vehicles. The result in Zürich is that transit is quicker and more convenient than driving for most trips, but traffic congestion is no worse than in a typical European city. Zürich's system uses about 1/3rd buses and 2/3rd streetcars and rail but other cities have had similar sucesses with only buses.
http://transweb.sjsu.edu/mtiportal/research/publications/summary/0113.html

While a 45% reduction in on road emissions may seem like an ambitious target, it seems to be based on reasonable assumptions given the experience in the GVRD, and BC as a whole. The University of British Columbia provides a 'test tube' example in that it is isolated at the end of a peninsula with little non-university traffic. The introduction of a mandatory U-pass transit pass for all students combined with parking price increases and a reduction of parking supply has resulted in about a 20% reduction of traffic to the campus and reduced GHG emissions by about

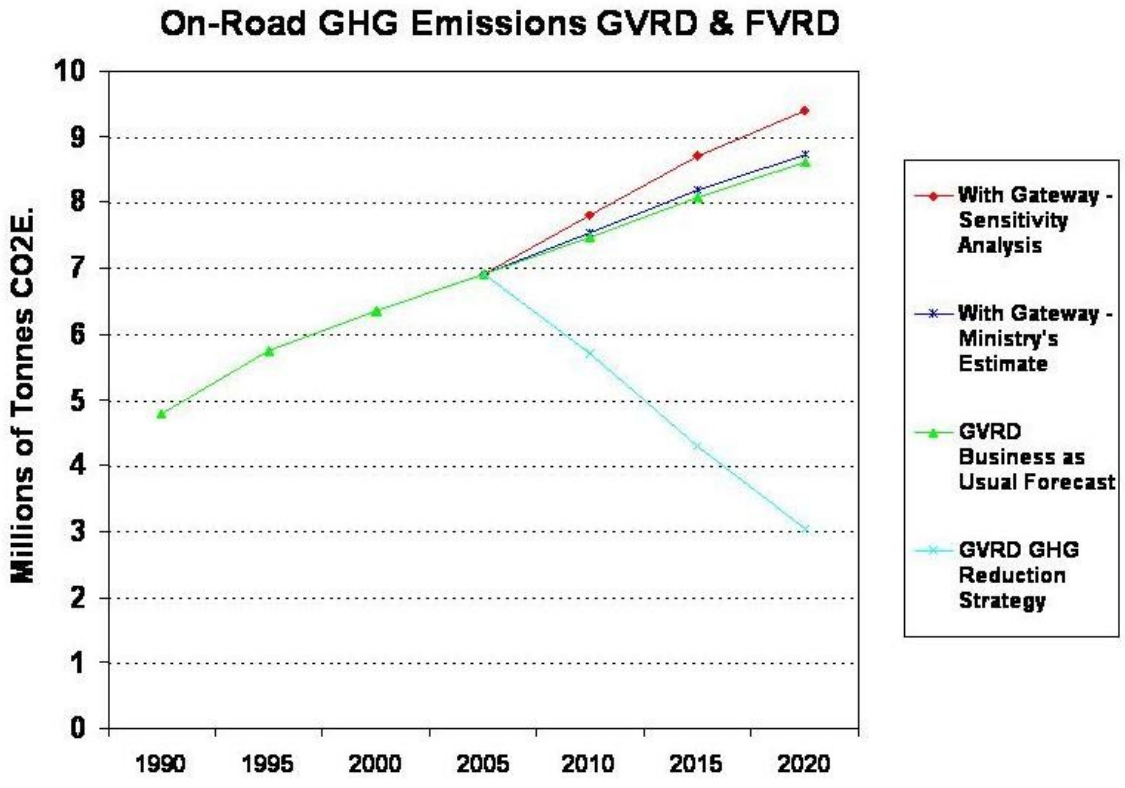
[32] http://www.gvrd.bc.ca/pdfs/GreenhouseGasReductionStrategy.pdf

16,000 tonnes in the first year[33]. This was achieved despite inadequate transit service that has resulted in chronic overcrowding. These reductions are considerably more than was expected when the program was introduced.

Recent public opinion polling reports that the majority of Canadians are willing to cut their driving in half in order to reduce greenhouse gas pollution[34]; an indication the kind of measures proposed by the GVRD might get public support and result in real behavioral change.

Many measures proposed in the GVRD report would be self-funding, or result in increased revenue or reduced expenses (e.g. increased parking fees and reduced construction of roads and parking structures). Therefore it is reasonable to expect that a re-allocation of the $3 to 4.5 billion cost of the Gateway Program would cover a considerable portion of the capital costs of implementing a transit strategy on the scale envisioned by the GVRD, if the most cost-effective technologies were used.

Figure 2: Transit Scenario Produces Radically Different Emissions Trend; Modeling Distortion Much Less Significant.



Sources: http://www.gvrd.bc.ca/air/pdfs/2000EmissionInventoryForecast.pdf; http://www.gvrd.bc.ca/pdfs/GreenhouseGasReductionStrategy.pdf

[33] http://www.planning.ubc.ca/corebus/pdfs/TransportationStatusReportFall05_20Feb06.pdf & University of British Columbia commuting greenhouse gas reduction between 2002 and 2003. University of British Columbia TREK Program Centre.

[34] Martin Mittelstaedt. *Vancouver Sun* Jan. 27, 2007 p. A6 *Why it's peak time to hit the brakes.* http://www.theglobeandmail.com/servlet/story/RTGAM.20070127.wclimatemain0127/BNStory/ClimateChange/home/?pageRequested=all

Comparing the aggressive GHG reductions scenario to the projected 2021 emissions with Gateway shows the extreme difference a re-allocation of resources could make (given an accompanying re-allocation of road space and other non monetary measures). *The Ministry predicts that on road emissions would increasse by 1.38 million Tonnes/yr with Gateway whereas the GVRD predicts a reduction of 3.87 million tonnes/yr for a difference of 5.25 million tonnes / yr, over forty two times the 124, 000 tonnes estimated in the Ministry's report as the difference between Gateway and a no-build scenario.* This difference dwarfs the difference between a business as usual scenario and either estimation of Gateway emissions.

2.8 Overall Analysis of Emissions Estimates

One of the purposes of sensitivity analysis is to determine if further research is needed, or if further research would not likely make a substantive difference to the outcome. In this case, modern and technically sound modeling of the Gateway program, including land use interaction, would likely produce substantially different results than the Ministry's present results. However, *the much more significant result is that a re-allocation of resources to cost-effective transit infrastructure as part of a GHG reduction strategy would likely produce radically different results from those in the Ministry's report. Therefore, developing a transit / transportation demand management (TDM) scenario is absolutely essential to any meaningful environmental assessment of the Gateway Program.*

3.1 GHG Pollution Cost Estimates

The upper limits to the consequences of anthropogenic global warming are difficult to fathom, let alone quantify in monetary terms. The outcomes which informed observers consider likely includes crossing a threshold (or tipping point) beyond which the environmental consequences would lead to a permanent societal collapse and the deaths of the majority of humanity, or even the extinction of our species. Recent studies have shocked the scientific and planning fields; for example a "rise of three to six meters in sea levels by 2100" is now considered a serious possibility by our regional government (GVRD 2006 p 4).

In their report for the Ministry of Transportation RDWI asserts that the overall value of damages due to air pollution and GHGs will decline between now and 2021 due to improved vehicle pollution control and fuel standards mandated by federal legislation. However they acknowledge that local air pollution and GHG emission and the resulting damage will increase due to Gateway.

> climate change impacts increase over the study period because of projected increases in GHG emissions . . . All categories of air quality-related economic impacts are higher for the Projected 2021 With Gateway scenario than for the Projected 2021 Without Gateway scenario. The higher global warming impacts in the With Gateway scenario account for the majority of the difference between the two Projected 2021 scenarios. (RWDI 2006 pp 50 -51)

Beyond the weaknesses of the Ministry's modeling and emissions estimates, their estimation of the damage caused by GHG emissions is also seriously flawed. The Ministry adopted a "damages cost estimate of $37 per tonne of GHG emissions" in 2005 dollars which is claimed to be based on the UK Government Economic Service Working Paper *Estimating the Social Cost of Carbon Emissions*[35]. This figure seems to have been used in both the 2003 and 2021 time frames.

[35] Clarkson, R. and K. Deyes. (2002). Estimating the social cost of carbon emissions. UK Department of Environment, Food and Rural Affairs http://www.hm-

The working paper surveys a number of studies which had been published at the time and concluded that

> "The most pragmatic policy response to existing studies would be to employ the most sophisticated of the studies published to date. This appears to be that produced by Eyre et al (1999). This paper considers a wide range of impact categories and geographical regions [and] uses the most sophisticated modeling techniques . . . **As such, a value of approximately £70/tC** [2000 prices] **seems like a defensible illustrative value for carbon emissions in 2000. This figure should then be raised by £1/tC for each subsequent year"** (Clarkson & Deyes 2002 pp 40-41 emphasis [bold] in original)

Therefore, a rough estimate of a value based on this report should start with a value of £70/tC and add 21 for a value in 2021 of £91/tC in 2000 GBP.

Since one tonne of carbon is equal to 3.667 tonnes of CO2 (IUEP) this is equivalent to £24.81 ($53.67 at a Nov. 2006 exchange rate[36]) per tonne of CO2 equivalent (CO2E.). Without adding £1 per year one gets a value of £19.09 ($41.30) per tonne CO2E. It seems likely that the RWDI value of $37 may have been arrived at by applying an earlier currency conversion factor to £19.09, and neglecting to raise the value "£1/tC per year in real terms for each subsequent year to account for the increasing damage costs over time" as recommended in the working paper (p6).

The working paper, however, does not recommend using the £70/tC as a single figure. Instead a range of values are recommended to allow for sensitivity analysis.

> Existing studies that have attempted to integrate uncertainty into their analysis have produced a distribution for marginal damages which is positively skewed (i.e. there is a higher probability of an extremely disastrous outcome than of a much more minor one). As such, a pragmatic approach could be to employ the £70/tC as an illustrative point estimate of marginal damages, but to also employ an upper value of £140/tC (i.e. 2x£70/tC) and a lower value of £35/tC (i.e. 0.5x£70/tC) (all 2000 prices) to perform sensitivity analyses. This approach does not take into account the full uncertainty associated with estimating the social cost of carbon emissions, but it does provide a useful sensitivity analysis to reflect the disproportionate upside risk associated with climate change damages (p6).

Therefore, it seems reasonable to compare the conclusions reached by the Ministry with the upper value suggested in the working paper. For simplicity since a much higher value will also be considered, the values are not increased over time and the same figure are used in the 2003 and 2021 time frames - £140/tC which at today's exchange rate converts to about **$83 per tonne CO2E**. Given the numerous scientific studies published since 2002 which point to increasingly serious impacts from present warming trends, the lower value no longer seems worth considering.

It also seems relevant to look to other valuations of GHG impacts by the Government of BC. The BC Ministry of Transportation and Highways working paper *Reviews of Transport 2021 costs of transporting people in the Lower Mainland* by Transportation Planning Economist Peter Bein provides one example (1996). Bein uses an upper value of **$700 per tonne** of CO2E (1991 dollars). Bein's estimate seems in keeping with the recent Stern Report and other recent studies. Note that none of these valuations account for the possibility of catastrophic damage on the scale now considered likely by some experts.

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treasury.gov.uk/documents/taxation_work_and_welfare/taxation_and_the_environment/tax_env_GESWP140.cfm

[36] £1 = $2.163 Canadian (XE.com 2006)

Table 3 Estimated Damage Costs per Year of Gateway GHG Emissions CO2E

Tonnes CO2/yr	$37 / tonne	$83 / tonne	$700 / tonne
124, 000	$4.6 million	$10.3 million	$86.8 million
781, 000	$28.9 million	$64.8 million	$547 million
5, 250, 000	$194 million	$436 million	$3.7 billion

The Ministry's report estimates the cost of Gateway related GHG emissions at $4.6 million per year. As shown in Table 5 above, my sensitivity analysis estimates place Gateway emissions damages in the range of 4.6 to 86.8 million assuming the 124, 000 tonnes of emissions estimated by the Ministry. The sensitivity analysis correcting for modeling distortion produces damage costs in the range of 28.9 to 574 million, and the damage costs of the difference between Gateway and the GVRD emissions reductions strategy range up to $3.7 billion per year. Considering that the Ministry estimates the construction cost of the entire Gateway program at $3 billion, this is a very significant figure.

This sensitivity analysis shows that estimates of the economic impact of GHG emissions also vary by an enormous degree depending on the monetary values used. Given the results of recent studies on the impacts of GHG emissions, and that earlier studies indicate "a higher probability of an extremely disastrous outcome than of a much more minor one"[37], it seems prudent to use a value towards the upper end in environmental assessment, or to use a range of values. This is a case where the precautionary principle should apply to environmental assessment.

4.0 Conclusion

While the Ministry's environmental assessment report has very serious technical flaws, these distortions are overwhelmed by the lack of a transit alternative designed to reduce GHG emissions. The source of both of these flaws seems to be political, the lack of political will to take serious measures to combat the global warming crisis.

Any serious environmental assessment process will address both of these flaws, demanding technically sound modeling of emissions, and including a transit scenario designed to reduce greenhouse gas emissions with a similar budget to the Gateway Program.

The first step to solving any problem is to stop making it worse; the Gateway Program would clearly make the greenhouse gas emissions problem in Greater Vancouver significantly worse.

[37] Clarkson, R. and K. Deyes. (2002). Estimating the social cost of carbon emissions. UK Department of Environment, Food and Rural Affairs.

Selected Internet Resources:

Society Promoting EnvironmentalConservation www.spec.bc.ca

Livable Region Coalition www.livableregion.ca

> *Transportation for a Sustainable Region: Transit or Freeway Expansion?*
> http://www.livableregion.ca/pdf/Transport_for_a_Sustainable_Region.pdf

BC Sustainable Energy Association www.bcsea.org

> BC Sustainable Energy Association - *Transportation*
> *http://www.bcsea.org/transport/*

Developing a greenhouse gas reduction strategy for Greater Vancouver. GVRD Air Quality and Management Division. http://www.gvrd.bc.ca/pdfs/GreenhouseGasReductionStrategy.pdf

South Fraser Perimeter Road Regional Air Quality Impact Assessment: Technical Volume 16 of the Environmental Assessment Application. RWDI Inc. (2006)
http://www.eao.gov.bc.ca/epic/output/documents/p196/d22440/1160695783733_8472cae2a0154601bf12ab205e7b4d0f.pdf

STERN REVIEW: The Economics of Climate Change
http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm