

[Working Title] Continental Benefits, Local Costs: Assessing Health Impacts from Vehicle Pollution along NAFTA's Trade Corridors¹

Paul J. Miller

Commission for Environmental Cooperation²
393, rue St-Jacques Ouest, Bureau 200
Montréal, Québec H2Y 1N9 Canada

Prepared for

North American Borders and Air Quality Symposium
University of Windsor, Faculty of Law
Windsor, Ontario, Canada
18 June 2004

Introduction

Since the signing of the North American Free Trade Agreement (NAFTA) in 1993, NAFTA trade between Canada, Mexico and the United States has nearly doubled. The value of U.S. merchandise trade with Canada and Mexico has risen from USD\$343 billion in 1993 to USD\$653 billion in 2000, and since 1994 has grown at an annual average rate of 11% (USDOT 2001). Among all the various modes of trade-related transportation during 2000, trucks were the primary movers – transporting about two-thirds of the NAFTA merchandise trade by value. Trucks also carried the largest share of NAFTA trade by weight at about 190 million tons, or about 35% of the total trade tonnage in 2000 (USDOT 2001).

Canada, Mexico, and the United States signed NAFTA to provide a range of benefits for North America, including strengthening cooperation among the nations, ensuring a predictable framework for business planning and investment, creating new employment opportunities, improving working conditions and living standards in each country, and promoting sustainable development. The increase in NAFTA trade since 1993 indicates some success in the pursuit of at least some of these goals. These continental benefits, however, are not necessarily without cost, and local communities have voiced concern over potential health impacts arising from exposure to vehicle exhaust in neighborhoods adjacent to major roadways arising from increasing traffic and its associated pollution.

A study done in 2001 found that NAFTA trade can make a significant contribution to air pollution in trade corridors, particularly for emissions of nitrogen oxides (NOx) and particulate matter less than 10 microns in diameter (PM₁₀) (ICF Consulting 2001). The study focused on five binational segments of three primary

¹ The author acknowledges many helpful contributions and discussions from participants at two workshops sponsored by the Commission for Environmental Cooperation on methods to assess public exposure to vehicle exhaust. The author also gratefully acknowledges individual contributions from Richard Baldauf and Kathryn Sargeant, U.S. Environmental Protection Agency, Michael Brauer, University of British Columbia, Barry Jessiman, Health Canada, Isabel Romieu, Instituto Nacional de Salud Publica, and Ronald H. White, Johns Hopkins Bloomberg School of Public Health.

² The opinions, views or other information contained herein are those of the author and do not necessarily reflect the views and policies of the Commission for Environmental Cooperation, or of the governments of Canada, Mexico or the United States of America.

NAFTA corridors (Vancouver-Seattle, Winnipeg-Fargo, Toronto-Detroit, San Antonio-Monterrey, and Tucson-Hermosillo). In these corridors, cross-border freight was responsible for 3 to 11 percent of all mobile source NO_x emissions in the corridors, and 5 to 16 percent of all mobile source PM₁₀ pollution. As trucking carried most of the freight in the corridors, it contributed the greatest bulk of the trade-related emissions – typically three-quarters of NO_x and more than 90 percent of PM₁₀. Border locations in particular are receiving attention where trucks and automobiles spend most of their time idling in long lines to cross, often immediately adjacent to populated neighborhoods (*see e.g.*, Diamond and Parker 2004 (Windsor, Ontario, Canada); Lwebuga-Mukasa et al. 2003 (Buffalo, New York, USA); Romieu et al. 2003 (Ciudad Juarez, Chihuahua, Mexico)). These situations are neither to the benefit of the vehicle drivers in terms of lost time and money nor to the adjacent communities exposed to greater levels of air toxics and other pollutants in vehicle exhaust. The latter gives rise to concerns that while NAFTA trade can have continental benefits, it can also give rise to disproportionate local costs placed on communities in close proximity to major trade corridors and congested border crossings.

Health impacts from exposures to vehicle

A number of health studies indicate that proximity to major roadways can have health implications from exposure to vehicle exhaust. Studies in Asia, Europe and North America have associated respiratory distress with vehicle exhaust exposure, including upper respiratory diseases (e.g. bronchitis), lower respiratory diseases (e.g., pneumonia and influenza), and airway diseases (e.g., asthma). Examples of studies linking traffic proximity and health effects span across locations in The Netherlands (Brauer et al. 2002; Brunekreef et al. 1997; Hoek et al. 2002), Toronto, Canada (Buckeridge et al. 2002), Italy, (Ciccone et al. 1998), Massachusetts, USA (Garshick et al. 2003); Taiwan (Guo et al. 1999), Japan (Shima et al. 2003), Belfast, Northern Ireland (Thompson et al. 2001), and Munich, Germany (Wjst et al. 1993).

Diesel exhaust is an important component of traffic pollution that is receiving special attention. The California Air Resources Board lists diesel particulates as a toxic air contaminant for its potential to cause cancer (CARB 1998). The U.S. Environmental Protection Agency (EPA) has declared diesel emissions a likely human carcinogen (EPA 2002) and included diesel particulates among a group of 33 air toxics of special concern in a national assessment of exposure to air toxics (NATA 2002).

Research at border cities in North America indicate potential health problems related to air pollution at sites dominated by vehicle exhaust where cross-border traffic is an important contributor to local air pollution. Near the Peace Bridge Complex in Buffalo, New York, health researchers found higher rates of asthma in Buffalo residences clustered within 700 meters from the major access roads leading to the bridge crossing with Canada (Oyana and Lwebuga-Mukasa 2004). Also, in a “real world” experiment at the Peace Bridge, investigators found a statistically significant decrease in respiratory-related hospitalizations and emergency room visits in Buffalo when border traffic decreased by 50% during the weeks immediately following the terrorist attacks of September 11, 2001. This suggests that current traffic levels at this border crossing may be affecting the respiratory health of nearby residents (Lwebuga-Mukasa et al. 2003). This result is consistent with another real-world experiment in Atlanta, Georgia that

found childhood asthma events in that city decreased when traffic decreased during the 1996 Summer Olympic Games (Friedman et al. 2001).

A study in Ciudad Juárez, Chihuahua, México, across the border from El Paso, Texas in the United States, found that children living in this border city suffered respiratory-related distress at smog levels below Mexico's national ozone standard, and indications of a possible higher mortality risk due to particulate matter exposure among young children living in poverty. While this study did not directly link the health effects to vehicle exhaust, air pollution in Ciudad Juárez is dominated by motor vehicles (>80% of total air emissions) and is heavily affected by border congestion along roadways leading to the international bridge crossing with the United States (Romieu et al. 2003).

In a study in Windsor, Ontario along a major access road for the Ambassador Bridge crossing to Detroit, Michigan, air pollution monitors found higher concentrations of fine particles several hundred meters downwind of the roadway relative to concentrations at a monitor upwind of the road during periods when trucks were waiting in long lines to cross the bridge (Diamond and Parker 2004). By 250 meters downwind of the road, concentrations of PM_{2.5} (particulate matter less than 2.5 microns in diameter) had peaked and were declining towards background levels. While the study did not look for possible health impact associations, the air monitoring results suggest that residents living nearer to this congested access artery might have disproportionately higher exposures to traffic-related exhaust relative to residents living farther away.

Policy context

The increasing recognition of localized public health impacts from vehicle exhaust exposure along road corridors is beginning to find its way into policy making, but the transition is not going smoothly. Traditionally, when transportation planners propose new highway expansion projects, any assessments of potential public health and environmental impacts have tended to look at the larger regional or metropolitan scales, rather than the local neighborhood level. The emerging science indicates that assessments based on large-scale geographic impacts may miss the more localized adverse health effects that can occur at the smaller-scale neighborhood level.

Under the U.S. Clean Air Act, for example, planning processes focus on attaining or maintaining the national ambient air quality standards (or NAAQS) within a city or some other geographically defined large region. States are responsible for developing and implementing state air quality plans to meet and maintain the standards. The pollutants covered under the national standards include ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, and particulate matter (PM_{2.5} and PM₁₀). The state plans establish air pollution "budgets" that must be met or maintained in order to comply with the air standards. A provision in the Clean Air Act requires "conformity demonstrations" to show that any new federally-funded highway project will not result in any region within a state to exceed its air pollution budget and cause violations of the national air quality standards. A conformity demonstration would not necessarily address localized exposures to vehicle exhaust along new roadways unless an air monitor used to verify compliance with the national air quality standards happens to exist at a nearby location within a potential "hot spot" adjacent to the road project. Typically, however, air quality planners seek to locate air monitors used for compliance purposes at some distance away from major roadways in order to avoid these potential "hot spots" based on the premise

that they *are not* representative of regional or metropolitan scale air pollution levels used to determine compliance with the national standards. There is one exception to the larger scale focus of air quality planning under the Clean Air Act in that it does require analysis of potential carbon monoxide “hot spots” related to transportation projects.

The National Environmental Policy Act (NEPA) in the U.S. requires an environmental impact statement for major federal actions, and most federally-funded highway projects fall within this mandate. The impact assessments, however, do not typically focus on potential health effects that could occur as a result of increased vehicle exhaust exposures in locations immediately adjacent to new highways.

In Canada, there is federal and provincial environmental legislation (e.g. the 1992 Canadian Environmental Assessment Act) that requires an examination of air pollutants associated with transportation and other major projects. These assessments often make use of national Canada-Wide Standards or provincial air quality standards as benchmarks against which to measure impacts, hence the approach is similar in concept to the United States in that the focus is on standards or objectives set for a regional or metropolitan scale. The environmental assessment identifies possible environmental effects, proposes measures to mitigate adverse effects, and predicts whether there will be significant adverse environmental effects even after implementing mitigation measures (CEAA 2004).

Within this regional scale context for air quality planning, the growing body of science on localized traffic-related health impacts has not gone unnoticed in the public health advocacy community. In the United States, for example, two recent lawsuits in the federal courts have sought requirements to perform more focused local assessments of potential health impacts from changes in traffic, particularly with regard to air toxics and diesel particulate matter. One case involved a proposed highway expansion project in Las Vegas, Nevada, and the second concerned a U.S. government decision to allow Mexican trucks greater access into the interior of the United States to redress a claim brought by Mexico under NAFTA.

In the Las Vegas situation, environmental groups sued the U.S. Federal Highway Administration (FHWA) under NEPA alleging that the FHWA failed to appropriately assess in its environmental impact statement the local impacts of traffic exhaust resulting from adding new lanes to a Las Vegas highway. In responding to the suit, the FHWA argued that the tools needed to make such local assessments of traffic exhaust were not adequate at the time to provide useful information for decision makers. In March 2004, a federal district court ruled in the FHWA’s favor (*Sierra Club v. U.S. Dept. of Transportation* 2004). It is important to note that the court did not say that local assessments of the type requested by the environmental groups were not necessarily required, but that it deferred to the FHWA’s view that the existing assessment tools were not adequate to inform decision makers. Therefore, it opens the door in the United States for more localized assessments as a requirement of proposed highway projects if a court or federal agency deems the assessment tools are adequate.

The need for more localized assessments has also been raised in the context of the North American Free Trade Agreement (NAFTA) in the U.S. This provides a clear example of a controversy arising from a nexus between public health and increased trade-related truck pollution. In 2002, several U.S. environmental and labor groups challenged a set of regulations promulgated by the U.S. Department of Transportation (DOT) that

would permit trucks from Mexico to operate in the U.S. beyond restricted border zones. The U.S. DOT promulgated the regulations following a NAFTA arbitral panel determination that said a continuing U.S. refusal to allow the entry of Mexican trucks beyond the restricted border zones violated NAFTA. In response to the legal challenge against the DOT regulations, the U.S. 9th Circuit Court of Appeals ruled that the U.S. DOT had to prepare an environmental impact statement under NEPA before promulgating the regulations. In doing the assessment, the court stated that the law required the U.S. DOT “to consider the most likely localities to be affected by increased Mexican truck traffic and to perform more localized analyses for these areas,” and that simply placing the potential pollution increases in the context of U.S. national emissions was inadequate (*Public Citizen v. Dept. of Transportation* 2003). While this ruling had opened the door for more specific localized assessments of vehicle pollution in the NAFTA context, it did not remain open for long. The U.S. Supreme Court reversed the 9th Circuit’s holding, but, similar to the Las Vegas decision, the Supreme Court did not hold that localized assessments were unnecessary. Rather, it held that because the U.S. DOT lacked the discretion to prevent cross-border operations of Mexican trucks, neither the Clean Air Act nor NEPA could require it to evaluate the environmental effects of truck traffic from Mexico resulting from the new regulations (*Dept. of Transportation v. Public Citizen* 2004).

In addition to the court cases, a recent California state law now requires local assessments of vehicle exhaust health impacts by school districts at proposed sites of new schools. California’s law prohibits the approval of school sites within 500 feet of a freeway or other busy traffic corridor unless the school district determines that air quality levels at the proposed school site do not pose significant short-term or long-term risks to students. Beyond the 500 foot distance, the law still requires school boards to identify freeways and other busy traffic corridors within one-quarter mile of the proposed school site and make a written determination that the health risks from the identified sources will not constitute an actual or potential endangerment or alternatively that corrective measures will mitigate the danger (*California Senate Bill 352*, 2003).

Other concerns are also playing a role in the drive towards greater assessments of vehicle exhaust impacts along major roadways. Environmental justice is one facet of this, as residents living close to major roadways are often minority or low income populations. Other health risks in the environment and in occupational settings disproportionately affect these population groups, such as poor nutritional status and limited access to health care, or they have a higher prevalence of some underlying diseases relevant to air pollution health effects (Frumkin 2002; O’Neill et al. 2003). These can be aggravating factors in air pollution exposures along major traffic arteries that could exacerbate the potential health effects.

Assessing vehicle exhaust exposure for decision making needs

The emerging science of vehicle exhaust exposure assessments along major roadways coupled with decision making needs, whether the result of litigation, statutory requirements, or public pressure, calls for increased efforts at gathering relevant information. The conceptual framework for evaluating public health impacts from vehicle exhaust exposures can be thought of as a series of steps. First, an investigation begins with an estimation of the amount and composition of air pollution emitted by

motor vehicles. This can include initial estimates of an individual vehicle's emissions under a range of driving and physical conditions. Individual vehicle emissions are then aggregated into collective traffic pollution using factors that can include the overall mix of different vehicle types in the fleet and roadway conditions such as grades and congestion levels. In the second step, the collective vehicle emissions undergo transformation and dispersion in the atmosphere, which can depend on local topography (e.g. street canyons, mountain basins, etc.) and atmospheric conditions affecting chemistry (e.g. temperature, sunlight, wind, deposition). The third step involves estimating actual exposure. Air pollution in the atmosphere doesn't necessarily result in human exposure, as people have to work, live or play in locations where they are likely to come into significant contact with the air pollution relevant to some health outcome. Analysis of exposure brings into consideration people's activity patterns, microenvironments such as the inside of vehicles, and transportation modes (walking, driving, mass transit). The fourth and final step looks for actual health outcomes as a result of air pollution exposure. Relevant health effects often include upper respiratory diseases (e.g., sinusitis, otitis, bronchitis), lower respiratory diseases (e.g. pneumonia, influenza), and airway diseases (e.g. asthma, chronic obstructive pulmonary disease). Assessing health outcomes should also include potential aggravating factors, such as socioeconomic conditions, behavior (e.g. smoking, nutrition), pre-existing conditions and illnesses, and age.

The Commission for Environmental Cooperation (CEC) held two workshops in 2003 to assess the state-of-the-science with regard to performing exposure assessments. The workshops brought together participants from government, academia, and the private sector to share their understanding of assessment methodologies along with their strengths and weaknesses relevant to decision making needs. The participants developed a summary of the state-of-the-science in assessing population exposures to vehicle exhaust that describes the existing science and future needs in this area (Van Atten et al. 2004). Diesel exhaust received special attention because of regulatory concerns over its toxic and carcinogenic potential. This has led to efforts to develop a "diesel signature" by identifying a set of marker chemicals in the atmosphere that can uniquely identify diesel exhaust (*see e.g.*, HEI Diesel Epidemiology Working Group 2002). The hope is to eventually be able to perform assessments targeted at assessing health effects from diesel exhaust exposure without interferences from other air pollution sources, such as gasoline vehicles.

Participants at the CEC workshops recognized that there were a number of existing useful tools in assessing population exposures to vehicle exhaust, and that each of these tools had its own strengths and weaknesses. These tools include surrogate metrics, modeling approaches, and measurement techniques. Examples of surrogate metrics include subjective and objective approaches to assess nearby traffic intensity, such as self-reporting by study participants of distances from their residences to major roads (subjective metric), and directly measuring traffic density and distance to roads within a neighborhood (objective metric). Modeling approaches include dispersion modeling based on estimates of air pollutants emitted from traffic that the model tracks to selected receptor locations for exposure assessments. Other approaches use geographic information system (GIS) frameworks to estimate exposures to traffic pollution derived from a small set of ambient air measurements coupled with local geographic data, such as

nearby traffic intensity, population density, and altitude. Measurement techniques use air pollution information directly collected by stationary ambient monitoring networks or personal monitors worn by study subjects to assess population exposures.

Surrogate metrics are generally the least resource intensive of the tools, applicable on an urban-wide scale, and are best suited for existing conditions. They are not well suited, however, for assessing exposures along individual roads and may be prone to bias in the case of subjective assessments, nor can they address individual pollutants within the mix of vehicle exhaust.

Dispersion modeling can be useful for forecasting potential impacts from changes in air pollution emissions from a limited number of roads, but they can be relatively resource intensive by requiring large amounts of input information that are specific to the locations modeled. Modeling based on GIS frameworks have the advantage of making use of existing local geographic and traffic count information coupled with minimal air monitoring data. The accuracy, however, of some of these data, such as road location and traffic counts, can severely affect the modeled population exposure results, so the approach may require more resources to improve the required input information. For example, mis-location of a major road by only a few 100 meters in the input geographic information can result in erroneous estimates of population exposures in nearby locations. This is an especially pertinent concern as some types of vehicle air pollution decrease significantly within several hundred meters of roadways. Therefore, a small misplacement in a road's location may greatly increase or decrease the modeled population exposure in nearby locations.

Air monitoring provides the most direct measurement of actual air pollutants and in some cases allow for greater temporal resolution of air concentrations for a range of specific pollutants from vehicle exhaust. Personal monitors provide concentration measurements at the actual point of exposure for specific individuals, so are well suited for validating models and for use in epidemiological studies. Personal monitors, however, are not feasible for use on a large population, may affect the daily behavior of those wearing them, and some passive types of personal monitors will lack temporal resolution if they require long sampling periods (hours or days). Established fixed-site networks are a good source of long-term trend lines for temporally well-resolved air pollutants at specific locations. They are also a low-cost source of data in places where they already exist for regulatory purposes. They are, however, relatively sparse and do not capture the spatial variability of many air pollutants related to vehicle exhaust. Hence, linking vehicle exhaust exposures to fixed-site monitoring data may require additional estimates of pollutant variability away from the site as well as estimates of human behavior affecting exposures.

What can be done now?

As with any active area of scientific inquiry, knowledge gaps remain and tools are continually improving in the field of population exposure assessments to vehicle exhaust. Greater information will be forthcoming, but policy makers typically must make planning decisions relevant to vehicle exhaust and public health based on the available information as it exists at the time. They may not have the luxury of waiting for the results of cutting edge research, which almost by definition is continually occurring, so will always be "just around the corner." Even so, public pressure and the threat of time-consuming

litigation, as well as a genuine desire to assess localized adverse public health impacts from traffic congestion at borders and new highway projects, call for making the best use of the most current knowledge, and supplementing it with locally specific information where it exists or can be reasonably collected within the time and resource constraints.

A useful starting point is to develop an assessment document that presents the basic information elements needed for informing decision makers and the public on the transportation alternatives. It should begin by providing a basic understanding of air toxics and other vehicle exhaust pollutants along with a description of the most sensitive populations to their effects. The U.S. EPA has available the National Air Toxics Assessment (NATA 2002) that contains information on 33 air toxics obtained during a national screening analysis, of which 21 are pertinent to mobile source emissions. Among these, the EPA has identified six mobile source air toxics as potential priorities that may deserve special discussion or quantitative analyses. These six are acetaldehyde, acrolein, benzene, 1,3-butadiene, diesel particulate matter, and formaldehyde.

It is also important for the assessment document to include information on other sources of air toxics in the vicinity of transportation corridors, such as industrial facilities, as part of the contextual background. In Canada, information is available in the National Pollutant Release Inventory, a government database maintained by Environment Canada (NPRI 2004). Comparable information in the U.S. is found in EPA's Toxics Release Inventory (TRI 2004). These government databases contain facility-specific information on releases of toxics to air, land and water collected through mandatory annual reports submitted by industrial facilities in each country.³ The EPA also has the National Toxics Inventory (NTI),⁴ from which EPA used the 1996 NTI information for the National Air Toxics Assessment.⁵

The NTI is a more complete inventory than the U.S. TRI as it also includes mobile sources, agricultural sources, and combustion sources such as incinerators that do not report to the TRI. The NTI also includes additional source details such as stack parameters, control technologies, and individual stack locations that models need as inputs to estimate exposure potentials. The NTI, however, is updated on a three-year cycle whereas the TRI is an annual inventory. Currently, the 1999 NTI inventory (actually now combined into the National Emissions Inventory) is the most recent complete year, with preliminary 2002 data for some sources becoming available in March 2004 (EPA 2004).

In addition to these national databases, local communities may have their own locally specific information collected through monitoring or modeling initiatives, and this should be sought and included when available.

³ Mexico has a voluntary database called the *Registro de Emisiones y Transferencia de Contaminantes* that contains some information on toxic releases, but few facilities voluntarily report to it and the existing information is non-public. Mexico changed its law in December 2001 to require mandatory reporting with public access to the information, but has yet to formally adopt new regulations to implement the law.

⁴ In 2002, the EPA combined the NTI with a separate database containing emissions information on criteria air pollutants, thus creating the more comprehensive National Emissions Inventory (NEI) (<http://www.epa.gov/ttn/chief/net/>). The most recent final version of the NEI, including air toxics, is for 1999, while some preliminary air toxics information for the 2002 NEI year became available in March 2004.

⁵ The EPA is now performing a new national scale assessment with 1999 air toxics data that it expects to complete in the summer of 2004.

There are additional information elements for the assessment document that can provide a greater understanding of the impacts from changes in traffic yet do not necessarily involve intensive modeling efforts. Many local planning agencies routinely gather information on population density, transit use, commuting patterns, and vehicle miles traveled (VMT). In the U.S., state air planning documents known as State Implementation Plans (SIPs) contain VMT information as well, along with related information on average vehicle occupancy, commute time and distance, and congestion levels. As an aid to local planners, relevant federal agencies, such as Environment Canada and the U.S. EPA, could assemble this information in a single document and make it more accessible for use in evaluating transportation alternatives (Moore 2001). Assessments could then use this type of geographical data overlaid onto population density maps in a GIS framework as a preliminary screening tool to identify potential “hot spots” arising from new highways or increased road traffic. The screening assessment could characterize the potentially affected population in adjoining areas, and identify nearby sites of special concern, such as neighborhoods, schools, hospitals, and retirement homes, as well as include consideration of environmental justice concerns. Fundamentally, such a screening approach would build upon the growing recognition that spatial patterns of many air toxics and other pollutants from vehicle exhaust are not uniform across large populated regions, but can exhibit local maxima in proximity to roadways.

When a preliminary assessment identifies potential increases in local population exposures to vehicle exhaust from changes in traffic levels, planners can apply more quantitative modeling assessments and field air monitoring campaigns that target key areas of concern. Dispersion modeling, for example, can be applied at specific locations previously identified through a GIS-based screening approach that can estimate quantitatively the downwind transport and chemical evolution of traffic exhaust in local “hot spots.” Modeling of various scenarios can be used in a relative sense to distinguish and compare differences in population exposures to changing traffic levels among a range of alternative transportation options. With this background, planners can better direct resources to specific locales deemed at potentially greater risk as a result of changing traffic levels, whether due to proposed new road projects or changes in traffic patterns, such as increased diesel truck idling at congested border crossings. Planners can then evaluate options to avoid, minimize or mitigate the potential impacts to public health.

Ideally, the preferred situation is to avoid transportation options that increase public exposures to air toxics and other pollutants arising from vehicle exhaust. Moving new roads and placing new border crossings away from populated areas would help avoid public health impacts. Shifting truck traffic to intermodal rail coupled with more stringent emission standards for rail locomotives and reducing the amount of sulfur in the diesel they burn would also avoid greater pollution in North America’s trade corridors.⁶

⁶ A study by ICF Consulting sponsored by the CEC found that diesel locomotives, if not subject to new standards for engine emissions and fuel quality, could emit more nitrogen oxides (NOx) and PM₁₀ on a per tonne-kilometer of freight transported than would newer diesel trucks in Canada and the U.S. subject to more stringent standards for engine emissions and diesel sulfur content. Rail emissions of volatile organic compounds (VOCs), carbon monoxide (CO), and carbon dioxide (CO₂) would still be lower than new diesel trucks under the current *status quo* (ICF Consulting 2001). **[check this]**

Mass transit alternatives for drivers of passenger vehicles should also be seriously considered.

To the extent avoidance is not sought, minimization should become the priority through options that will reduce vehicle exhaust in areas of concern. At congested border crossings, for example, border crossing agencies could create idling areas for trucks that are located outside of populated areas, and bring the trucks to the border in small groups at intervals for customs clearance, rather than having all trucks idle in long lines immediately at the border crossings and roadways leading to them.

Finally, mitigation options need to be considered as the last line of defense for protecting public health from vehicle exhaust exposure. This could include making available incentives for cleaner alternative fuels and their infrastructure, retrofitting existing diesel engines with particle traps, and reducing border idling times through pre-clearance of trucks. Congestion pricing is another tool in which highway tolls or border crossing fees can be set at higher rates during peak congestion times to encourage drivers to shift their driving to lower rate off-peak traffic periods, thus improving traffic flows and reducing idling times.

In summary, a useful and informative assessment of transportation alternatives, whether to address changes in traffic flows along existing highways (e.g. increased trade-related truck traffic) or assess new highway projects, should provide several essential information elements. It should contain relevant background information on the nature and effects of air toxics and other vehicle exhaust pollutants. It should seek out and include all locally relevant health benchmarks, as well as any local monitoring and modeling information. It should clearly identify locally-affected populations and specific sites of concern, such as nearby schools and hospitals. It should forthrightly address any environmental justice concerns. It should seek to identify and assess alternative transportation options, with the highest priority going to those options that avoid adverse public health impacts, followed by options that minimize and mitigate public health impacts from vehicle exhaust exposures. Ultimately, the true success of NAFTA will be in achieving the continental benefits of sustainable trade that avoids imposing disproportionate costs on local communities through which major trade corridors traverse.

References

- Brauer M, Hoek G, Van Vliet P, Metliefste K, Fischer PH, Wijga A, et al. 2002. Air pollution from traffic and the development of respiratory infections and asthmatic and allergic symptoms in children. *Am J Respir Crit Care Med* 166:1092-1098.
- Brunekreef B, Janssen NAH, de Hartog J, Harssema H, Knape M, van Vliet P. 1997. Air pollution from truck traffic and lung function in children near motorways. *Epidemiology* 8:298-303.
- Buckeridge DL, Glazier R, Harvey BJ, Escobar M, Amrhein C, Frank J. 2002. Effect of motor vehicle emissions on respiratory health in an urban area. *Environ Health Perspect* 110:293-300.
- California Senate Bill 352. 2003. California Statutes Chapter 668.
- Canadian Environmental Assessment Act. 1992. c. 37 Available: <http://laws.justice.gc.ca/en/C-15.2/28956.html> [accessed 25 May 2004].
- CEAA. 2004. Environmental Assessment: Making a Difference. Canadian Environmental Assessment Agency. Available: <http://www.ceaa-acee.gc.ca/> [accessed 2 June 2004].
- Ciccone G, Farostiere F, Agabiti N, Biggeri A, Bisanti L, Chellini E, et al. 1998. Road traffic and adverse respiratory effects in children. *Occup Environ Med* 55:771-778.
- Dept. of Transportation v. Public Citizen. 2004. Case No. 03-358, Supreme Court of the United States, Washington, DC (Slip Opinion June 7, 2004).
- Diamond G and Parker M. 2004. Preliminary air quality assessment related to traffic congestion at Windsor's Ambassador Bridge. Ontario Ministry of the Environment, Southwestern Region. Available: <http://www.ene.gov.on.ca/envision/techdocs/4624e.pdf> [accessed 14 April 2004].
- EPA. 2002. Health Assessment Document for Diesel Engine Exhaust. U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment, Washington, DC EPA/600/8-90/057F.
- EPA. 2004. National Emissions Inventories for the US. U.S. Environmental Protection Agency, Technology Transfer Network Clearinghouse for Inventories and Emission Factors. Available: <http://www.epa.gov/ttn/chief/net/> [accessed 21 May 2004].
- Friedman MS, Powell KE, Hutwagner L, Graham LM, Teague WG. 2001. Impact of changes in transportation and commuting behaviors during the 1996 Summer

- Olympic Games in Atlanta on air quality and childhood asthma. *JAMA* 285:897-905.
- Frumkin H. 2002. Urban sprawl and public health. *Public Health Reports* 117:201-217.
- Garshick E, Laden F, Hart JE, Caron A. 2003. Residence near a major road and respiratory symptoms in U.S. veterans. *Epidemiology* 14:728-736.
- Guo YL, Lin YC, Sung FC, Huang SL, Ko YC, Lai JS, et al. 1999. Climate, traffic-related air pollutants, and asthma prevalence in middle-school children in Taiwan. *Environ Health Perspect* 107:1001-1006.
- HEI Diesel Epidemiology Working Group. 2002. Research Directions to Improve Estimates of Human Exposure and Risk from Diesel Exhaust, Special Report, Health Effects Institute, Boston, MA.
- Hoek G, Brunekreef B, et al. 2002. Association between mortality and indicators of traffic-related air pollution in the Netherlands: a cohort study. *Lancet* 360:1203-1209.
- ICF Consulting. 2001. North American Trade and Transportation Corridors: Environmental Impacts and Mitigation Strategies. Prepared for the Commission for Environmental Cooperation. Montreal, Quebec. Available: http://www.cec.org/files/pdf/POLLUTANTS/corridors-e_EN.pdf [accessed 25 May 2004].
- Lwebuga-Mukasa JS, Ayirookuzhi SJ, Hyland A. 2003. Traffic volumes and respiratory health care utilization among residents in close proximity to the Peace Bridge before and after September 11, 2001. *J Asthma* 40:855-864.
- Moore C. 2001. Smart Growth and the Clean Air Act. Northeast-Midwest Institute. Washington, DC.
- NATA. 2002. The National-Scale Air Toxics Assessment. U.S. Environmental Protection Agency. Available: <http://www.epa.gov/ttn/atw/nata/> [accessed 2 June 2004].
- NPRI. 2004. National Pollutant Release Inventory. Environment Canada. Available: <http://www.ec.gc.ca/pdb/npri/> [accessed 2 June 2004].
- O'Neill MS, Jerrett M, Kawachi I, Levy JI, Cohen AJ, Gouveia N, et al. 2003. Health, wealth, and air pollution: advancing theory and methods. *Environ Health Perspect* 111:1861-1870.

- Oyana TJ, Lwebuga-Mukasa JS. 2004. Spatial relationships among asthma prevalence, health care utilization, and pollution sources in neighborhoods of Buffalo, New York. *J Environ Health*, 66:25-37.
- Public Citizen v. Department of Transportation. 2003. Case No. 02-71249, U.S. Court of Appeals for the Ninth Circuit, San Francisco, CA (reversed on appeal to U.S. Supreme Court in 2004).
- Romieu I, Ramirez Aguilar M, Moreno Macias H, Barraza Villarreal A, Hernandez Cadena L, Carbajal Arroyo L. 2003. Health Impacts of Air Pollution on Morbidity and Mortality among Children of Ciudad Juárez, Chihuahua, Mexico. Commission for Environmental Cooperation Working Paper. Available: http://www.cec.org/pubs_docs/documents/index.cfm?varlan=english&ID=1347 [accessed 14 April 2004].
- Shima M, Nitta Y, Adachi M. 2003. Traffic-related air pollution and respiratory symptoms in children living along trunk roads in Chiba Prefecture, Japan. *J Epidemiol* 13:108-119.
- Sierra Club v. U.S. Dept. of Transportation. 2004. Order No. CV-S-02-0578-PMP, U.S. District Court, District of Nevada.
- Thompson AJ, Shields MD, Patterson CC. 2001. Acute asthma exacerbations and air pollutants in children living in Belfast, Northern Ireland. *Arch Environ Health* 56:234-241.
- TRI. 2004. Toxics Release Inventory (TRI) Program. U.S. Environmental Protection Agency. Available: <http://www.epa.gov/tri/> [accessed 2 June 2004].
- USDOT. 2001. U.S. Department of Transportation, Bureau of Transportation Statistics. *North American Trade and Travel Trends*, BTS01-07. Washington, DC.
- Van Atten C, Brauer M, Funk T, Gilbert NL, Graham L, Kaden D, et al. 2004. Honing the methods: assessing population exposures to motor vehicle exhaust. Submitted for publication. [Available upon request from the Commission for Environmental Cooperation (contact Paul Miller, 514-350-4326, pmiller@cemtl.org)].
- Wjst M, Reitmeir P, Dold S, Wulff A, Nicolai T, Von Loeffelholz-Colberg EF, von Mutius E. 1993. Road traffic and adverse effects on respiratory health in children. *Brit Med J* 307:596-600.