



The Centre for Sustainable Transportation

Le Centre pour un transport durable

# Sustainable Transportation Monitor

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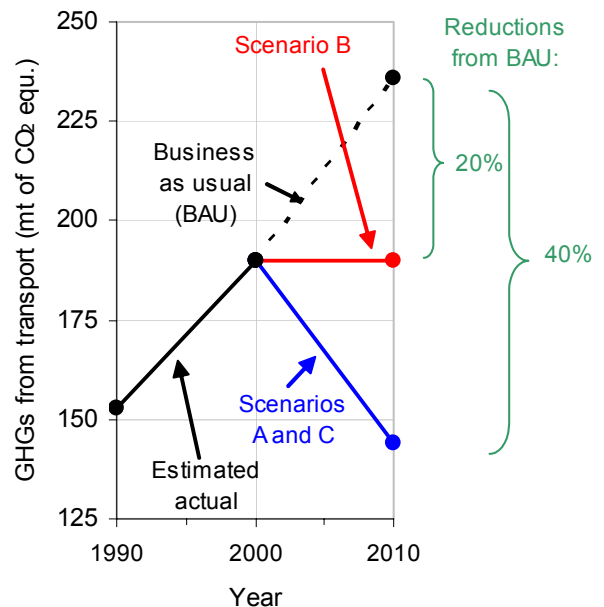
## A MEDIUM-TERM STRATEGY FOR CANADA'S TRANSPORT

**This issue of the Monitor deals with what transportation in Canada should be like during the period from about 2010 to 2025.** The year 2010 is significant because it is when Canada must meet its obligation under the Kyoto Protocol to reduce greenhouse gas (GHG) emissions to six per cent below 1990 levels.<sup>†</sup> The year 2025 was chosen as being the outer limit of the medium term.

**It's important to look beyond 2010 for two reasons.** One is to help stress the point that the transport targets for 2010 are modest. They fall far short of representing sustainable transportation. (This point is discussed below.) We need to look ahead so that meeting the Kyoto obligation is recognized as **the beginning of a process of transforming transportation in Canada, rather than the end of a process.**

The other reason is that what should be done after 2010 may affect how we go about meeting the targets for 2010. For example, we may feel that there should be considerable intensification of urban land uses between 2010 and 2025. However, an effective level of intensification could be achieved only if a start were made before 2010. Thus, transport-related policy for the period before 2010 should speak to intensification of land use even though it could contribute little to meeting a 2010 target

Box 1. GHG emissions in 1990 and 2000, and scenarios for 2010 discussed at the workshops



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for reducing GHG emissions.

To give consideration to these matters, **the Centre for Sustainable Transportation (CST) organized four workshops between February 2001 and September 2002.** They were held in Vancouver, Brampton, Montreal (in French), and Halifax. The workshops were attended by 266 Canadians with a deep interest in transport issues, including more than 200 transport professionals. Of the total, 139 were officials of governments or their agencies, 68 were from private-sector businesses, 38 were from not-for-profit organizations, and 21 were university faculty or students.

The organization of each workshop was similar. There was discussion of two issues papers, several set questions were answered, and conclusions were drawn. The issues papers were revised after each workshop to reflect new research findings and relevant matters as they unfolded, but the basic propositions held out for discussion were the same from workshop to workshop.<sup>2</sup>

This Monitor summarizes the results of the workshops and identifies the expectations of the participants with respect to actions to be taken before and after 2010. It then reviews the federal government's *Climate Change Plan for Canada*—released after the fourth workshop—in the light of the participants' expectations. Finally, conclusions are drawn as to what actions should be taken concerning transport in Canada during the period 2010 to 2025.

### WHAT WAS PROPOSED TO THE WORKSHOPS FOR THE PRE-KYOTO PERIOD

The documentation for the workshops set out four scenarios for 2010 illustrated in Box 1. A BAU scenario assumed that there would be 'business as usual' until 2010. Canada would not ratify the Kyoto Protocol and would take no particular action towards reducing GHG emissions.

Two scenarios assumed that the Kyoto requirement would be met, at least in respect of transportation. The Kyoto Protocol sets overall national targets, not sectoral targets within or across countries. Nevertheless, the two scenarios assumed that the overall Kyoto target for Canada would apply to the transport sector, i.e., in 2010, GHG emissions from transportation would be six per cent below 1990 levels. **This is known here as the transport target.**<sup>3</sup> Scenario A involved fulfillment of the transport target through measures designed to reduce energy use and thus GHG emissions. Scenario C assumed that much of the reduction in energy use would result from external factors that raised the price of vehicle fuels.

Scenario B assumed partial attainment of the transport target. Here, there was to be no assist from externally caused fuel price increases. The reduction in energy use and GHG emissions would occur through the implementation of appropriate measures that would nevertheless be insufficient to produce the reduction necessary to push GHG emissions below the 1990 level.

**The main measure proposed at the workshops for securing re-**

**ductions in greenhouse gas emissions before 2010 was introduction of stringent fuel-intensity requirements for new vehicles of all kinds.** Specifically, the document spoke to achievable reductions in energy use by 60 per cent in the case of Scenario A and by 30 per cent in the case of each of the other two scenarios.

Two other measures were proposed: increases in vehicle purchase price and increases in fuel taxes. For Scenario A, these increases were respectively 25 and 12 per cent, with the percentages being half for the other two scenarios.

**Complementary measures** included rebates and penalties to increase the rate of fleet turnover and thus hasten the introduction of less fuel-intensive vehicles,<sup>4</sup> and provision of enhanced transit, bicycle, and pedestrian amenities. **Possible additional measures** noted included several transportation demand management (TDM) measures including tax exemptions for employer-provided transit benefits, road pricing, and traffic calming.<sup>5</sup>

**Further additional measures** to be enacted before 2010 concerned intensification of land use and major investments in transit infrastructure. These would be unlikely to contribute towards meeting the Kyoto target, but action before 2010 is essential if their benefits are to be realized soon after 2010.

As in the case of the *Climate Change Plan for Canada*, CST's pre-workshop documentation may well have underestimated the potential for early reduction of GHG emissions through improving the efficiency of freight transport.

## WHAT WAS PROPOSED TO THE WORKSHOPS FOR THE POST-KYOTO PERIOD

The pre-workshop documentation set the target for the post-Kyoto period of reducing GHG emissions from transport to 30 per cent below the 1990 level, to be achieved by 2025. The documentation explained that this would not achieve sustainable transportation, as defined by CST. According to CST's vision of sustainable transportation, an *80-per-cent reduction below 1990 levels* will be required, with 2030 as the target year.<sup>6</sup> The work of the Paris-based Organization for Economic Cooperation and Development (OECD) has set a similar target.<sup>7</sup> The less ambitious target level was nevertheless proposed as providing a more productive basis for the workshop discussions.

**The challenge for the post-Kyoto period** was thus characterized as that of figuring out how to change transportation from its 2010 position to the position targeted for 2025, i.e., from 6 per cent below the 1990 level in terms of GHG emissions (Scenarios A and C) or 25 per cent above the 1990 (Scenario B) to 30 per cent below the 1990 level.

**The main measure proposed for the post-Kyoto period was market-based rationing by quota of fossil fuel use for transport.**<sup>8</sup> An example of this kind of rationing would be the following: Each Canadian would receive an annual entitlement to use a certain amount of fossil fuel for transport. The total entitlement of all Canadians would correspond to the target for GHG emissions from transport, plus a margin for expected unused entitlements. Entitlements would be stored on 'smart cards' and deducted when

fuel or transport services were purchased. Entitlements could be freely purchased and sold through automatic tellers and in other ways. Individuals and businesses who needed more entitlements would purchase them. Individuals who needed less would sell them.

**A scheme involving market-based rationing by quota was proposed for three reasons:** (i) unlike other measures, rationing by quota allows a reduction target to be set for GHGs and, if properly implemented, met with certainty; (ii) rationing by quota ensures widespread availability of the rationed resource and greater equity than rationing by price; and (iii) market-based rationing allows flexibility according to need.

A rationing scheme of this kind is similar in principle to schemes of **tradable emissions credits** that are becoming more popular for several purposes and are permitted under the Kyoto Protocol.<sup>9</sup>

**Other proposed focuses of action during the post-Kyoto period** included attitude change to help acceptance of rationing and other proposed measures, further land use change to offset transport-intensive sprawl, and further enhancement of urban transit. The need for massive extension of electrified transit was noted, particularly transit powered from rails or wires. Such systems allow use of a wide range of primary energy sources, including renewable sources.

**The post-Kyoto documentation was admittedly weak in respect of freight transport.** The only positive proposal concerned electrification of Canada's rail system so that freight could be moved using non-

fossil-fuel sources when conventional transport fuels became scarce.

## WHAT WAS CONCLUDED AT THE FOUR WORKSHOPS

In brief, the participants in the four workshops endorsed CST's targets and proposed measures with the following significant comments and exceptions:

- There was general acceptance of the proposition that the Kyoto Protocol's requirement of an overall six-per-cent reduction in GHG emissions should apply to transportation, i.e., what was described above as **the 'transport target' should be met**. However, there was skepticism as to whether it could be met. The skepticism was mostly in respect of Scenario A. Participants felt that sufficiently stringent measures would not be implemented. Scenario C—that very high world oil prices would occur before 2010—was regarded as the best hope for attainment of the transport target, i.e., that GHG emissions from transportation in 2010 will be six per cent below 1990 levels. (The discussion below—in connection with Box 4—suggests that such prices may be more likely to occur after 2010.)
- **Participants felt that the proposed target for 2025 is realistic only if the transport target for 2010 is met.** They said that without high fuel prices before 2010 this would likely not happen.
- **Reductions in new-vehicle fuel intensity should not be relied on to the extent proposed for the pre-2010 period;** other



measures should be given more emphasis, notably provision of enhanced transit, bicycle, and pedestrian amenities, and TDM measures including those noted above.

- **Rationing should be used only as a last resort**, not as a key element of the post-2010 strategy, except that the threat of rationing could be used to help ensure the effectiveness of other measures.
- More attention than proposed should be given to changing attitudes, reversing sprawl, and enhancing transit, recognizing that improved high-order transit lines are a key incentive to achieve compact, mixed-use development in nodes and corridors. Above all, **more attention should be given to freight transport** before and after 2010.
- In general, **policy-making for the post-2010 period should not rely on unproven technology**. However, there should be intensive research on relevant technology and its results should be incorporated into strategy as they become available.

### CANADA'S PLAN FOR MEETING THE KYOTO COMMITMENT

Two significant related events occurred between the final workshop, held in September 2002, and the preparation of this report early in 2003. One was Canada's ratification of the Kyoto Protocol on December 17, 2002. The other was the release on November 21 of the Government of Canada's proposals for meeting the Kyoto commitment, in a document entitled *Climate Change Plan for Canada*.<sup>10</sup>

This section briefly overviews the *Plan* as it applies to transportation. The next section provides comments on the *Plan* made in the light of the conclusions drawn from the four workshops, with a particular focus on whether or not the *Plan* sets the stage for the post 2010 actions agreed at the workshops.

The *Plan* has two key points of relevance to consideration of what should be done during the post-Kyoto period. They both concern the projection of what will be emissions from transportation in 2010.<sup>11</sup> The **first point of relevance** is that the *Plan* sets out targets for 2010

for reductions in GHGs by each sector, including transportation. Box 2 shows these targets for transportation and for other sources of GHG emissions. (The reductions in Box 2 are those expected from activities in Canada only. An additional 45 megatonnes (mt) is to come from international emissions trading and credit for clean exports.)

The *Plan* proposes proportionately less in the way of GHG reductions from transportation than from other domestic sources. The reductions are to amount to only 12 per cent of the expected 'business-as-usual' (BAU) level compared with 28 per cent for reductions from all other sectors.<sup>13</sup> Thus, the proposed reduction from transportation would fall far short of that required to meet the transport target, i.e., what was regarded by many workshop participants as the proper target for GHG reductions from transport, namely the average required of all sectors.

No reason was given in the *Plan* for favouring transport in this way.<sup>14</sup> Its result could be a higher rate of GHG emissions in 2010 than would

Box 2. Transport's GHG emissions in 1990 and 2000, and reductions by 2010 according to the *Climate Change Plan for Canada*

	Actual GHG emissions in megatonnes (mt)			'Business as usual' (BAU) projection for 2010 in the <i>Plan</i>		Estimated required reduction in GHG emissions (mt), from actions in Canada only	Required reduction in GHG emissions as a per cent of the BAU projection
	1990	2000	Change over 1990	Mega-tonnes	Change over 2000		
Transportation	153	190	24%	206	8%	24*	12%
All other sectors	454	536	18%	603	13%	171	28%
<i>Transport's share of total</i>	25%	26%		25%		12%	

\*This value is larger than that given in the *Plan* (which is 21 mt). For the derivation of this value from the *Plan*, see Note 12



occur if transport were expected to contribute the same reduction in GHG emissions as other sectors, and a larger challenge for transport after 2010.

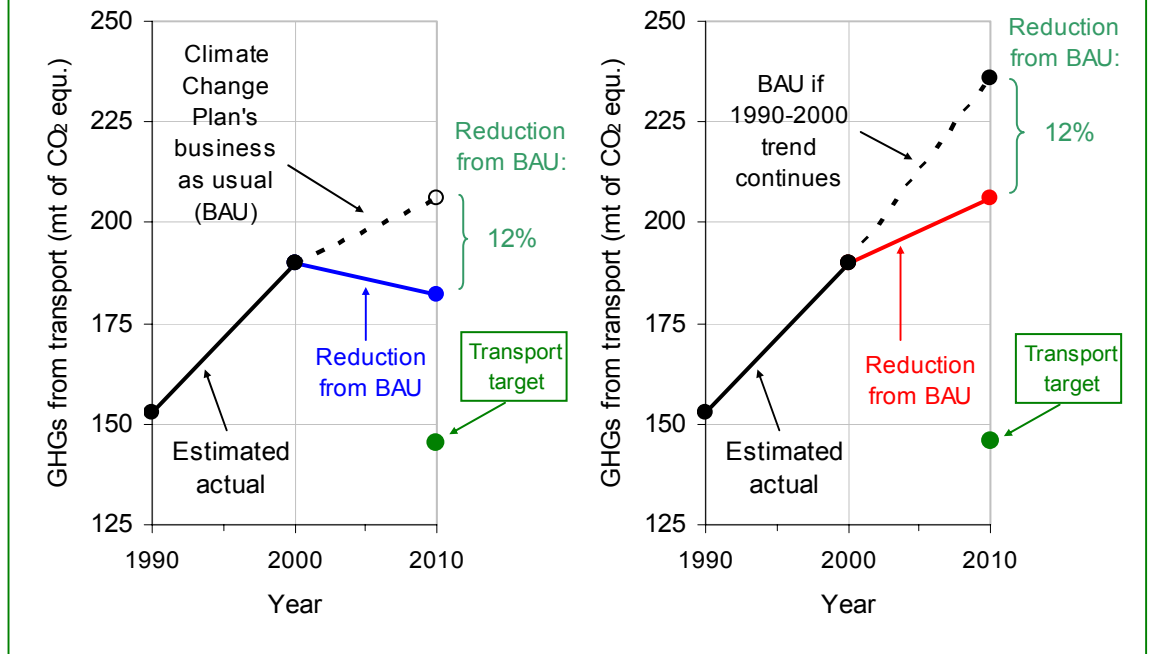
The **second point of relevance** is that the *Plan* projects what may be an unreasonably low BAU (business as usual) level of GHG emissions from transportation during the period 2000-2010.

Even though transport emissions increased by 24 per cent during the period 1990-2000 compared with 18 per cent for other sectors, they are expected to increase by only 8 per cent during the period 2000-2010, compared with 13 per cent for other sectors (see Box 2). This would be a remarkable turnaround that is not explained in the *Plan*, and is not consistent with some of the data to date.<sup>15</sup>

Box 3 charts the *Plan's* proposal for transportation (left panel). It also sets out the case where overall BAU trends for transport for 2010 are a continuation of those for 1990-2000 (right panel), with transport having the same proportionate reduction as in the *Plan*, i.e., 12 per cent from the BAU level. The right-panel is presented as a more conservative and perhaps more prudent approach to estimating BAU trends.

The left-hand panel of Box 3 shows that if the *Plan's* BAU projection is correct, the proposed reduction in GHG emissions from transport will

Box 3. Transport's GHG emissions and reductions by 2010 according to the *Climate Change Plan for Canada*, and if there were a continuation of 1990-2000 trends



leave these emissions below the 2000 level, but far above the 1990 level and even farther above what is described here as the 'transport target'. The right-hand panel of Box 3 shows that if the trends of the 1990s continue to 2010, then the reduction proposed in the *Plan* will not even return GHG emissions from transport to the 2000 level.

Thus, by not requiring transport to meet the transport target, and by possibly underestimating BAU trends until 2010, the *Climate Change Plan* may be adding substantially to what has to be achieved from the transport sector during the period 2010-2025.

**The measures proposed in the *Plan* for securing the reductions in GHG emissions from transportation include "actions under way" and "proposed next steps",** resulting in reductions totalling 9 mt and 12 mt, respectively.<sup>16</sup>

More than half of the **contribution by the actions under way** is to result from a "25-per-cent improvement in new vehicle fuel efficiency by 2010",<sup>17</sup> resulting in a reduction of 5.2 mt of GHG emissions.<sup>18</sup> This is to be negotiated with auto manufacturers.

Here are **other actions under way**, and the reductions in GHG emissions they are to be responsible for:<sup>19</sup>

- negotiation of voluntary agreements with air, rail, truck, and marine sectors to reduce the fuel intensity of goods transport, 2.0 mt;<sup>20</sup>
- increased ethanol production to support introduction of ethanol blending of 25 per cent of the gasoline supply, 0.8 mt;
- demonstration of integrated strategies, technologies, and planning to reduce urban transportation emissions, 0.8 mt; and
- development and demonstration of refueling technologies and infra-



structure for commercialization of fuel cell vehicles, 0.1 mt.

More than half of the **contribution by the proposed next steps** would comprise a reduction of 7.0 mt of GHG emissions from “increased use of public transit, and alternative approaches to passenger transportation and sustainable urban planning”.

**Other proposed next steps**, and the reductions in GHG emissions they will be responsible for, are:

- more efficient goods transport, including intermodal, 2.3 mt;
- increasing the target for ethanol blending to 35 per cent of gasoline supply, and setting a target of 500 million litres of biodiesel in use by 2010, 2.0 mt; and
- consumer action to reduce vehicle fuel intensity, including that of off-road vehicles, 0.8 mt.

### COMPARING CANADA'S PLAN TO THE EXPECTATIONS FROM THE WORKSHOPS

When comparing the actions proposed in the *Climate Change Plan for Canada* to those discussed at the workshops, the following observations are indicated:

- **The target for transport is seen as too modest.** Even if the proposed target is met GHG emissions from transport in 2010 would be well above those in 1990 (see Box 2). If the BAU increase from 2000 to 2010 has been underestimated, as suggested above, GHG emissions in 2010 could even be above the 2000 level (see Box 3). Neither result would represent sufficient progress towards sustainability. A more stringent target could be adopted that would benefit the

Canadian economy, as well as providing the greater health and economic benefits that could come with larger reductions in emissions from transport.<sup>21</sup>

- For moving people, **the early emphasis on reducing new-vehicle fuel efficiency is appropriate.** However, **voluntary agreements will probably not be sufficient** for timely achievement of the proposed 25-per cent improvement. Legislated standards will be required to achieve even this improvement,<sup>22</sup> and certainly the greater improvements proposed by CST (see above). As well, incentives and penalties for ensuring a higher rate of fleet turnover may be required (also see above).
- **The focus on public transit is desirable, but it will likely not achieve the anticipated result,** for two reasons. The first reason is that securing the targetted reduction through mode shifts from cars to transit implies an impracticably large increase in transit use by 2010.<sup>23</sup> The second is that increased use of public transit will in any case likely require increased residential and commercial densities, which are not achievable by 2010.
- As well as reductions in fuel intensity and increases in transit use, actions should be taken to **reduce overall travel**—i.e. TDM measures. In addition, actions are required to **prepare Canadians for changed transport circumstances** after 2010, including action to increase urban settlement densities.
- **It is possible that much more than is proposed in the Plan could be achieved from improvements in the efficiency of**

**freight transport**, particularly through improved logistics and supply-chain management.<sup>24</sup>

**In short, the workshop findings suggest that the Government of Canada's target for reduction of GHG emissions from transport by 2010 is too modest, and the means proposed for achieving the target are unlikely to result in the target being met.** The good news is that the Government may have greatly underestimated the reductions that could be achieved through more efficient freight transport. These comments on the *Climate Change Plan*, particularly the first and the last comments, are consistent with what was said about the pre-Kyoto period at the four workshops.

### DISCUSSION OF THE WORKSHOP RESULTS AND SUBSEQUENT EVENTS

Publication in November 2002 of the *Climate Change Plan for Canada* (see above) has confirmed the view expressed at the workshops that Kyoto-Protocol-related measures will be insufficient to ensure that the transport sector experiences its proportionate share of reductions in GHG emissions by 2010.

CST's view, and probably that of most workshop participants, is that **even the much more modest target proposed for transport in 2010 will be difficult to meet because the measures proposed to meet it will probably be insufficiently effective**, as discussed above. Only a concerted effort to improve the operational efficiency of freight transport could possibly lead to attainment of the *Plan's* target. However, we cannot be certain



that freight transport could save the day because too little is known about the present condition of freight transport.<sup>25</sup>

Moreover, recent assessments of the availability of liquid petroleum products suggest that the credibility of the proposed Scenario C (see Box 1 and associated text)—which assumed large increases in world oil prices before 2010—may be less than indicated. The current best estimate may be that in Box 4, which suggests a **peak in world production of oil and other petroleum liquids shortly after 2010**.<sup>26</sup>

It follows that truly large price increases in crude oil may not occur until after 2010. However, progressive price increases throughout the present decade can be expected because of the increasing use of more expensive sources such as oil sands, deep water, and polar oil.<sup>27</sup> The possibility raised before and during the workshops that very large fuel price increases before 2010 could contribute to attainment of the transport target should perhaps be discounted.

**Thus, in 2010, Canada's GHG emissions from transportation may well be above the 2000 level and very far above the 1990 level.**

Opposing conclusions about a post-Kyoto strategy could be

drawn from this conclusion. One is that the 2025 target proposed to the workshop of a 30-per-cent reduction in GHG emissions below the 1990 level is now impracticable and should be abandoned. The other is that the target should be maintained, even though it would require heroic efforts after 2010. **CST's Board believes the 2025 target should be maintained.** As noted, even this target was insufficient in relation to CST's vision of sustainable transportation.<sup>28</sup> Abandoning the target for 2025 could amount to abandoning a key part of CST's vision.

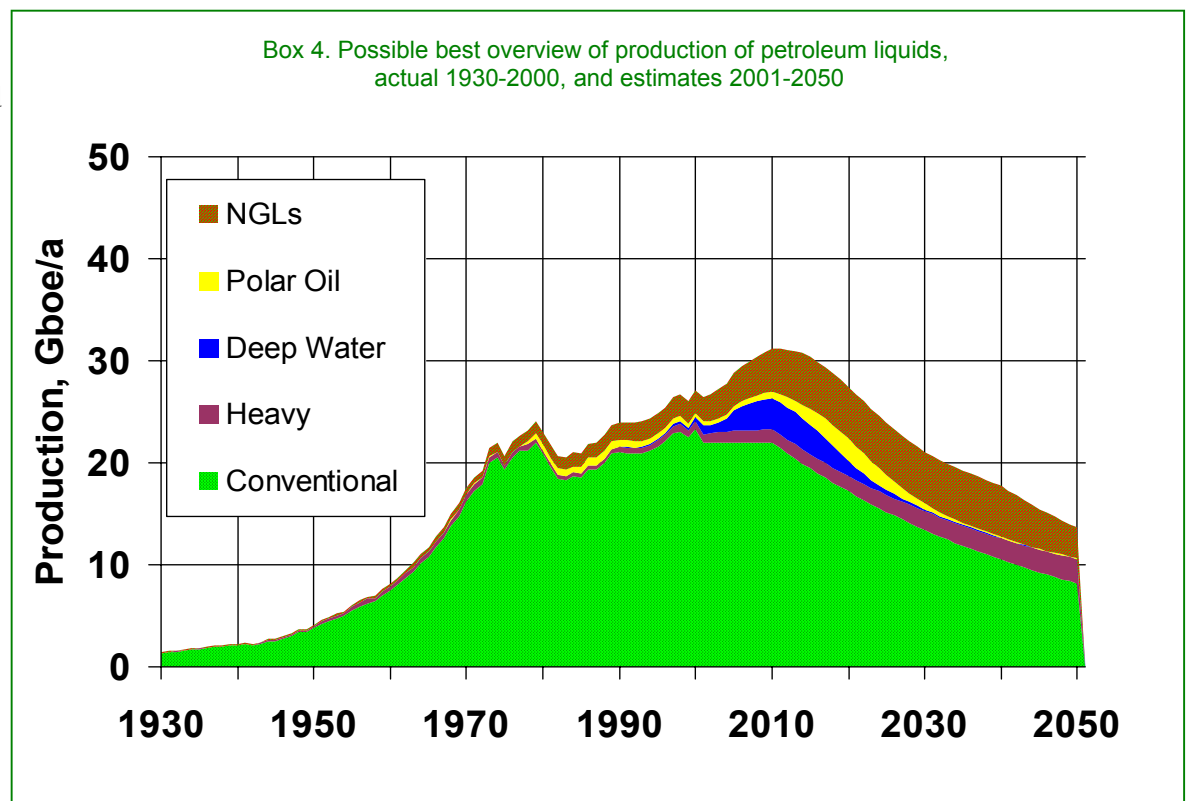
**The key to attainment of the 2025 target for GHG emissions may be the occurrence of very high oil prices during the post-2010 period.** It seems increasingly likely that the worldwide peak production of petroleum liquids will occur during this period, perhaps nearer the beginning than the end. Thereafter, consumption will irrevocably de-

cline, notwithstanding high potential demand, with associated very high prices.<sup>29</sup>

Thus, the main challenge for transport policy-making over the next several years should perhaps not be how to meet specific GHG emission-reduction targets, whether for 2010 or 2025, or even how to make progress towards sustainable transportation. **The main challenge may be that of helping energy-dependent and transport-dependent Canadians prepare for inevitable energy constraints and very high fuel prices.**

In reality, reducing GHG emissions, making progress towards sustainable transportation, and preparing for an era of energy constraints all amount to the same thing: drastically reducing fossil fuel use.

The question then becomes how this should be achieved. Workshop



participants were clear in saying there should not be reliance on unproven technology. In practice, this means that present strategy for the post-2010 period should focus on measures designed to change attitudes, change land-use practices, provide for massive expansion of electrified transportation, and reduce overall travel, as agreed at the workshops.

One means governments have of preparing for and coping with severe shortages is rationing by quota, discussed above.<sup>30</sup> This means did not find favour at the workshops. It was regarded as too extreme. However, at each workshop the view was expressed that such rationing should be used as a last resort. As prices rise during the present decade, Canadians may well find rationing by quota more desirable.

The alternative is rationing by price. If the production projections in Box 4 are correct, and worldwide demand for oil continues to rise, very high vehicle fuel prices could well be a feature of the decades after 2010. The increases in demand would be driven more by developing than developed countries. Very high oil prices will themselves limit demand but they will do it unfairly so that only the rich have access to transport fuels and services. Rationing by quota would be fairer in that it would ensure access by all to transport fuels and services.

With or without rationing by quota, aggressive action by governments will serve to provide Canadians with a 'soft landing' when very high energy prices arrive. Without such action, our highly transport-dependent society may be unable to cope. Alternatives to what will be very expensive automobile travel

will not be available. The poor will be especially affected because prices for all kinds of transport will increase. The economy will suffer because people will not be able to get to their jobs and the cost of freight transport could become prohibitive. The most strongly affected could be people who live in low-density suburbs. They would not be able to afford use of their cars for every journey, but there would be no alternatives.

### CST'S PROPOSALS FOR THE MEDIUM TERM

Set out below are **several recommendations by the Centre for Sustainable Transportation to the federal government and other agencies** based on the foregoing:

1. The possibility of severe shortages of vehicle fuels during the decade after 2010 or very high fuel prices, or both, should become a prime concern of transport policy-making during the present decade. The possibility should be critically examined from a Canadian perspective with careful mapping of the likely parameters of transport fuel supply.
2. Early reductions in the use of fossil fuel for transport should become a national priority for three reasons: (i) to ensure that the Kyoto target is met; (ii) to prepare Canadians for an era of energy constraints; and (iii) to secure progress towards sustainable transportation.
3. In the short term, two key focuses should be reducing the energy intensity of all kinds of ve-

hicles and improving the efficiency of use of freight transport. Early meaningful reductions in fuel intensity would likely have to be legislated. They could be complemented by measures that increase penetration of new, less fuel-intensive vehicles. Taken together, these measures could improve economic efficiency and economic activity and thus the well-being of Canadians.

4. The focuses on these types of measure should be accompanied by early use of other measures, notably measures that enhance amenity for transit users, cyclists, and pedestrians and measures that manage travel demand.
5. Of special importance are early measures that will help prepare Canadians for later fuel constraints. These include education and information about energy constraints and transport, changes in how land is used so as to reduce sprawl, and massive investment in transit, particularly in rail- and wire-based systems that will allow the most efficient use of the widest range of renewable energy sources and encourage more compact development nodes. At least as much attention should be given to the movement of freight as to the movement of people. Market-based rationing of transport fuel by quota should be considered only as a last resort.





## THE CENTRE FOR SUSTAINABLE TRANSPORTATION

The Centre is a federally chartered, non-profit organization.

The Centre's mission is to provide leadership in achieving sustainable transportation in Canada by facilitating cooperative actions, and thus contributing to Canadian and global sustainability.

**To achieve its mission the Centre provides reliable information, fills knowledge gaps through research, educates stakeholders and raises awareness among them, and offers strategic policy advice in selected areas.**

**The Centre's first publication was its *Definition and Vision of Sustainable Transportation*, published in mid 1997. You are reading the eighth issue of the *Sustainable Transportation Monitor*, published annually from 1998 to 2000 and now twice or more times a year. All issues of the *Monitor* are available at the Centre's Web site, as are the Centre's other publications (visit [www.cstctd.org](http://www.cstctd.org)). The *Monitor* provides evaluation of progress towards or away from sustainable transportation and discussion of related matters.**

This issue has been written by Richard Gilbert, the Centre's research director. The content has been endorsed by the Board of Directors acting as individuals rather than as representatives of the organizations with which they are affiliated (and not unanimously in every instance).

Comments on this issue of the *Monitor* and proposals as to what should be covered in coming issues are much appreciated. E-mail is the preferred mode of communication but feedback by any mode is welcome. **Please see Page 1 for our e-mail address, fax and phone number, and mailing address.** Contact the Centre to become a corporate or individual member of the Centre.

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## REFERENCE NOTES

1. The Kyoto Protocol is an amendment to the United Nations Framework Convention on Climate Change (UNFCCC) adopted at the Third Conference of the Parties to the UNFCCC, held in Kyoto, Japan, in December 1997. The Protocol concerns reductions in emissions of six greenhouse gases (GHGs), i.e., gases whose concentration in the earth's atmosphere influences the mean temperature of the earth's surface by affecting the rate of energy loss of the earth (see the first URL below). By February 24, 2003, the Protocol had been signed by 120 countries and ratified or similarly adopted by 104 of these countries (see the second URL below). The Protocol is binding on the 38 countries listed in Annex 1 to the UNFCCC, i.e., most of the industrialized countries, including those with economies in transition (former Soviet Union and eastern European countries). The Protocol comes into effect when two criteria are met: (i) it has been ratified by 55 Parties to the UNFCCC, and (ii) it has been ratified by Annex 1 countries responsible for 55% of the total 1990 GHGs emitted by Annex 1 countries (see the third URL below). The first criterion has been met. Regarding the second criterion, 30 Annex 1 countries have ratified the Protocol, representing 44% of 1990 Annex 1 GHG emissions (see the second URL below). Ratification by the Russian Federation would increase this share to 61% (see the fourth URL below), thereby implementing the Protocol. This was promised during 2002 (see the fifth URL below), but is now in doubt (MacKinnon M, Russian stalling could kill Kyoto consensus, *Globe & Mail*, March 1, 2003). Significant non-ratifiers of the Protocol are the U.S., responsible for 33% of the 1990 Annex 1 total, and Australia, responsible for 2% of the total. Canada, responsible for 3% of the total, ratified the Protocol on December 17, 2002. When the Protocol comes into effect, Canada's obligation will be to reduce its GHG emissions so that the average during the five years 2008 to 2012 is 6% below the 1990 level. **Here the year 2010 is used as shorthand for the five-year average.** As well, "demonstrable progress" must be made by 2005 (see the third URL below).  
<http://unfccc.int/resource/iuckit/fact02.html>. Accessed March 4, 2003.  
<http://www.unfccc.int/resource/kpstats.pdf>. Accessed March 4, 2003.  
<http://unfccc.int/resource/iuckit/fact21.html>. Accessed March 4, 2003.  
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[http://www.iisd.ca/linkages/climate-l/Climate-L\\_News\\_3.pdf](http://www.iisd.ca/linkages/climate-l/Climate-L_News_3.pdf). Accessed March 6, 2003.
2. The latest versions of the two issues papers used at the four workshops are available at the URL below.  
<http://www.cstctd.org/CSTwhatsnew.htm>. Accessed March 4, 2003.
3. When the *Background Paper* for the workshops (see Note 2) was being prepared, the federal government had not released its *Climate Change Plan for Canada* (see Note 10), and no targets for individual sectors had been set. The *Background Paper* took what was described as "the most conservative and realistic approach", which was to assume that all sectors would have to make roughly similar proportionate contributions to attainment of sustainability. However, it was noted that "the reduction required from transportation [could] be less than that required on average by other sectors because transportation is so important or so intractable, or both". The assumption was nevertheless made that transport's contribution to meeting the Kyoto Protocol would be the average of all sectors, in part to avoid disputes among sectors. This assumption became something of a moral position endorsed by workshop participants.
4. More rapid penetration of new technology through increased vehicle turnover would sharpen the need to address the fate of end-of-life vehicles, unrecycled portions of which may be adding to Canada's waste-management challenges. For a recent assessment of this situation in Ontario, see *Management of end-of-life vehicles (ELVs) in Ontario*, Recycling Council of Ontario, September 1999, available at the first URL below. The European Union has addressed this matter by legislating extended producer responsibility for ELVs, described in the document at the second URL below.  
<http://www.rco.on.ca/research/proceedings/elv.html>. Accessed March 4, 2003.  
<http://www.epa.gov/epaoswer/non-hw/reduce/epr/products/vinterm.html>. Accessed March 4, 2003.
5. A useful resource on Transportation Demand Management (TDM) is the *Online TDM Encyclopedia* produced by the Victoria Transportation Policy Institute, available at the URL below. According to the *Encyclopedia*, "TDM is a general term for strategies that result in more efficient use of transportation resources. There are many different TDM strategies with a variety of impacts. Some improve the transportation options available to consumers, while others provide an incentive to choose more efficient travel patterns. Some reduce the need for physical travel through mobility substitutes or more efficient land use. TDM strategies can change travel timing, route, destination or mode." A subset of TDM measures is known as 'Win-Win solutions', described in the *Encyclopedia* as "technically feasible, cost-effective changes to current policies and practices that use market principles to help solve transportation problems by removing distortions, increasing consumer choice, and encouraging more efficient travel behaviour." For a recent European perspective on TDM see *Managing the Fundamental Drivers of Transport Demand*, European Conference of Ministers of Transport, Paris, April 2003.  
<http://www.vtpi.org/tdm/>. Accessed March 25, 2003.
6. For CST's vision see the document *Definition and Vision of Sustainable Transportation* at the URL below. The vision is for the year 2030. The actual words in the vision that speak to an 80% reduction in GHG emissions are these: "The impacts [of transportation] are so low they no longer provide reason for concern about people's health or any part of the natural environment, in the present or the future. In particular, emissions of carbon dioxide and other greenhouse gases from transportation are *less than one fifth* of the total of such emissions in the 1990s." [italics added]  
Two articles in a recent issue of the prestigious journal *Science* provide support for the need for such major reductions in GHG emissions. One suggests that an 80% reduction by 2030 could be required for later stabilization of atmospheric CO<sub>2</sub> emissions at double the pre-industrial level (Caldeira K, et al, Climate sensitivity uncertainty and the need for energy without CO<sub>2</sub> emission. *Science*, 299, 2052-2054, March 28, 2003). The other suggests that even with no more than such a doubling of the CO<sub>2</sub> level, large, abrupt climate change events could occur, including diver-



- sion of the warm North Atlantic current that makes northern Europe habitable (Alley RB, et al, Abrupt climate change. *Science*, 299, 2005-2010, March 28, 2003).  
<http://www.cstctd.org/CSTadobefiles/definitionvisionadobe.pdf>. Accessed March 4, 2003.
7. For the OECD work, see *Synthesis Report of the OECD Environmentally Sustainable Transport (EST) Project*, 2000 at the first URL below. A summary of the Canadian case study developed for this project appears at the second URL below.  
<http://www.oecd.org/pdf/M00019000/M00019258.pdf>. Accessed March 4, 2003.  
<http://www.ec.gc.ca/transport/publications/tos406/makingsustrans1.htm>. Accessed March 4, 2003.
  8. **Rationing by quota** means that overall consumption is limited to a desirable total by issuing entitlements to use a portion of the total. The entitlements could be distributed in several ways: equally to every resident (as in the example in the text), by presumed need, or by auction. **Market-based rationing by quota** means that entitlements, once received, can be freely traded. **Rationing by price** means that overall consumption is restrained by means of a sufficient increase in price. For further discussion of oil prices and their effects see Note 27.
  9. Domestic and international trading of entitlements to emit GHGs are key features of the *Climate Change Plan for Canada* (see Note 10). A useful resource on trading emissions entitlements is the Web site of the National Round Table on the Environment and the Economy, at the URL below.  
<http://www.nrtee-trnee.ca/EmissionsTrading/en/index.htm>. Accessed March 26, 2003.
  10. The document *Climate Change Plan for Canada*, Government of Canada, November 21, 2002, is available at the URL below.  
<http://www.climatechange.gc.ca>. Accessed March 4, 2003.
  11. This note is a reminder that the year 2010 is used as shorthand for the five-year average for the years 2008-2012 (see Note 1).
  12. Note that the reduction for transport has been factored upwards from the 21-mt reduction to be achieved by the end of Step II of the *Plan* to include a further 3-mt reduction to be achieved after Step II. The 3 mt is the prorated portion of the domestic part of the “60-mt gap” left at the end of Step II. It should be stressed that this factoring upwards has been done by CST; the federal government’s intentions with respect to the allocation of this 60-mt reduction are not known at this time.
  13. ‘Business as usual’ projections are defined in the *Climate Change Plan for Canada* as “emissions growth in the absence of additional policy initiatives”.
  14. Six key principles underpinning the *Plan* are set out in Section II of the *Plan*, but there is no derivation of the sectoral targets from these principles. Moreover, it is not possible to understand from the *Plan* how reduction targets were assigned to specific instruments, nor why several potential instruments do not comprise part of the *Plan*.
  15. 2001 was an extraordinary year for transport data because of the events in the U.S. on September 11. Fuel sales for and thus GHG emissions from trucking and aviation in Canada fell between 2000 and 2001 and did not regain 2000 levels during 2002. However, the major source of transport GHG emissions, road gasoline use, increased by 1.2% between 2000 and 2001 and by 2.1% between 2001 and 2002. At the overall 2000-2002 rate, the overall 2000-2010 increase in road gasoline use will be 17.9%. (Source: Statistics Canada, *CANSIM II*, Table 1340004, Series V22455 and V23190.)
  16. The reductions presented in Box 1 and Box 2 include an additional 3 mt of reductions for later implementation as part of a total of 60 mt of emissions left unaccounted for in the *Plan*. The additional 3 mt of emissions is explained in Note 12.
  17. For clarification, it should be noted that the quoted phrase means a 25 per cent reduction in fuel intensity, for example, a reduction from 10 litres per 100 kilometres to 7.5 L/100 km.
  18. The source of the reduction given in the *Climate Change Plan* is the “Motor Vehicle Fuel Efficiency Initiative in *Action Plan 2000*”. There is no initiative with this name in *Government of Canada Action Plan 2000 on Climate Change*, available at the URL below. There is reference in *Action Plan 2000* to a fuel efficiency measure to comprise the phasing in of significant voluntary reductions in new-vehicle fuel intensity beginning in 2004, although no mention of a 25% target.  
[http://climatechange.gc.ca/english/whats\\_new/pdf/gofcdaplan\\_en\\_g2.pdf](http://climatechange.gc.ca/english/whats_new/pdf/gofcdaplan_en_g2.pdf). Accessed March 4, 2003.
  19. These actions are set out on Pages 20-24 of the *Climate Change Plan for Canada*, detailed in Note 10.
  20. The fuel intensity of freight transport can be reduced in one or both of two ways. The vehicles used to carry freight can consume less fuel, or the same amount of freight can be carried in fewer vehicles. The former approach is mostly a matter of technology, driving practice, and vehicle maintenance. The latter approach is mostly a matter of logistics and supply chain management. *Action Plan 2000* (see Note 18) spoke to “the take-up of best practices and technologies such as the use of synthetic fuels, improved fuel injection systems, and optimized tire pressure”. This suggests an exclusive focus on the former type of approach.
  21. *Climate Change Plan for Canada* (see Note 10) suggests that measures to reduce GHG emissions will “contribute to cleaner air and reduce traffic congestion, making our cities healthier and more sustainable” (Page 20). In these ways, the measures will improve health and economic performance. Further reductions could improve health and economic performance more. There would be a point where further reductions could impede economic performance by reducing the services that transport provides, but Canadian transport systems are likely far from this point, which would not be reached in efforts to meet the Kyoto commitment.
  22. There are **three reasons for being pessimistic** about the ability of voluntary agreements to ensure the required reductions in new-vehicle fuel intensity:  
**The first** is that most auto manufacturers have said that an overall 25% reduction by 2010 is not achievable, only a 4-5% reduction. (See Erwin S, Auto sector quietly fumes over tough Kyoto targets, *Financial Post*, December 23, 2002.) One reason given was the need to harmonize efforts with the U.S. However, the cited article notes that California, which has an auto market of similar size to that of Canada, is forging a separate path from the rest of the U.S. in the related matter of GHG emissions. The article also notes that the Canadian Auto Workers union believes the Government of Canada’s target is achievable. The position of management was restated during a press conference held by the

president of General Motors of Canada who said that the 25% reduction “is an admirable goal but at this point ... with the product portfolio, the technology, the cost and price issues, we don’t see a way to get there” (Van Alphen T, GM warns about fuel-economy plans. *Toronto Star*, January 21, 2003).

**The second reason for being pessimistic** is that the new models being unveiled by the industry appear on balance to be more fuel intensive than in previous years. One commentator wrote, “Anyone who is of the belief the onslaught of monster-tired, over-engined cars and trucks, especially SUVs, would somehow be diminished by Sept. 11, the impending invasion of Iraq or the price of a barrel of crude obviously hasn’t visited this year’s North American International Auto Show” (Booth D, Another year, another SUV, *National Post*, January 10, 2003). Japanese auto makers, historically more concerned with low fuel intensity, also seem to have joined the race for increased fuel use (Keenan G, Japan’s auto makers trotting out increased horsepower. *Globe and Mail*, January 20, 2003). The Auto Show also saw the unveiling of more vehicles with hybrid drive trains, which are inherently less fuel intensive but more expensive and thus less popular.

**The third reason for pessimism** is that a present federal government voluntary agreements program covering all sectors, the Voluntary Challenge and Registry Program, appears not to be meeting its goals. See, Bramley M, *The Case for Kyoto: the Failure of Voluntary Corporate Action*. Pembina Institute, October 2002, available at the URL below. Nevertheless, the voluntary agreement between the European Commission and the European Automotive Manufacturers Association (ACEA) to reduce the average carbon dioxide emissions (i.e., fuel intensity) of cars made in Europe does seem to be producing results. The target is a 25% reduction between 1995 and 2008. The 2001 average was almost on track. It was 10.9% below the 1995 average. To be on track it would have had to have been 11.5% below. (From Plotkin S, *Progress under European agreement on CO<sub>2</sub> reduction from passenger cars*. Presentation at the 82nd Annual Meeting of the Transportation Research Board, session on Vehicle Efficiency and Greenhouse Gases, Part 2, Washington DC, January 12-16, 2003).

[http://www.pembina.org/pdf/publications/VCR\\_publication\\_101702.pdf](http://www.pembina.org/pdf/publications/VCR_publication_101702.pdf). Accessed March 4, 2003.

23. The conclusion that an impracticably large increase in transit use would be required is based on the following. Most of the increase by 2010 would have to be increases in bus trips because there is not time to build infrastructure for other modes. Assume that the average car trip results in GHG emissions of 150 grams per passenger-kilometre and the average transit trip that would replace the car trip results in 75 g/pkm. (These assumptions make use of the estimates in Table 2 of IBI Group, *Making Transport Sustainable*, Environment Canada, March 2002, available at the URL below. They were interpolated to estimate 2010 values, assuming that 25% of urban personal vehicles in 2010 are SUVs, etc., and assuming too that the average occupancy of personal vehicles in urban areas in 2010 will be 1.6 rather than the indicated 1.2.) The *Climate Change Plan for Canada* (see Note 10) specifies that the required reduction from switching to transit is about 4.5 mt. Achievement of this reduction would thus require that 60 billion pkm be switched from cars to transit. Such switching would be more likely to occur in urban areas, particularly the largest urban areas, where there is a good transit base to build on. Thus, it may be reasonable to assume that about a third of the Canada-wide switching of pkm would happen in the Greater Toronto Area

(GTA), i.e., about 20 billion pkm. Assuming each trip to be 10 km in length, this would represent about two billion new transit trips per year. The current total number of transit trips per year in the GTA is near 500 million. Thus, to the extent these assumptions are valid, there would have to be an improbable fourfold increase in transit use in the GTA by 2010 for this part of the *Plan* to be met.

The *Plan* speaks as well to “alternative approaches to passenger transportation and sustainable urban planning”. Neither of these “proposed next steps” is explained, in particular how they could have an impact by 2010.

[http://www.ec.gc.ca/transport/publications/tos406/tos406\\_e.pdf](http://www.ec.gc.ca/transport/publications/tos406/tos406_e.pdf). Accessed April 17, 2003.

24. According to a report prepared for the North American Commission on Environmental Cooperation (ICF Consulting, *North American Trade and Transportation Corridors: Environmental Impacts and Mitigation Strategies*, February 2001, available at the first URL below), “It is not uncommon to find 30% to 40% of trucks on major urban highways travelling empty”. The specific concern of ICF Consulting’s report in this respect was cross-border traffic between Ontario and Eastern Michigan, where the fraction of empty trucks is believed to be relatively low. Using results of the Government of Ontario’s 1995 *Commercial Vehicle Survey*, ICF Consulting reported that approximately 15% of large trucks in both directions are empty, and another 15% are quarter to half full. Moreover, if the proportion of empty trucks alone were to be reduced to 10%, there would be a 5% overall reduction in energy use and GHG emissions.
- Another example of the potential for improvement comes from a 48-hour audit in the UK of the performance of 36 food-distribution truck fleets (1,450 tractors, 2,150 trailers, 180 rigid vehicles) that revealed a more than five-fold range among the fleets in fuel use per pallet-kilometre. On average, trucks were fully laden less than half the time they were on the road. Half of the fleets had trucks running empty more than 20 per cent of the time on the road. Fuel savings of 29 per cent overall were estimated if the performance of all fleets were brought up to at least the average of the top third. See McKinnon A, *Vehicle utilisation and energy efficiency in the food supply chain*, Heriot-Watt University, Edinburgh, November 1999, available at the second URL below. This audit was conducted in 1998. A new audit was conducted in 2002. Its results should be available soon at the third URL below. If this kind of finding were to apply to all freight transport by medium- and heavy-duty trucks in Canada, and if the proposed fuel savings could be realized in Canada, they would correspond to a reduction in GHG emissions from medium- and heavy-duty trucks by more than 18 mt from the 2010 BAU level based on extrapolation of the 1990-2000 trend. (This calculation uses estimates from *End-Use Energy Data Handbook, 1990 to 2000*, Natural Resources Canada, June 2002. The estimates are also available at the fourth URL below.) The 18-mt reduction is an extraordinary reduction, equivalent to three quarters of the estimated total reduction required from transport in the Government’s *Climate Change Plan for Canada* (see Note 10 and Box 1). This result—for one type of freight transport in a different country—may well not be fully applicable to Canada. Taken with the limited Canadian data noted above, it does suggest nevertheless that the scope for reducing GHG emissions from freight transport may be considerably larger than implied by the 4.3-mt reduction from this source proposed in the *Plan* (much of which, in any case, is to come from improvements to vehicles rather than logistics, as indicated in Note 20).



- [http://www.ccc.org/files/PDF/POLLUTANTS/corridors-e\\_EN.Pdf](http://www.ccc.org/files/PDF/POLLUTANTS/corridors-e_EN.Pdf). Accessed April 21, 2003.
- <http://www.som.hw.ac.uk/logistics/pdf/KPI98.pdf>. Accessed March 4, 2003
- <http://www.som.hw.ac.uk/logistics>. Accessed March 6, 2003.
- [http://oee.nrcan.gc.ca/neud/dpa/data\\_e/databases.cfm](http://oee.nrcan.gc.ca/neud/dpa/data_e/databases.cfm). Accessed March 4, 2003.
25. The gaps in data on freight transport chiefly concern trucking. Data on the other modes are acceptable in their scope and quality. The lack of data on trucking is astonishing, considering its importance for the Canadian economy. In general, there are almost no available data on what may be about three quarters of freight movement by truck in Canada. Statistics Canada no longer collects data on ‘private trucking’—i.e., movement of goods by shippers in their own trucks—which may account for as much as half of all trucking by value (*Profile of Private Trucking in Canada*, Industry Canada, 1998, available at the URL below). Moreover, data may be collected in a comprehensive systematic manner only on half of the remaining trucking—i.e., the ‘for-hire’ trucking—omitting the half that may be carried by trucking firms having annual revenues of less than \$1 million.
- <http://strategis.ic.gc.ca/SSG/ti01101e.html>. Accessed March 4, 2003.
26. Box 4 was produced by the Association for the Study of Peak Oil (ASPO). Information about the association is in the Association’s newsletters, available at the first URL below. A black and white version of the chart in Box 4 appears in ASPO Newsletter No. 23 (November 2002). Full technical details of the projections in Box 4 are in Laherrère J, *Forecast of world oil and gas supply until 2050*. Paper presented at PETROTECH-2003, 5th International Petroleum Conference and Exposition, New Delhi, India, January 2003, and available at the second URL below.
- <http://www.energiekrise.de/e/index.html>. Accessed March 4, 2003.
- <http://www.oilcrisis.com/laherrere/Petrotech090103.pdf>. Accessed March 4, 2003.
27. Reference was made in one of the two issues papers prepared for the four workshops (see Note 2) to the possibility that production of *conventional* oil could peak before 2010 resulting in a “massive increase in oil prices”. This statement was based on several indicated sources but above all on the following conclusion: “The all-world conventional oil peak is 5-10 years away, after which production will decline at about 3%/year. Non-conventional oil production will increase, but significant constraints, including cost, energy content, and CO<sub>2</sub> emissions, will likely prevent these sources from fully offsetting conventional oil’s decline.” (Bentley RW, *Global oil & gas depletion: an overview*. *Energy Policy*, 30, 189-205, 2002). The current preferred view, reflected in Box 4, is that the availability of non-conventional oil and natural gas liquids will be sufficient to push the peak in production of petroleum liquids to a few years beyond 2010. How many years beyond 2010 is uncertain, but there can be some confidence in the view that the production peak will occur before 2025.
- It should be stressed that the view that worldwide oil production will peak in or near 2012 is a **middle position among credible alternatives**. Bentley’s prediction of a pre-2010 production peak is noted above. An even earlier peak, during the period 1999-2003, has been suggested by a respected economist, Henry Groppe, founder and partner of Groppe, Long & Littell, oil and gas analysts and forecasters. The analysis was summarized in his April 2002 presentation to the Executive Oil Conference held in Midland, Texas (available at the first URL below).
- An alternative view was presented in May 2001 by 11 members of the staff of the U.S. Department of Energy and affiliated agencies in a report entitled *Future U.S. Highway Energy Use: A Fifty Year Perspective* (prepared for the Office of Transportation Technologies, U.S. Department of Energy, and available at the second URL below). This paper assessed oil futures worldwide and concluded that peak production of petroleum liquids will occur in or near 2020. The report represents completion of the first phase of a two-phase analysis, with Phase II in progress. The report on Phase I is still listed as a draft receiving comment. There does not seem to be a credible source that speaks clearly to a later peak in production than 2020, i.e., none is beyond the post-Kyoto period as defined for the present exercise.
- Occasionally in the present context, statements are made to the effect that ‘there are studies that show sufficient proven reserves for the next 50 years’. Their implication is that the onset of very high prices is far in the future. Such analyses often depend on a simple division of estimated reserves by current annual use, sometimes with allowances for one or both of reserve growth and increased demand. These analyses are mostly irrelevant to the issue of when prices will become extreme. The onset of very high prices will occur when production can no longer keep up with growing demand, i.e., when the production peak is reached worldwide.
- Oil production will peak because growth in worldwide supply will be constrained by petrogeological factors, as it has been locally in numerous places including the continental United States, the North Sea, and it seems in most of the countries that have produced oil (see the sources detailed in Note 26). This means that however much in the way of resources and new technology will be applied, supply will not be increased. It will not be the end of oil; indeed oil production may stay at or near the peak for several years before irrevocably declining. However, in the meantime, the factors that result in increased use of oil will continue to apply, more oil will be wanted, and the potential demand for oil will exceed the supply of oil. This is a prescription for high prices, which will rise until demand and supply are in balance. Given previous experience, prices will rise to very high levels.
- The argument has been made that no matter what the underlying petrogeological factors, high prices will stimulate more discovery and extraction and thereby defer the peak. There is little evidence to support this argument and much to the contrary, as indicated in the sources detailed in Note 26.
- The reasonable conclusion is the one given in the text. Oil prices will become very high during the period 2010-2025, earlier in the period rather than later.**
- <http://www.petroleumstrategies.com/eocpresentations/2002/Groppe.ppt>. Accessed March 15, 2003.
- <http://www.afdc.doe.gov/pdfs/hwyfuture.pdf>. Accessed April 15, 2003.
28. The workshop target of a 30% reduction in GHG emissions by 2025 from the 1990 level is much less stringent than the target in CST’s vision, which speaks to an 80% reduction by 2030 (see Note 6).
29. See Note 27 for a discussion of the date of the peak in world oil production.
30. Also see Note 8 for a discussion of rationing by quota.

