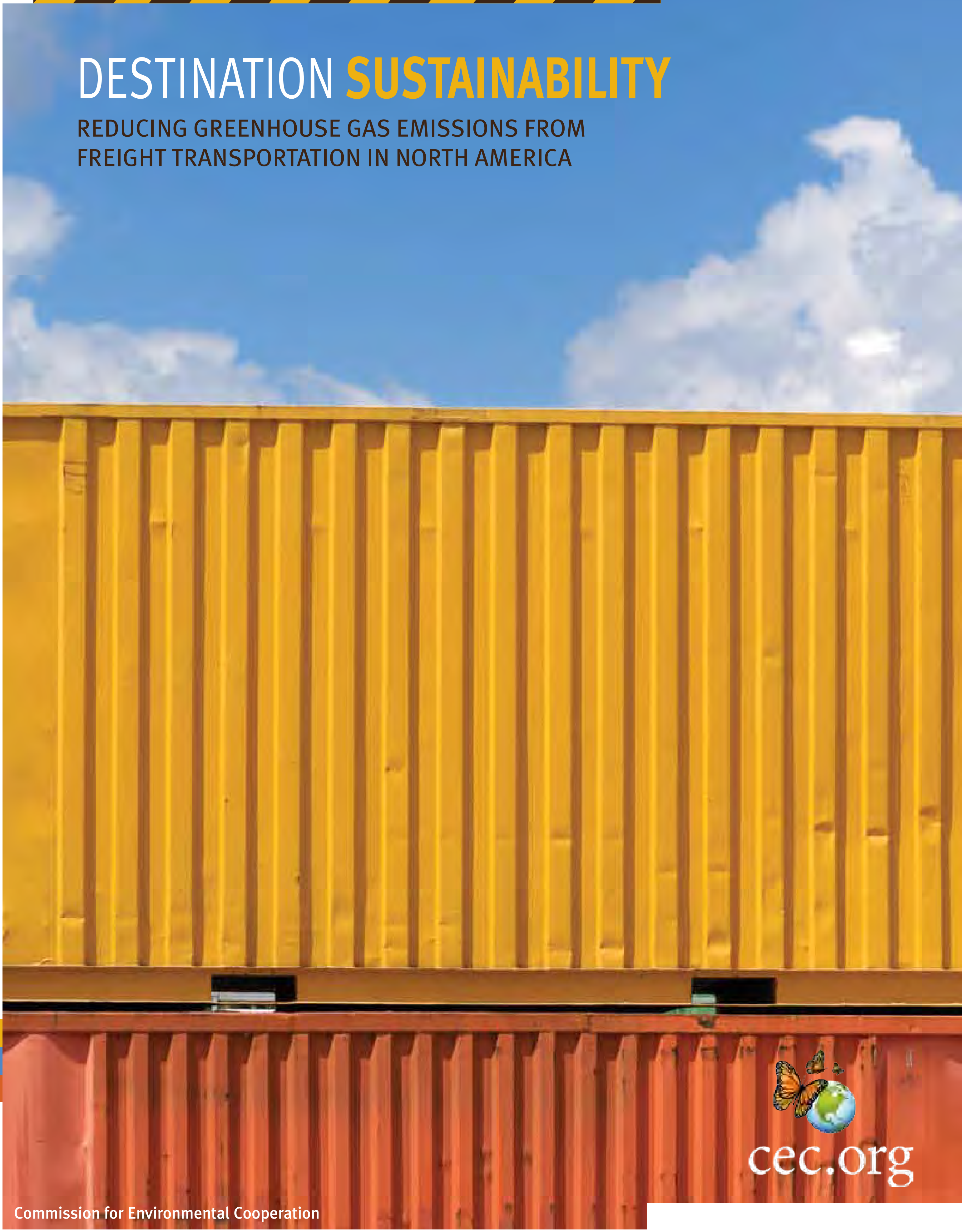
DESTINATION **SUSTAINABILITY**

REDUCING GREENHOUSE GAS EMISSIONS FROM FREIGHT TRANSPORTATION IN NORTH AMERICA



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Commission for Environmental Cooperation
Comisión para la Cooperación Ambiental
Commission de coopération environnementale

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PREFACE

For the 194 countries negotiating the successor to the Kyoto Protocol, it's a long road to 2012—the deadline for negotiation and ratification of a new international framework to deliver stringent global reductions in greenhouse gas (GHG) emissions.

Canada, Mexico and the United States, meanwhile, have an opportunity to focus more immediately on mitigating GHG emissions from key sectors of the North American economy. For instance, the transportation sector in North America today is second only to electricity generation in terms of CO_2 emissions produced. These emissions have grown steadily during the past 40 years and, given continued economic growth and integration of our three economies over the next twenty years, are forecast to increase, with freight transportation leading the way.

New technologies, standards, and regulations are already making a difference. However, the projected rates of growth in GHG emissions in coming decades vary greatly by transport mode. Despite an expected increase in vehicle miles traveled, light-duty vehicle emissions are expected to decline with continued improvements in fuel economy and efficiency, the adoption of advanced technologies, and low- or no-carbon fuels.

Total emissions from freight trucks, on the other hand, are projected to show a significant increase in emissions over this same period. This is in spite of better technology and fuel efficiency, and stems mostly from the cumulative impact of more trucks moving more freight.

Accordingly, in terms of environmentally sustainable transportation, this report focuses on the opportunities to reduce freight-related GHG emissions from road and rail modes in North America.

The most important requirement in avoiding the increases in freight-related GHG emissions anticipated as a consequence of continued trade and commercial growth in the NAFTA region is not simply continued progress in cleaner and more-efficient fuels and technologies, but the vision and willingness—at a continental scale—to foster an integrated, intelligent, freight transportation *system* that will play an integral part in greening the North American economy.

Ensuring environmental sustainability requires continental cooperation among transportation and environmental authorities at all levels along with myriad stakeholders in the private sector, on policies and actions to optimize demand, invest in infrastructure, set an effective price on carbon pollution, ensure an optimal modal mix (truck/rail/marine), and manage our borders in the most secure and efficient manner possible.

The CEC Secretariat's previous Article 13 report, *Green Building in North America,* found that the policies and practices required to enhance the energy efficiency of our built environment are both cost-effective and significant in terms of greening the economy. Similarly, this report also concludes that the policies, regulations, and incentives necessary to accomplish sustainable transportation—at a continental scale—will also make our freight system more efficient, competitive, and energy-secure.

Evan Lloyd
Executive Director
CEC Secretariat

FOREWORD

Our advisory group was driven by a question:

What would an efficient, competitive and environmentally sustainable freight transport system for North America look like in 2030?

This report provides some of the answers, and sets out a plan for change and investment for the next 20 years.

If the trade and intermodal freight system in North America is to play a global role in reducing greenhouse gas emissions, improve environmental quality, enhance regional competitiveness and reduce our dependence on foreign oil, we ask our political leaders and decision makers to pay heed to this report.

I come from the West Coast of North America, where environmental concerns and sustainability have been a driving force for many years. Governments and transport industry operators—challenged by the dramatic impact of poor air quality on the health of thousands of people from vulnerable communities around our great ports—have taken political action to dramatically reduce emissions and promote energy independence in the face of competition from countries and regions investing billions in infrastructure and with different environmental regimes.

North America can show the world how to make freight a leader—not a follower—in addressing the challenges of energy security and climate change while enhancing economic prosperity.

I am grateful for the extraordinary amount of time our committee of public- and private-sector leaders invested. “Stakeholder” may be an overused term, but without the talent and knowledge of our private-sector freight and logistics members this report would not have a real-world foundation. I also thank the CEC staff and consultants for their patience in supporting numerous drafts and edits. It was worth the effort.

Bruce Agnew
Cascadia Center for Regional Development
Seattle

EXECUTIVE **SUMMARY**

This report describes the steps needed to enhance environmental sustainability in freight transportation among Canada, Mexico and the United States. It was also prepared to stress the important link between environmental sustainability and an efficient, competitive, and secure freight transportation system throughout North America.

The report focuses on North-South (and equally, South-North) freight transportation between Canada, Mexico and the United States. The principal environmental goal examined was to find ways to reduce carbon dioxide (CO_2) emissions, which account for 95% or more of all freight transportation–related greenhouse gas (GHG) emissions. Importantly, measures to improve the GHG performance and energy efficiency of the transportation sector also carry significant air quality co-benefits.

It is estimated that the North American economy will grow by 70–130% between the years 2005 and 2030.[1] Throughout this period, the transportation sector is expected to maintain its position as a dominant end-user of energy. To avoid a corresponding increase in freight-related GHG emissions, we will need not only continued progress in developing fuel economy, technologies, and alternative fuels, but also the vision and will to create an integrated, intelligent, freight transportation *system*[2] in North America. Ensuring that the freight system is environmentally sustainable in the future also requires implementing a broad set of cooperative policies and actions to optimize demand, invest in infrastructure, set a price for carbon, ensure an optimal modal mix (e.g., truck/rail/marine), and manage our borders in the most secure and efficient manner possible.

Economic growth in North America over this period will occur against a background of increasing globalization of trade, finance, technology, and culture. Other trading blocs, such as the European Union, and rapidly developing countries, notably China, are devoting considerable resources to the improvement of their transportation systems. North America will need to make a comparable investment to maintain and modernize its transportation infrastructure. The time for vision and cooperation among NAFTA countries is now.

In the absence of concerted action by all three countries, freight transport–related emissions will continue to increase and will undermine the ability of NAFTA countries to meet their GHG emissions reduction targets. We have chosen a timeframe for this report of 20 years—from 2010 to 2030—while recognizing that transportation infrastructure and technologies can take many decades to fully transform. However, a start has to be made, and soon, if we are to get on the path to a more sustainable freight transportation system.

Although each of the NAFTA countries has unique transportation challenges, the countries face common issues for which cooperation and concerted action will be to their mutual benefit. This report examines those issues and, drawing upon the knowledge, expertise, and perspectives of more than sixty transportation experts, government officials, operators, and other key stakeholders, we make recommendations for actions that we believe will make a profound contribution to the environmental sustainability of the North American transportation system.

A summary of findings and recommendations follows.

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1 Commission for Environmental Cooperation (CEC), *North American Environmental Outlook to 2030* (Montreal, July 2010), <www.cec.org>.

2 An intelligent transportation system (ITS) adds information technology to transportation infrastructure and vehicles. It aims to manage vehicles, loads, and routes to improve safety and reduce vehicle wear, transportation times and fuel costs.



CHALLENGES

Based on the research and consultations done for this study, we identify seven challenges to achieving more–environmentally sustainable freight transportation in North America (see section 3.4 for a discussion of each challenge):

- Lack of internalization of external costs of freight transportation
- Inadequate coordination among North American transportation agencies
- Lack of integrated land-use and freight transportation planning
- Extensive delays in truck freight movement across borders
- Time needed for turnover of inefficient "legacy" truck fleet
- Inadequate funding of transportation infrastructure
- Lack of essential transportation data

Failure to address these challenges will mean accepting increasing freight transportation–related CO_2 emissions due to road congestion, excessive vehicle idling, empty vehicle backhauls, poor matching of freight transport modes, burning of high-carbon fuels, excessive trip lengths, inadequately trained drivers, and other inefficiencies that lead to an increase in fossil fuel usage.

KEY FINDINGS

The research and consultations conducted for this study reveal eleven action areas in which progress, at a North American scale, is required (these are elaborated on in section 4):

- Pricing carbon
- Reducing border delays and enhancing security
- Integrating transportation and land-use planning
- Shifting to more-efficient transportation modes
- Shifting to lower-carbon fuels
- Increasing the efficiency of transportation technologies
- Funding transportation infrastructure and pricing its use
- Greening supply chains and implementing best practices
- Acquiring data and developing performance metrics
- Reducing demand for inefficient freight transportation
- Improving freight transportation governance and stakeholder networking

RECOMMENDATIONS

The CEC Secretariat's Sustainable Freight Transportation Advisory Group provides the following recommendations to help Canada, Mexico, and the United States to foster a more efficient, competitive, secure, and environmentally sustainable freight transportation system in North America:

Coordination and Networking

- A North American Transportation Forum should be established in which transportation and environmental ministers (or equivalents) and a working group of officials maintain an ongoing dialogue on the efficiency and sustainability of our freight transportation system. The Forum should lead an initiative to develop a long-term vision of low-carbon, low-emissions, sustainable freight transportation for North America, and to communicate policy-relevant findings to governments.
- In parallel with the North American Forum, a network should be created to facilitate collaboration on a continental basis among freight industry, transportation experts, and stakeholders. This network should maintain a dialogue with the Forum, as well as share information on best practices and innovations in freight transportation.
- Existing public/private partnerships, such as FleetSmart (Canada), SmartWay (US), and *Transporte Limpio* (Mexico) should be strengthened and harmonized to enable the collection and sharing of freight performance data and emission factors among the three countries, such that freight policies and programs can be enhanced to ensure maximum effectiveness.

Carbon Pricing and System Efficiency Strategies

All three nations need a portfolio of policies to attract the significant investments required to make the transition to a low-carbon transportation system, including the establishment of an effective price on carbon emissions that would create incentives to use and generate less CO_2 in freight transportation.

- A cooperative study should be conducted on the potential for carbon pricing to contribute to a dedicated North American multi- and intermodal transport infrastructure fund to minimize congestion and security-related bottlenecks along trade corridors and at borders and ports of entry.
- CO_2 emissions and other environmental externalities should be major considerations when pricing strategies are developed to address freight transport.
  A trinational study should be undertaken to align the freight-related GHG mitigation potential with transportation-specific carbon pricing components.

Investments to Improve the Efficiency of the Freight Transportation System and Promote Advanced Technologies

- Adequate sources of funding for major freight transportation infrastructure investments should be created. In particular, investments are required to support reducing the carbon intensity of moving goods, recognizing that shifts from high-carbon to low-carbon transportation modes and greater use of technology are needed.
- All three nations should provide meaningful incentives to support the development and deployment of advanced fuel-saving technologies and freight transportation operational strategies, including intelligent transportation systems. Incentives include pricing *negatives*, such as CO_2 emissions, as well as incenting *positives*, such as research and development.

Supply-chain Management

- Trinational collaboration on supply-chain carbon accounting and reporting should be developed for locomotives, marine vessels, airplanes and diesel trucks to help the freight sector lower fuel use and GHG emissions, thus reducing costs across the supply chain and improving competitiveness.

Training Eco-drivers

- Truck drivers should be trained in eco-driving practices, including the use of intelligent transportation systems, to operate trucks (and other transportation equipment) in the most fuel-efficient manner. A North American green driver certification program should be developed to train and certify drivers for the North American supply chain. Such training should be coupled with safety and maintenance training to ensure marketable job skills for this vulnerable sector.

Gathering and Sharing Data

- Transportation, environmental and statistical agencies in the United States, Canada, and Mexico should enable the North American Transportation Statistics Interchange (NATS-Interchange) to develop a comprehensive North American freight data collection and dissemination plan that ensures comparability, interoperability, and consistency in data and data formats, and that provides a common platform and methodology for collecting transport-related information, including data that measure environmental impacts. A memorandum of understanding (MOU) should be signed that makes NATS-Interchange a mandatory component of cooperation among the NAFTA countries, and that facilitates the collection and sharing of freight transportation data.
  Transportation stakeholders should be engaged in identifying the key performance goals to be evaluated, and should be involved in discussions on the feasibility of developing a *freight sustainability index* that combines multiple performance measures.

1

INTRODUCTION

PERHAPS THE MOST CONSISTENT IMPACTS FROM FREIGHT TRANSPORTATION ARE THOSE BORNE BY THE ENVIRONMENT, PARTICULARLY AIR POLLUTION FROM THE FUEL BURNED BY TRUCKS AND TRAINS HAULING THE FREIGHT.

The movement of goods among Canada, the United States, and Mexico is such a part of our daily life that it is easy to take it for granted. However, the challenge of efficacy and sustainability in the movement of goods has wide-ranging impacts on the North American economy, its environment, and its natural resources—impacts that have grown substantially in the years since the North American Free Trade Agreement came into being in 1994. The daily effects from the increases in trade volume since 1994 are readily apparent to anyone living near our national borders, and particularly in border cities or close to traffic corridors: clogged highways and border crossing stations, and air quality impacts, including particulate matter and greenhouse gases. But those effects should be of great concern to us all, regardless of where we live.

Perhaps the most consistent impacts from freight transportation are those borne by the environment, particularly air pollution from the fuel burned by trucks and trains hauling the freight. Given the current discussions on climate policy, the evaluations and initiatives to make freight transportation as environmentally sustainable—environmentally "friendly," if you will—as possible must assume great importance. Thus, the Secretariat of the Commission for Environmental Cooperation has undertaken this study, completed under Article 13 of the North American Agreement on Environmental Cooperation (NAAEC), to present findings and recommendations on environmentally sustainable freight transportation in North America.

PROCESS

The study that has resulted in this report followed a work plan that was developed in Fall 2009 and completed in August 2010. The process included the establishment of an Advisory Group composed of key stakeholders from the private sector who are part of the borderless supply chain stretching from Mexico through the US to Canada, as well as experts from the trucking and rail industries, academia, and civil society, including officials from national transportation departments and the Organisation for Economic Co-operation and Development (OECD), in order to obtain an international perspective. The members are listed in the box "Advisory Group," below, and in Appendix A.

Public consultations were held in all three NAFTA countries by the CEC Secretariat and the Advisory Group, in order that the Article 13 process might have the benefit of the public's input and experience. The first consultation was held in Cuernavaca, Mexico, in December 2009; the second in February 2010, in College Station, Texas; and the third in Vancouver, British Columbia, in

Environmental Impacts of Freight Movement: *Criteria Pollutant Emissions*

Trucks and locomotives that are powered by diesel engines move most of the freight in North America. Diesel engines are a major source of nitrogen oxides (NO_x), particulate matter (PM) and volatile organic compound (VOC) emissions. NO_x and VOCs are precursors to ground-level ozone, which can trigger health problems, including a variety of respiratory illnesses. Ozone is also associated with other adverse environmental impacts, such as crop and ecosystem damage. Exposure to PM is also linked to serious health conditions, such as aggravated asthma, difficulty breathing, heart attacks, and premature death. PM is the major source of haze that reduces visibility and creates unsafe conditions for airplanes and other modes of transportation. In the US, NO_x, carbon monoxide (CO) and VOCs are three of seven criteria pollutants that are regulated based on standards set by the US Environmental Protection Agency.

March 2010. These meetings included the members of the Advisory Group, supplemented by invited experts. Following these meetings, the CEC Secretariat organized meetings during March 2010 in Mexico City, Washington DC, and Ottawa, Canada, to solicit input and comments from government officials of environment, transportation, and commerce ministries and agencies, as well as from states and provinces. The government consultations helped give the CEC Secretariat a better understanding of policies and programs in the three countries, and also helped us identify key areas in which cooperation to improve the efficacy and environmental sustainability of North America freight movement could be put in place.

The CEC Secretariat commissioned the Texas Transportation Institute to prepare a "Foundation Paper" which profiles the movement of goods throughout North America and deals with some of the technical aspects of freight movement. This document is available from the CEC website at <www.cec.org/freight>. More than 140 recent reports on freight transportation and transportation-related pollutant emissions were reviewed and form part of the background research conducted for the study. They provided input for the policy and operational aspects discussed herein and for the recommendations that the Advisory Group has advanced with a North American perspective.

ADVISORY GROUP

Article 13 Initiative on Sustainable Freight Transportation in North America

Member	Organization	Country
Bruce Agnew	Cascadia Center for Regional Development	United States
Lloyd Axworthy	University of Winnipeg	Canada
Scott Belcher	The Intelligent Transportation Society of America (ITS America)	United States
Nils Axel Braathen	Environment Directorate, Organisation for Economic Co-operation and Development (OECD)	International
Jeanne Broad	Coalition for America's Gateways and Trade Corridors	United States
Juan Carlos Camargo	Wal-Mart Mexico	Mexico
Mariana Chew-Sánchez	Sierra Club	United States
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Glen P. Kedzie	American Trucking Association	United States
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Nick Nigro	Pew Center on Global Climate Change	United States
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Susan Shaheen	Transportation Sustainability Research Center University of California, Berkeley	United States
Glen Wright	CEC Joint Public Advisory Committee (JPAC)	Canada, Mexico and United States

Ex Officio* Members of the Advisory Group

Member	Organization	Country
Roberto Aguerrebere Salido	Instituto Mexicano del Transporte	Mexico
Pierre Marin	Transport Canada	Canada
Christopher "Buddy" Polovick	SmartWay Transport Partnership US Environmental Protection Agency	United States
Robert Ritter	Federal Highway Administration	United States

* Note: *Ex officio* government representatives participated in the meetings, discussions and all of the other activities related to membership in the Advisory Group. However, they did not take part in any vote involving the decisions and/or recommendations made by the Advisory Group and the recommendations in this report do not necessarily reflect their positions or those of other government participants.

SCOPE OF THE STUDY

The focus of this report is on north-south (and south-north) freight transportation, particularly road and rail. It examines how the freight transportation system in North America can be made more environmentally sustainable, both in terms of the energy/fuel required for freight movement and of the greenhouse gases (GHGs) liberated by fuel combustion. It concludes that the policies and related regulations and incentives necessary to accomplish environmental sustainability at a continental scale will also make our freight transportation system more efficient, competitive, and energy-secure.

It is important to observe at the outset of this report that there are significant differences among Canadian, Mexican, and US approaches to federal-state/provincial-local authorities and relationships that are central to understanding key issues that we discuss, such as coordination of programs among transportation agencies, funding of infrastructure, and integration of freight transportation and land-use planning. Nevertheless, this report argues that a cooperative partnership among the three NAFTA countries is needed, while recognizing that principles of federalism in each country must be respected. The federal governments have significant responsibilities for national transportation systems and for facilitating interstate/interprovincial and interagency cooperation. Our report and recommendations center on potential roles of the federal governments at the continental level, and especially on the challenge of reducing greenhouse gas (GHG) emissions. We note that recent comprehensive reports have examined potential strategies for reducing GHG emissions at the national and subnational levels in North America.[3] We have avoided duplicating their extensive work. Few of these reports, however, have looked at freight transportation from a continental perspective.

[3] See, for example, US Department of Transportation, *Transportation's Role in Reducing US Greenhouse Gas Emissions: A Report to Congress*, April 2010.

WHY A **NORTH AMERICAN APPROACH** TO **FREIGHT TRANSPORTATION** IS **IMPORTANT**

THERE IS BOTH A NEED AND AN OPPORTUNITY FOR THE THREE NAFTA COUNTRIES TO WORK TOWARD A COMMON VISION FOR A MORE EFFICIENT, COMPETITIVE, SECURE, AND ENVIRONMENTALLY SUSTAINABLE FREIGHT TRANSPORTATION SYSTEM.

Significant changes in North American freight transportation have occurred in recent decades. In the 1980s and '90s, many American firms rationalized their Canadian and Mexican branch plants into integrated North American production, supply, and distribution operations (as the US auto industry did in the 1960s). Flows of goods across North America's internal borders grew rapidly in this period—and an increasing share of these flows consisted not only of final products but also of components and parts moving within company supply chains. Cross-border supply chains linking production, distribution, and marketing resources across the NAFTA nations became a distinguishing characteristic of the North American economic system. NAFTA provided critical support for these developments, not only by removing tariffs and some other trade barriers, but also by signaling that the three North American governments would encourage open cross-border market growth in most sectors of their economies.[4]

It is important to develop a North American approach to freight transportation for the following reasons, which are elaborated on in this report:

1. Growing population and integrated North American economies
2. Deteriorating and inadequately funded freight transportation infrastructure
3. Excessive border delays for truck freight movement
4. Data gaps and inconsistencies between and among Canada, Mexico and the United States
5. Significant technology development and deployment opportunities
6. Increasing global competition
7. Increasing concern about climate change impacts and adaptation

Thus, there is both a need and an opportunity for the three NAFTA countries to work toward a common vision for a more efficient, competitive, secure, and environmentally sustainable freight transportation system.

[4] Stephen Blank, with Malcolm Cairns, *Drivers of Change: Envisioning North America's Freight Transportation System in 2030*, Working Paper No. 7, North American Transportation Competitiveness Research Council, August 2008, p. 4.

3

TRADE, TRANSPORTATION, AND CLIMATE CHANGE IN NORTH AMERICA

TO AVOID A CORRESPONDING INCREASE IN FREIGHT-RELATED GHG EMISSIONS, WE WILL NEED NOT ONLY CONTINUED PROGRESS IN FUEL ECONOMY, TECHNOLOGIES, AND ALTERNATIVE FUELS, BUT ALSO THE VISION AND WILL TO CREATE AN INTEGRATED, INTELLIGENT, FREIGHT TRANSPORTATION SYSTEM IN NORTH AMERICA.

We must face the challenges of reducing greenhouse gas (GHG) emissions from road and rail modes while recognizing other environmental and health impacts related to the movement of freight in North America. When considering measures to reduce CO_2 emissions, it is important to assess the health and environmental impacts and co-benefits of mitigation initiatives, including changes to emissions of criteria pollutants.

This study complements other research, consultation, and analysis conducted by the CEC on reducing GHG emissions from significant sectoral wedges of the North American economy. Previous CEC work has included examination of energy-related activities, such as electric power generation and industrial fuel use, as well as the potential for green building to reduce CO_2 emissions.

The North American economy is predicted to grow significantly over the coming decades. Throughout this period, the transportation sector is expected to maintain its position as a dominant end-user of energy. To avoid a corresponding increase in freight-related GHG emissions, we will need not only continued progress in fuel economy, technologies, and alternative fuels, but also the vision and will to create an integrated, intelligent, freight transportation system in North America. Ensuring that the freight system is environmentally sustainable in the future also requires implementing a broad set of cooperative policies and actions to optimize demand, invest in infrastructure, set a price for carbon, ensure an optimal modal mix (e.g., air/truck/rail/marine), and manage our borders in the most secure and efficient manner possible.

North America is home to less than seven percent of the world's population, but it currently emits approximately 25% of global emissions of the most important greenhouse gas, carbon dioxide (CO_2).[5] Per person, North America emits twice as much CO_2 as Europe, over five times as much as Asia, and over 13 times as much as Africa. Per capita emissions are several times higher in Canada and the United States than in Mexico. The high rates in Canada and the US are largely a result of higher per capita levels of economic activity, which have historically driven greenhouse gas emissions, especially those related to energy consumption.[6] The link between per capita income and CO_2 emissions is strong, as has been the general relation of economic growth to environmental degradation. Finding ways to break this link, and *decouple* growth and related stress on the environment, is a fundamental challenge.

Reducing freight transportation CO_2 emissions is particularly challenging, for reasons that include the following:

- There is little or no discretionary freight transportation by shippers.[7]
- Impacts on freight transportation can have substantial implications for North America's economy and global competitiveness.

[5] Commission for Environmental Cooperation (CEC), *The North American Mosaic: An Overview of Key Environmental Issues*, 2001, <www.cec.org/Storage/32/2354_SOE_Climate_en.pdf> (accessed 15 April 2010).
[6] Ibid.
[7] Meaning that shippers will move freight if the client is willing to pay the price.

- Freight vehicle fleet turnover occurs slowly, delaying the potential to reduce emissions by the rapid introduction of new technologies.
- Freight carriers already have an incentive to minimize costs (including fuel use, and hence GHG emissions), due to stiff economic competition, but they face financial and other barriers.[8]
- Freight vehicle-miles traveled are projected to grow as the North American population and economy grow over the coming decades.

Despite these difficulties, strategies to reduce GHG emissions from freight transportation have been proposed by many experts and advisory bodies. In preparing this report, the CEC Secretariat reviewed the work done by others and consulted with a wide range of transportation stakeholders to explore strategies that should be considered for North America. A number of in-depth reports contain strategies and measures that can be implemented by industry and governments. This report focuses on strategies and measures that are most relevant from a North American perspective.

3.1 POPULATION AND ECONOMIC GROWTH

The combined population of Canada, Mexico, and the United States is currently 460 million and has been projected by the United Nations to be 540 million by 2030 (and 600 million by 2050).[9] Global population is growing more rapidly and is expected to exceed nine billion people by 2050, with North America accounting for approximately 6.4% of the world's population. The population growth rate in Mexico is slightly higher than in Canada or the US, at present, but by 2030 all three countries are projected to have similar growth rates.[10]

The CEC's *North American Environmental Outlook to 2030* identifies three key demographic trends:

- North America's population will increase by 60–135 million people between 2005 and 2030, or by 14–31%;
- North America's population will become increasingly urban; and
- the population distribution between countries will remain roughly constant, with North America's percentage of the world's population falling slightly, from 6.7 to 6.4%.

The overall North American economy is projected to increase in size by 70 to 130% between 2005 and 2030.[11]

3.2 TRADE GROWTH

The CEC's *North American Environmental Outlook to 2030* summarizes recent research on the major trends related to trade and the environment in North America.[12] The *Outlook* report highlights two key socio-political developments of interest to this study:

- NAFTA has deepened and is expected to continue to deepen North America's economic integration, and
- North American integration is occurring against a background of increasing globalization of trade, finance, technology, and culture.

These meta-developments provide a backdrop for this report. They highlight two, sometimes competing trends—North American trade growth and integration in the context of

[8] Note: Policy makers see a market failure in this sector, even though there is an incentive to reduce fuel cost. The freight sector is highly competitive and has traditionally operated with the thinnest of profit margins, but market demands (e.g., Just-In-Time logistics model) and decades of cheap energy have fostered inefficient operations and wasteful business practices, such as excess idling (with more than 1 billion gallons of diesel wasted annually in the US) and empty backhauls. Trucking companies have been risk-averse to new technologies and methods when freight schedules don't allow for experimental equipment breakdowns. Per Buddy Polovick, US EPA.

[9] UN Department of Economic and Social Affairs, *World Population Prospects: The 2008 Revision Population Database* (medium variant), Population Division, 9 March 2010, <http://esa.un.org/unpp>.

[10] Commission for Environmental Cooperation (CEC), *North American Environmental Outlook to 2030*, (Montreal, July 2010), <www.cec.org>.

[11] Ibid.

[12] ibid.

globalization. These trends are important because the movement of goods and services is often referred to as a "derived demand"—one that correlates strongly with population and economic drivers. In other words, freight moves to meet consumer demand.

Commodity movements in North America are concentrated in trade between Canada and the US, and between Mexico and the US, as the amount of goods shipped between Mexico and Canada is relatively small. Canada is the United States' largest global trading partner and Mexico is the third-largest. By value, about 88% of US trade with Canada and Mexico moves on land.

FIGURE

Source: Graph created with data from the North American Transborder Freight Database, <www.bts.gov/programs/international/transborder/TBDR_QA.html>. Accessed 07/08/2010.

FIGURE

Source: Developed by the CEC from: Texas Transportation Institute, *Greening North American Transportation Corridors: Challenges and Opportunities*, May 2010, Texas A&M University.

Source: Developed by Texas Transportation Institute (TTI) with information from the US Department of Transportation, Research and Innovative Technology Administration, TransBorder Freight Data. Port names from Bureau of Transportation Statistics: *America's Freight Transportation Gateways*, Appendix, Top 125 US Freight Gateways Handling International Merchandise Valued at Nearly $1.6 billion: 2008.

Trucks the dominant for the movement of goods (by value) among the three countries (Figure 1). During the period 1995 to 2008, US land trade with Mexico and Canada nearly doubled in value, with Mexican trade with the US growing faster (i.e., average annual rate of 8.9%) than Canadian trade (i.e., average annual rate of 4.2%).[13]

Flows of freight between the three countries move along principal highway and rail corridors, as shown in Figure 2. In 2008, approximately half of the total truck and rail traffic by value in North America was handled by three land ports of entry: Detroit/Windsor, Nuevo Laredo/Laredo, and Buffalo/Niagara Falls. At the US-Canadian border, more than 75% of the surface trade was handled by only five land ports of entry, while at the US-Mexican border only four ports of entry handled about the same amount of the total land trade. Figure 3 shows the major land ports of entry and volumes of freight imported by trucks between Canada, the United States, and Mexico.[14]

Forecasts indicate that US Interstate highway travel demand, measured in vehicle-miles traveled, will increase from 690 billion in 2002 to 1.3 trillion by 2026. US total freight tonnage is expected to nearly double from the 2002 level of approximately 17,500 megatonnes (Mt) to almost 34,000 Mt by 2035.[15]

Figures 4–6 show freight activity, by selected mode, for Canada, Mexico and the United States since 1990.

[13] Juan C. Villa and Annie Protopapas, *Sustainability and Freight Transportation in North America: Foundation Paper*, Texas Transportation Institute, The Texas A&M University System, College Station, Texas, March 2010.

[14] Ibid.

[15] **2002 and 2035:** US Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework, version 2.2, 2007. **2008:** US Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework, 2008 provisional estimates, 2009.

FIGURE 4 CANADIAN DOMESTIC FREIGHT ACTIVITY, IN SELECTED MODES

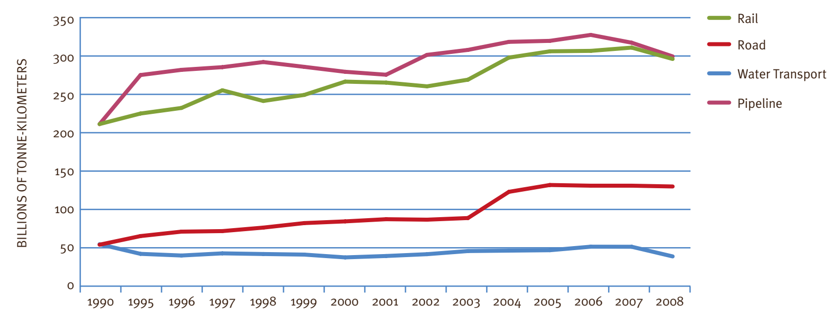


FIGURE 5 MEXICAN DOMESTIC FREIGHT ACTIVITY, IN SELECTED MODES

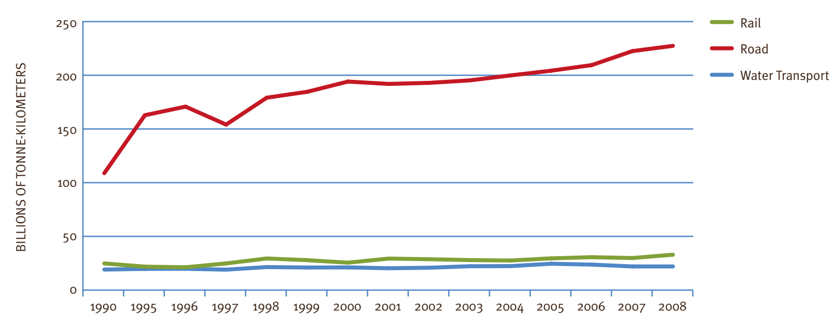
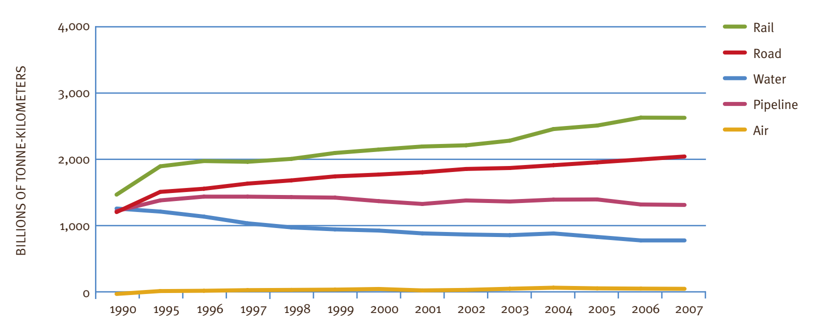


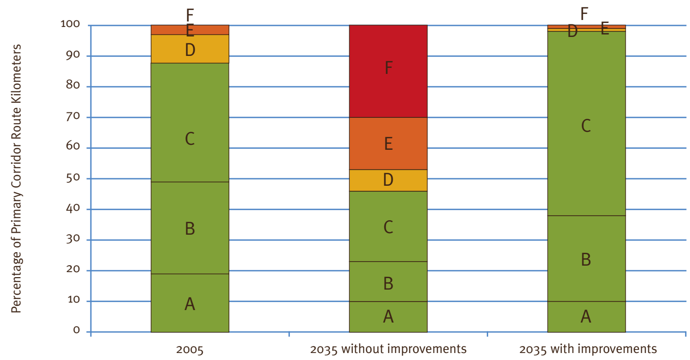
FIGURE 6 US DOMESTIC FREIGHT ACTIVITY, IN SELECTED MODES



Sources for Figures 4–6: US Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics; US Department of Commerce, Census Bureau; Statistics Canada; Transport Canada; *Instituto Mexicano del Transporte; Instituto Nacional de Estadística y Geografía; Secretaría de Comunicaciones y Transportes*; North American Transportation Statistics Database, Section 05 "Domestic Freight Activity," Table 5-2, Domestic Freight Activity by Mode (tonne-kilometers), <nats.sct.gob.mx/nats/sys/themes.jsp?id=5&i=3>, accessed 30 August 2010.

FIGURE 7

IMPACT ON THE RAIL-FREIGHT CORRIDOR IN LEVEL OF SERVICE BY 2035 WITH AND WITHOUT CAPACITY IMPROVEMENTS



Note: Based on 2005 train volumes on the 85th percentile day compared to 2007 capacity. Rail corridor kilometers are classified as Level of Service Grades (LOS Grades): A, B, C–below capacity; D–near capacity; E–at capacity; F–above capacity.
Source: Cambridge Systematics, Inc., 2007, Figure 8.1.

Figure 7 shows the potential for serious rail capacity constraints by 2035 if capacity improvements are neglected, given the significant growth in daily train transportation use of primary rail corridors in the United States that is expected. (Red indicates the percentage of kilometers operating above capacity; yellow and orange the percentage at or near capacity; and green, the percentage below capacity.) Lacking improvements, 30 percent of the rail kilometers in primary corridors will be operating above capacity by 2035. Investment in rail transportation infrastructure is in the hands of corporations, since they are privately owned in all three NAFTA countries; hence, governments currently have limited options to directly affect changes in the rail transportation system.

While water, air, and other modes of freight transportation are not covered in any depth in this report, it is important to note that air freight transportation is growing rapidly.

International trade with countries outside North America is primarily handled by maritime ports that send or receive goods to and from other parts of the world. Some ports handle petroleum products and other fluids, which account for a large part of the total cargo tonnage. However, those products are usually processed in the port and do not leave the terminal or are transported by pipeline, as opposed to by truck or rail. Containerized cargo movement, however, has increased substantially, and containers at ports are usually transported to and from production and consumption centers by truck or rail. North American container port traffic doubled between 1995 and 2008—an almost 6% average annual growth rate during that period.

There is growing interest in the United States in moving cargo on "marine highways." On 7 April 2010, the US Department of Transportation unveiled an initiative to move more cargo on water, rather than on crowded highways.[16] This new initiative will identify rivers and coastal routes that could carry cargo efficiently, bypassing congested roads around busy ports, reducing GHG emissions and air pollution, and creating jobs for skilled mariners and shipbuilders.

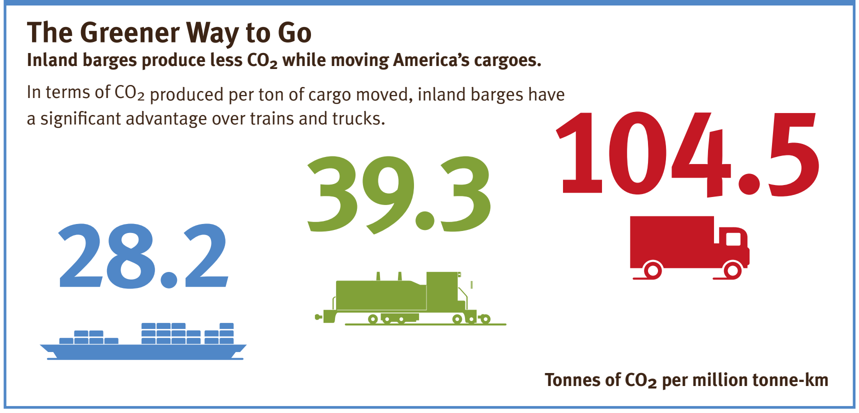
[16] See *The Journal of Commerce*, 7 April 2010, <www.joc.com/maritime/dot-launches-formal-marine-highway-program>.

Figure 8 indicates the potential GHG emissions reduction benefits of inland barges.

There has been considerable public discussion in Canada about short sea shipping as a means of addressing highway congestion while at the same time reducing GHG emissions. In spite of this, the growth in short sea business activity in Canada has been slow to develop. It is more than five years since Canada, Mexico, and the United States signed a Memorandum of Co-operation to accelerate the adoption of short sea shipping by North American businesses, but to date there has been no significant impact in terms of either new service provision or diversion of traffic from trucks to ships.[17]

Very little control is exercised over aircraft and maritime emissions by national, regional, or international agencies, largely due to jurisdictional, geographical, and technical difficulties. They are, however, important transportation modes and must be part of a comprehensive approach to creating a more sustainable freight transportation system for North America. Each of these modes has its own benefits, costs, and environmental and social impacts that must be weighed against the advantages and disadvantages of other freight transportation modes.

FIGURE 8 TONS OF CO_2 PER MILLION TONNE-KILOMETERS, BY MODE



Source: Modified from *The Journal of Commerce*, <www.joc.com/maritime/dot-launches-formal-marine-highway-program>.

Growth in US International Trade outside NAFTA

During the past two decades, the relative importance of international merchandise trade to the overall US economy has increased significantly. In inflation-adjusted terms, the ratio of goods traded in comparison to GDP was 23% in 2008, up from 12% in 1990. In 2008, US merchandise trade with NAFTA partners Canada and Mexico totalled $964 billion, more than one-fourth (28%) of the value of overall US merchandise trade. As trade with Asia expanded, however, this share declined from the record high of 33% in 2001.[18]

North America competes with other trading nations and blocs. The North America tariff-free bloc has been losing relative market share to the rest of the world since the North America Free Trade Agreement was enacted in 1994. For example, since 2000, annual trade among Mexico, Canada, and the United States has grown from just under US$700 billion to $1 trillion, whereas North American trade with the rest of the world has grown from US$1.5 trillion to $3 trillion.[19] One of the reasons advanced for this is the underinvestment in North American freight transportation systems, along with inadequate attention to labor and mobility needs.[20]

In his State of the Union Address of 27 January 2010, US President Obama set a new goal of doubling US exports over the next five years—a measure that would "support two million jobs" in America. To meet this goal, the US will launch a National Export Initiative that will help farmers and small businesses increase their exports, and that will reform export controls consistent with national security.

[17] Mary R. Brooks and James D. Frost, *Short Sea Developments in Europe: Lessons for Canada*, Working Paper No. 10, North America Center for Transborder Studies, Arizona State University, July 2009, <http://nacts.asu.edu/files/u1/REA05B10.PDF>, p. 1.

[18] Bureau of Transportation Statistics, *America's Freight Transportation Gateways*, US Department of Transportation, Research and Innovative Technology Administration, November 2009, p. 2, <www.bts.gov>.

[19] D. Rick Van Schoik and Christopher Chamberlin, Proximity Lost—The NAFTA Trade Deficit, *NACTS Policy Analysis Review No. 6*, North American Center for Transborder Studies, Arizona State University (2009).

[20] Ibid., p.2.

The magnitude of US NAFTA-related land trade highlights the importance of north-south freight transportation corridors and the role of key land gateways. Regarding modal shares, in 2008, trucks moved 33% of the tonnage of total land trade imports, rail moved 32%, and pipelines accounted for 35%. Trucks transported a larger percentage of the tonnage of US land imports from Mexico (74%) than from Canada (25%). By comparison, in 2008, rail transported 24% of the tonnage of land imports from Mexico and 33% from Canada.[21]

In Canada, overall freight movement is expected to increase by 60% between 1990 and 2020, with the greatest growth occurring in the air and trucking sectors.[22]

In Mexico's case, freight transport activity grew moderately through the 1990s. Freight transport demand is driven by trade with the US, which accounts for 88% of exports and 63% of imports. The modal split for land transport has remained broadly stable since 1990. This stability is of particular note, given the major changes in the rail sector spurred by privatization in the mid-1990s. Road freight has been forecasted to grow by an annual average of 3.2% over the period 2010–2014. Rail freight growth, at 3.9%, is expected to lead the way in ground transportation, boosted by the development of private railways and the growing realization that rail is a cost-effective mode for bulk freight transport.[23]

While the changes to North American freight transportation in the 1980s and 1990s were profound, the freight transportation system was seriously challenged in the early 2000s when security concerns took center stage and trumped other aspects of North American freight transportation, especially at border crossings. Today, problems of chronic underinvestment in road freight transportation infrastructure, ongoing structural changes in transportation systems, and issues related to safety and security interact with concerns about air quality, climate change, and societal issues, such as environmental justice[24] and livable communities.

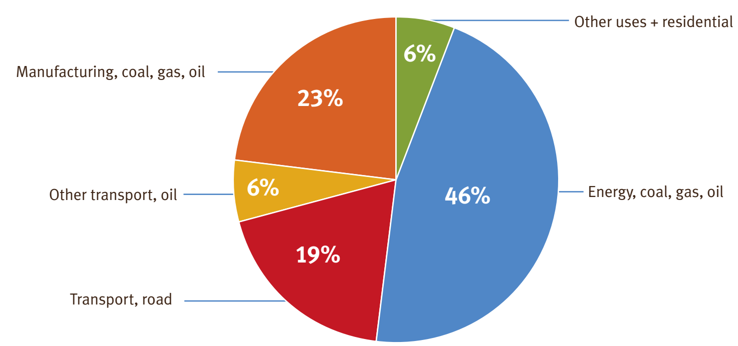
The efficient delivery of goods and services contributes to the economies and quality of life of people around the world. Visionary investments in transportation infrastructure, such as the US Interstate highway system and national freight rail systems, meant that for many decades, freight transportation in North America was a source of global competitive advantage. These systems are aging, and competitive advantage is eroding. North America's transportation infrastructure is not being adequately supported, and transportation systems are not being expanded and modernized at rates comparable to those of global competitors.

3.3 CLIMATE CHANGE AND TRANSPORTATION

3.3.1 Global greenhouse gas emissions

Along with increasing population, economic growth, and increasing trade have come increasing greenhouse gas emissions and evidence of a changing climate.[25] Global GHG emissions increased by about 61% from 1970 to 2005 (roughly 1.4% per year), with CO_2 being the largest source, growing by about 86% (or 1.8%).[26] The largest growth in global CO_2 emissions came from power generation and road transport.[27] Figure 9 shows transportation's share of global CO_2 emissions from fuel combustion.

FIGURE 9 SECTORAL BREAKDOWN OF GLOBAL GHG EMISSIONS FROM FUEL COMBUSTION, 2007



Source: International Energy Agency (OECD). 2009. *IEA Statistics: CO_2 Emissions from Fuel Combustion*. Compiled from "Key sources for CO_2 emissions from fuel combustion in 2007," p. 115.

[21] Ibid., p. 10.
[22] Transport Canada, *Transport Canada Sustainable Development Strategy 2007–2009*, Part 4: Key Issues in Transportation and Themes for 2007–2009.
[23] Business Monitor International, Mexico Freight Transport report Q2 2010, <www.reportlinker.com/p0178025/Mexico-Freight-Transport-Report-Q2-2010.html>. Accessed 21 March 2010.
[24] National Environmental Justice Advisory Council, *Reducing Air Emissions Associated With Goods Movement: Working Towards Environmental Justice*, A Report of Advice and Recommendations to the US Environmental Protection Agency, November 2009.
[25] *Climate change* refers to a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be caused by natural internal processes or external forcing or by persistent anthropogenic changes in the composition of the atmosphere or in land use. Taken from: *CEC, The North American Mosaic: An Overview of Key Environmental Issues*, <www.cec.org/Storage/32/2354_SOE_Climate_en.pdf>.
[26] OECD, *Reducing Transport Greenhouse Gas Emissions: Trends and Data*, 2010, International Transport Forum, p. 5.
[27] Intergovernmental Panel on Climate Change. *Climate Change 2007: Synthesis Report—Summary for Policymakers*, 2007.

THE EFFICIENT DELIVERY OF GOODS AND SERVICES CONTRIBUTES TO THE ECONOMIES AND QUALITY OF LIFE OF PEOPLE [...] FOR MANY DECADES, FREIGHT TRANSPORTATION IN NORTH AMERICA WAS A SOURCE OF GLOBAL COMPETITIVE ADVANTAGE.

Atmospheric CO_2 concentrations have increased by more than 100 parts per million (ppm) since their pre-industrial level, reaching 391 ppm by volume as of April 2010.[28]

3.3.2 Freight transportation CO_2 emissions

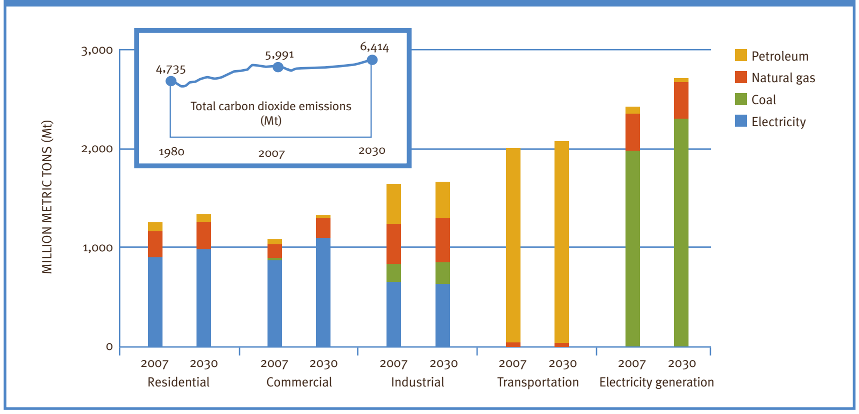
The transport sector (all modes, including passenger) is a significant contributor to GHG emissions in most countries, representing 23% (global) and 30% (OECD nations) of overall CO_2 emissions from fossil fuel combustion in 2007. Global CO_2 emissions from transport grew by 45% from 1990 to 2007. And under "business as usual," including many planned efficiency improvements, global CO_2 emissions from transport are expected to continue to grow by approximately 40% from 2007 to 2030—though this is lower than estimates previous to the 2008 economic crisis.[29] Growth in transport-sector GHG emissions has typically mirrored growth in economic wealth and has kept pace with or even surpassed growth of emissions from the energy sector. The sector as a whole is 98% dependent on petroleum.[30]

In absolute terms, North America and the European Union dominated transport-sector GHG emissions, representing 34.7% and 19.2%, respectively, of global transport emissions in 2005. The road sector (including both passenger and freight transportation) dominates in all regions, representing approximately three-fourths of total transport CO_2 emissions.[31]

In North America, the transportation sector is the second-largest sectoral contributor to emissions of CO_2 (next to electricity generation). Emissions from transportation have grown steadily during the past 40 years and have grown most rapidly in Mexico, the country that is the most dependent on road transport. Figure 10 shows US CO_2 emissions broken down by economic sector and fuel for 2007, and projected to 2030.

In North America, freight transportation CO_2 emissions represented approximately 7.8% of total US emissions in 2008 and 8% of total Canadian CO_2 emissions in 2007.[32] The entire transportation sector (including both passenger and freight transportation) accounted for 18% of total Mexican emissions in 2002.[33] Freight transportation CO_2 emissions are projected to continue to increase their share relative to passenger transportation emissions in all three countries.

FIGURE 10 US CO_2 EMISSIONS, BY ECONOMIC SECTOR AND FUEL, 2007 & 2030



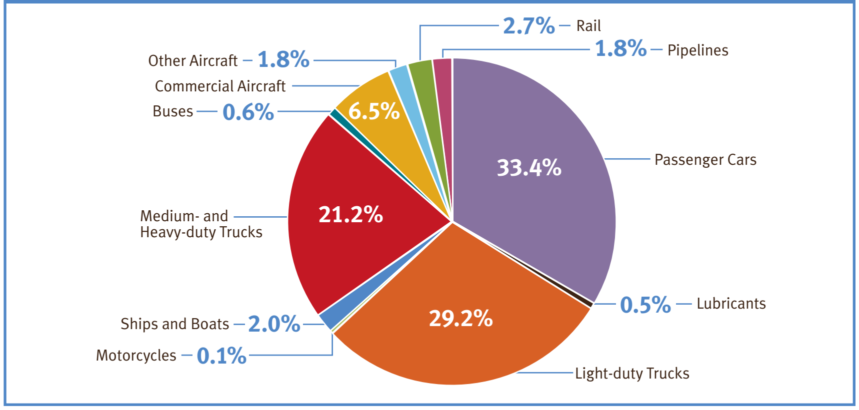
Note: Bars show 2007 and 2030 data in million metric tons.
Source: US Department of Energy, Energy Information Administration. *International Energy Outlook 2009* with projections to 2030, <www.eia.doe.gov/oiaf/aeo/emission.html>. Accessed December 2009.

[28] Mauna Loa CO_2 annual mean data from US National Oceanic and Atmospheric Administration.
[29] OECD, International Transport Forum, 2010, op. cit. (note 26), p. 5.
[30] OECD, *Greenhouse Gas Reduction Strategies in the Transport Sector: Preliminary Report*, 2008, International Transport Forum, <www.internationaltransportforum.org/Pub/pdf/08GHG.pdf>, p. iii.
[31] Ibid., p. 12.
[32] Note: Railways and Domestic Marine emissions estimates include passenger transportation and exclude Domestic Aviation. These variables do not have a large impact on the total share of freight emissions.
[33] Mexico's National GHG Inventory (1990–2002).

Figures 11–15 show emissions segmented by transportation mode for the United States, Canada, and Mexico.

FIGURE 11

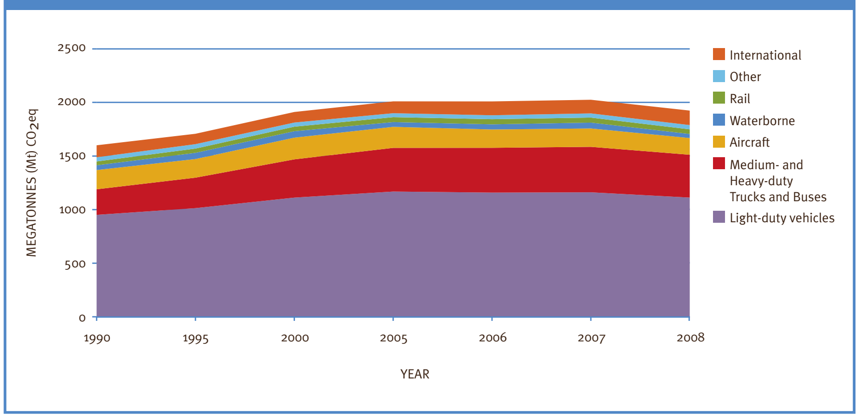
US TRANSPORTATION GHG EMISSIONS, BY TRANSPORTATION MODE, 2008



Source: Excerpted from US Environmental Protection Agency (EPA), *Inventory of US Greenhouse Gas Emissions and Sinks: 1990–2008* (April 2010), US EPA # 430-R-10-006, Table 2-15 "Transportation-Related Greenhouse Gas Emissions," <http://epa.gov/climatechange/emissions/usinventoryreport.html>.

FIGURE 12

TRANSPORT CO_2 EMISSIONS IN THE UNITED STATES, 1990–2008



Source: Calculated from US EPA, *Inventory of US Greenhouse Gas Emissions and Sinks: 1990–2008* (April 2010), US EPA # 430-R-10-006, Table 3-12 "CO_2 Emissions from Fossil Fuel Combustion in Transportation End-Use Sector ($TgCO_2eq$)," <http://epa.gov/climatechange/emissions/usinventoryreport.html>.

According to the US Environmental Protection Agncy's (EPA's) Inventory of GHG Emissions, US freight-related emissions increased by 74% from 1990 to 2008, while at the same time passenger transportation emissions increased by 33%. Overall, the increase in GHG emissions during this period from all US emissions sources was 14%.[34] Thus, both freight and passenger transportation emissions have increased their shares of overall US GHG emissions.

Projections for the US show little growth in GHG emissions from transportation in coming decades—with total GHG emissions growing only 0.7% between 2007 and 2030, as shown in Table 1 (page 26). Note, however, that modes show very different rates of growth. Despite a 42% increase in vehicle miles traveled (VMT) over the period, light-duty vehicle GHG emissions are projected by the US Department of Transportation to decline nearly 12% in response to expected increases in fuel economy from fuel efficiency regulations, advanced technologies, and alternative fuels. Freight trucks, on the other hand, show a projected 20% increase in emissions.[35]

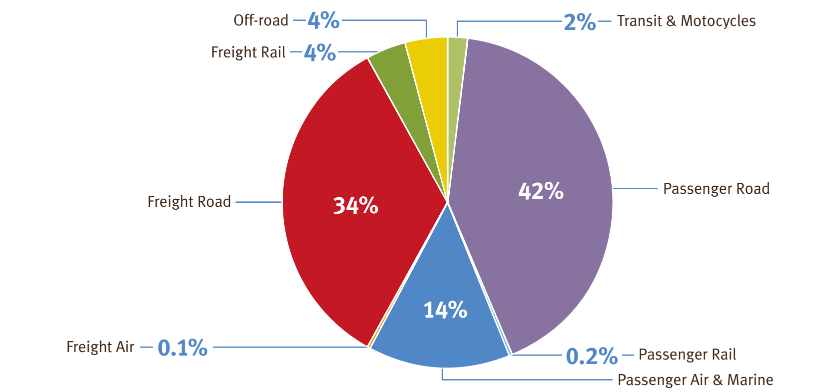
Since 1990, the CO_2 intensity of freight movement, measured in tons of CO_2eq (carbon dioxide equivalent) emissions per tonne-kilometer of cargo, has increased significantly. This trend is mainly the result of the increasing utilization of energy-intensive freight modes, especially freight trucks, which provide faster and more reliable service at the expense of energy efficiency. Table 1 shows that freight trucks accounted for 17.4% of total transportation CO_2eq emissions in the US in 2007 and is projected to be 20.7% by 2030.

Within the freight transportation sector, emissions from trucks constituted about three-quarters of the US total in 2006. Notably, Class 8 trucks[36] consumed 78% of the fuel use among Classes 3–8 trucks, despite making up only 42% of the Classes 3–8 trucking fleet.[37]

In Canada, the transportation sector (all modes) is the second-largest contributor to GHG emissions. Within the transportation sector, freight transportation accounted for approximately 38% of the sector's GHG emissions in 2007 (see Figure 13). Moreover,

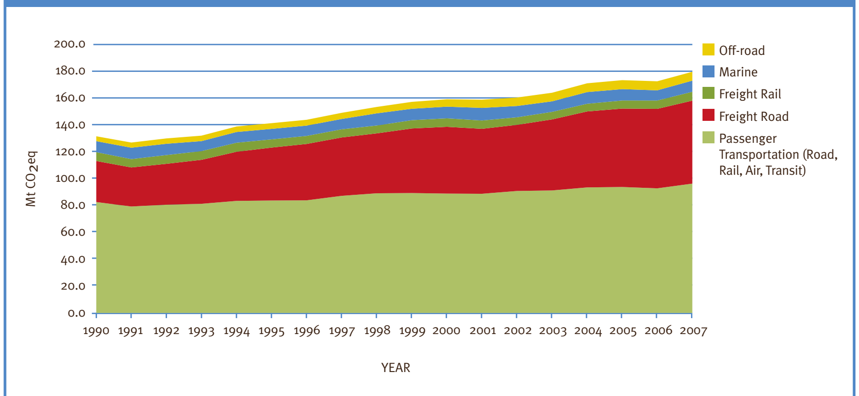
[34] US EPA, *Inventory of US Greenhouse Gas Emissions and Sinks: 1990–2008*, 2010, Washington, DC, <www.epa.gov/climatechange/emissions/usinventoryreport.html>.
[35] US Department of Transportation, *Transportation's Role in Reducing US Greenhouse Gas Emissions*, Volume 1, April 2010, pp. 2–26.
[36] Class 8 trucks are trucks over 33,000 lb gross vehicle weight rating (GVWR—see Glossary). In most cases, Class 8s are three-axle vehicles.
[37] Edgar Blanco and Kwan Chong Tan, *EPA SmartWay Transport Partnership*, Massachusetts Institute of Technology Center for Transportation and Logistics, 6/1/2009.

FIGURE 13 CANADA TRANSPORTATION GHG EMISSIONS, BY TRANSPORTATION MODE, 2007



Source: a) Statistics Canada, *Report on Energy Supply-Demand in Canada, 1990–2007*, Ottawa, February 2009;
b) Natural Resources Canada, Transportation End-Use Model, Ottawa, August 2009;
c) Environment Canada, *Canada's Greenhouse Gas Inventory 1990–2007*, Ottawa, April 2009.

FIGURE 14 TRANSPORT CO_2 EMISSIONS IN CANADA, 1990–2007



Source: a) Statistics Canada, *Report on Energy Supply-Demand in Canada, 1990–2007*, Ottawa, February 2009;
b) Natural Resources Canada, Transportation End-Use Model, Ottawa, August 2009;
c) Environment Canada, *Canada's Greenhouse Gas Inventory 1990–2007*, Ottawa, April 2009.

emissions from freight transportation are growing at a faster rate than those of passenger transportation.[38] GHG emissions from heavy-duty diesel vehicles increased by 23.8 Mt of CO_2eq from 1990 to 2007—a 161% rate of growth.[39]

In Mexico, transportation is considered to be responsible for about 18% of total country GHG emissions and is second only to energy generation as an emissions source.[40]

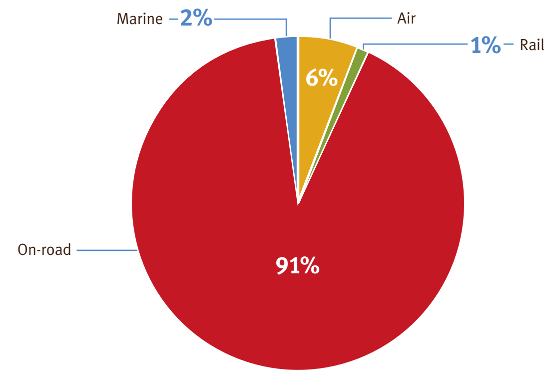
Other research projects substantially higher GHG impacts from freight transportation (both road and rail) by 2035, depending on the sizes of the truck and rail fleets and the degree to which the vehicle and locomotive populations in service utilize the most current emission control technologies and engine designs.[41] Regardless of the exact amounts, it seems certain that GHG impacts along principal trade corridors will be noticeably greater by 2035.

As an example of this, Figures 16 and 17 (pages 27–28) show possibilities for the increased GHG levels in different segments of the road and rail transportation corridor stretching from Mexico City to Montreal, Canada.[42] Emissions, indicated through color coding, are given only for CO_2 levels, for the sake of graphical simplicity, because these are two or three orders of magnitude higher than those of other pollutants. As analyzed by the Texas Transportation Institute (TTI), "trucks emit more than 75 times as much CO_2 as freight locomotives in 2010 (the base case). In 2035 the total CO_2 contribution of both modes will be higher than in the base year; however, the increase in the portion from trucks will be at a greater rate: it is expected that in 2035, trucks will emit more than 110 times the total CO_2 from freight locomotives."[43]

In closing this section, we note that despite the focus on CO_2 emissions in this report, CO_2 is not the only significant freight-related environmental and climate-forcing emission. There is also concern about other Kyoto GHG emissions and non-Kyoto emissions, such as black carbon (see text box) and organic carbon emissions, as well as emissions of NO_x, SO_x, and other criteria air pollutants.

[38] Transport Canada, *Transport Canada Sustainable Development Strategy 2007–2009,* Part 4, Key Issues in Transportation and Themes for 2007–2009, <http://tc.gc.ca/policy/acs/sd/sds0709/keyissues.htm>; and/or Natural Resources Canada, National Energy Use Database, <www.oee.nrcan.gc.ca/corporate/statistics/neud/dpa/tableshandbook2/tran_00_2_e_4.cfm?attr=0>.
[39] Environment Canada, *Canada's Greenhouse Gas Inventory 1990–2007*, Freight Transportation GHG Emissions by Transportation Mode (Mt of CO_2eq), Ottawa, April 2009.
[40] Juan C. Villa and Annie Protopapas, *Sustainability and Freight Transportation in North America: Foundation Paper*, Texas Transportation Institute, The Texas A&M University System, College Station, Texas, March 2010.
[41] Somewhat higher emission impacts are projected in *Greening North American Transportation Corridors: Challenges and Opportunities*, May 2010, Texas Transportation Institute, Texas A&M University, pp. 20–21.
[42] Prepared for the CEC by the Texas Transportation Institute.
[43] Texas Transportation Institute, op. cit. (note 41), p. 20.

FIGURE 15 MEXICO GHG EMISSIONS, BY TRANSPORTATION MODE, 2002



Source: Taken from Juan C. Villa and Annie Protopapas, *Sustainability and Freight Transportation in North America: Foundation Paper*, Texas Transportation Institute, The Texas A&M University System, College Station, Texas, March 2010.

TABLE 1: US GHG EMISSION PROJECTIONS (Mt CO_2eq), BY MODE

	2007	2030	% Change 2007–2030	2007 Share, by Mode	2030 Share, by Mode
Light-duty vehicles	1,221.4	1080.9	-11.5	56.7	49.8
Commercial light trucks	43.3	41.6	-4.3	2.0	1.9
Bus transportation	20.2	20.6	2.0	0.9	0.9
Freight trucks	374.9	449.7	20.0	17.4	20.7
Rail, Passenger	6.6	8.2	24.7	0.3	0.4
Rail, Freight	48.8	55.4	13.5	2.3	2.6
Shipping, Domestic	28.3	32.7	15.7	1.3	1.5
Shipping, International	78.0	79.9	2.5	3.6	3.7
Recreational boats	19.7	21.2	7.8	0.9	1.0
Air	194.1	246.6	27.1	9.0	11.4
Military use	50.3	55.2	9.8	2.3	2.5
Lubricants	5.2	5.6	7.5	0.2	0.3
Pipeline fuel	31.8	37.4	17.6	1.5	1.7
Other	33.0	36.3	10.0	1.5	1.7
Total Transportation	**2,155.5**	**2,171.3**	0.7		

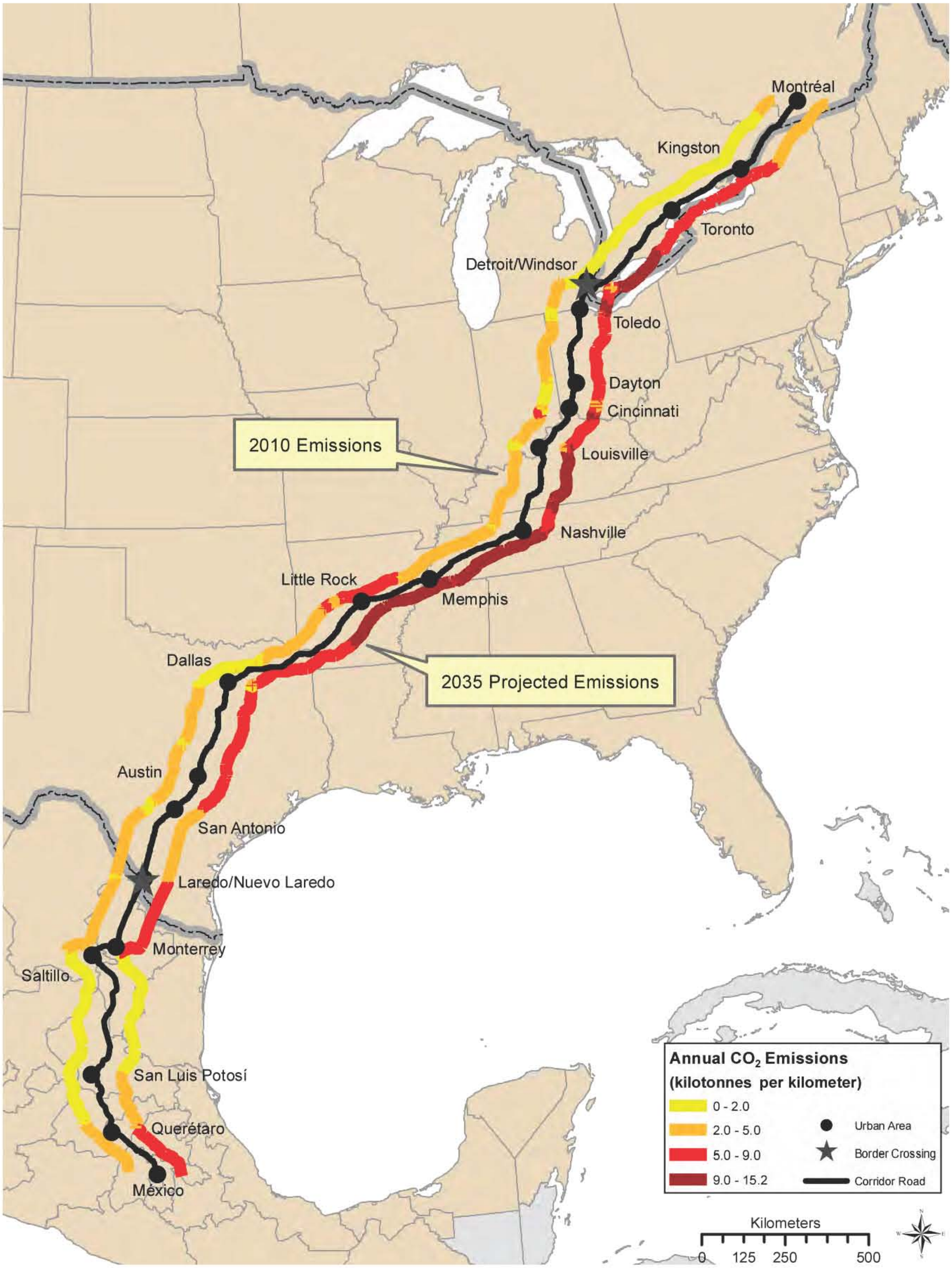
Source: US Department of Transportation, *Transportation's Role in Reducing US Greenhouse Gas Emissions*, Vol. 1: *Synthesis Report*, April 2010, Table 2.3, pp. 2–27.

3.4 CHALLENGES TO SUSTAINABLE FREIGHT TRANSPORTATION

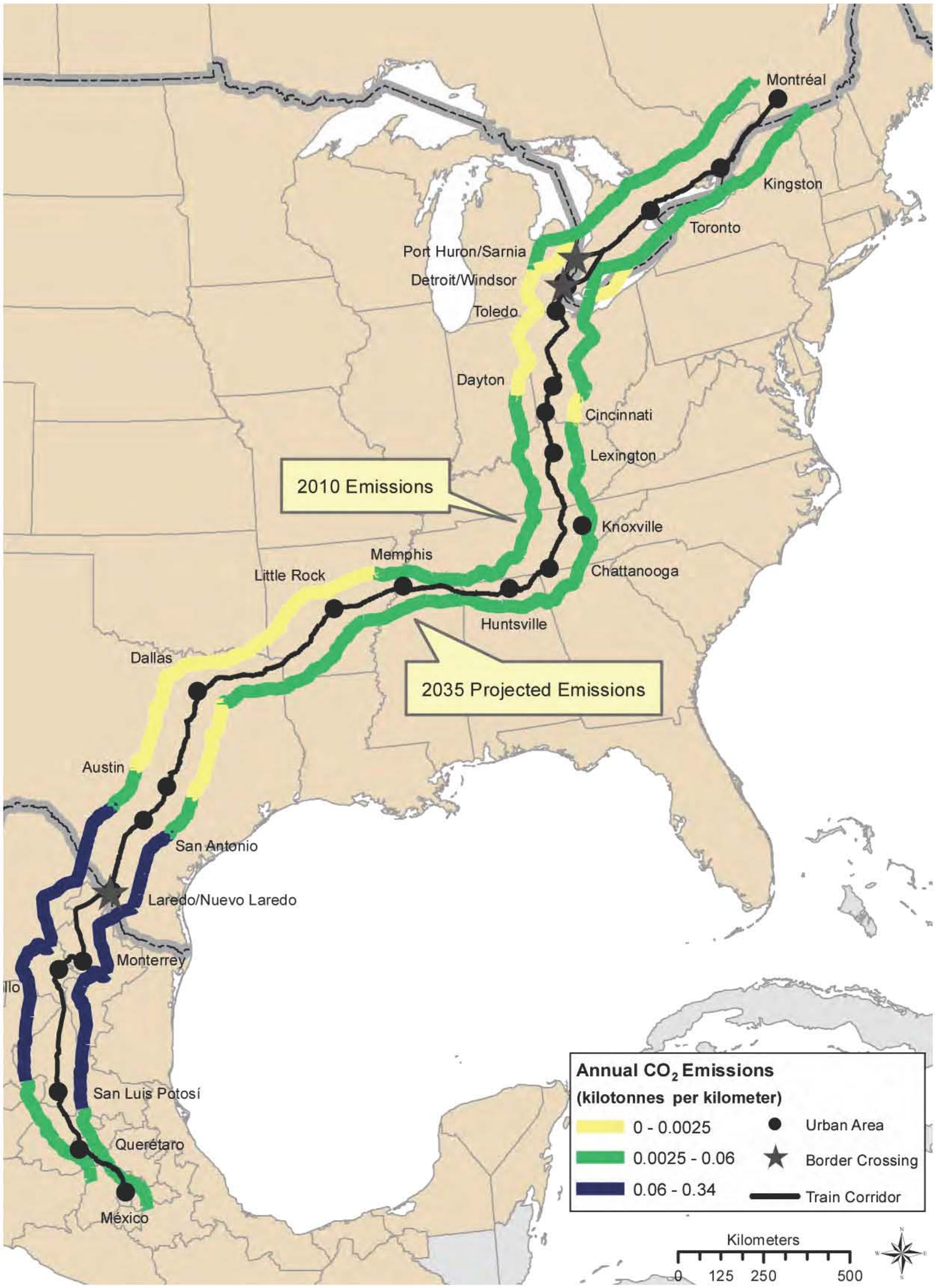
Concerns about freight transportation systems have been voiced in Canada, Mexico and the United States, bolstered by calls for the development of an integrated North American freight transportation system. The Canadian Chamber of Commerce, for example, advocates treating the Canada-US border as part of the freight supply chain and passenger travel system. The Chamber claims that if the border works well, it will allow the countries' economies to grow and will support the seven million jobs in the United States and three million in Canada that rely on a close partnership.[44] It has also been stated that Mexico is at a crossroads between stagnation and advancement. Mexico's future in advanced manufacturing depends on addressing a range of issues, such as privatization, regulatory frameworks, inter-modal transport, and security.[45]

A large number of studies, reports, and a wide range of transportation stakeholders have identified challenges confronting freight transportation in North America. Many have called for national and North American visions of sustainable transportation. The US National Surface Transportation Policy and Revenue Study Commission, for example, stated that the transportation challenges facing the US have reached crisis proportions. Key issues identified by the Commission included deferred maintenance of basic infrastructure, crippling traffic congestion, burgeoning international trade, and the use of fossil fuels to power cars and trucks.[46]

[44] The Canadian Chamber of Commerce, *Transportation Strategy Series—Pillar #1: A North American Vision*, April 2009, <www.chamber.ca>.
[45] Stephen Blank with Malcolm Cairns, *Drivers of Change: Envisioning North America's Freight Transportation System in 2030*, Working Paper No. 7, North American Transportation Competitiveness Research Council, August 2008.
[46] National Surface Transportation Policy and Revenue Study Commission, *Transportation for Tomorrow, Report of the National Surface Transportation Policy and Revenue Study Commission*, Volume 1, Recommendations, December 2007, Washington, DC, <http://transportationfortomorrow.org/final_report/>, p. 2.



Source: Adapted from Texas Transportation Institute, *Greening North American Transportation Corridors: Challenges and Opportunities*, May 2010, Texas A&M University.



Source: Adapted from Texas Transportation Institute, *Greening North American Transportation Corridors: Challenges and Opportunities*, May 2010, Texas A&M University.

Black Carbon[47]

Black carbon is a solid particle emitted during incomplete combustion. All particle emissions from a combustion source are broadly referred to as particulate matter (PM) and usually delineated by size: PM_{10} = less than 10 micrometers, $PM_{2.5}$ = less than 2.5 micrometers. Black carbon is the solid fraction of $PM_{2.5}$ that strongly absorbs light and converts that energy to heat. When emitted into the atmosphere and deposited on ice or snow, black carbon causes global temperature change, melting of snow and ice, and changes in precipitation patterns.

Fossil fuel combustion in transport; solid biofuel combustion in residential heating and cooking; and open biomass burning from forest fires and controlled agricultural fires are the source of about 85% of global black carbon emissions. Maximum feasible reductions in 2030 can capture 2.8 Tg/yr (teragrams per year, equal to 2.8 million tonnes/year) of black carbon, a reduction of 60% from business-as-usual. Co-emitted pollutants and the location of emission activity will determine the net impact of control strategies on the climate.

Public health protection is already a strong argument for actions that control black carbon. Exposure to PM is responsible for hundreds of thousands of global deaths each year. Actions that reduce PM—such as new requirements for exhaust after-treatment, with the lower-sulfur fuels; fuel switching; and reductions in fuel consumption—can reduce a substantial fraction of black carbon emissions. Regardless of the climate protection benefits, there is a strong case for taking these actions in order to protect public health.

The climate impacts of black carbon reinforce the public health need for actions to control PM emissions. According to the IPCC, black carbon is the third-largest contributor to the positive radiative forcing that causes climate change. One kilogram is about 460 times more potent than an equivalent amount of carbon dioxide over a 100-year time horizon and 1,600 times more potent over a 20-year horizon, based on unofficial IPCC estimates. IPCC estimates of radiative forcing are conservative compared to others in the published literature.

Controls on black carbon can produce rapid regional and global climate benefits. Like all aerosol particles, black carbon washes out of the atmosphere within a few thousand kilometers from its source, so it produces essentially short-lived radiative forcing. This forcing produces strong regional climate impacts that extend beyond the forcing region and approach a global scale. In the aggregate these regional impacts are a global problem. A climate change mitigation strategy that incorporates short-lived forcing agents like black carbon can more rapidly reduce the positive radiative forcing that causes climate change, especially when rapid action is needed to avert tipping points for large-scale impacts like the loss of Arctic summer sea ice, the Himalayan-Tibetan glaciers, and the Greenland ice sheet.

Black carbon reductions supplement but do not replace actions to control carbon dioxide and other greenhouse gases. A focus of climate change mitigation is to reduce all positive radiative forcing, and carbon dioxide is the largest positive forcing agent, so any delay in CO_2 emission reductions extends its climate impacts. Actions that reduce black carbon and carbon dioxide emissions in parallel will more effectively reduce total positive radiative forcing.

Controls on black carbon will reduce both positive and negative radiative forcing, so decisions to act on a climate basis alone should focus on the net effect. Black carbon is emitted with other pollutants that reflect light and offset its positive forcing. These include primary and secondary organic carbon, sulfates, and nitrates produced in amounts that vary with the combustion and fuel type of each source. The net effect of sources is modified by the transport and deposition of its black carbon emissions onto ice and snow, so major sources that produce negative forcing in the atmosphere can still be net positive forcers if they deposit sufficient amounts into the Arctic or atop mountain glaciers.

The highest priority targets strictly from a climate mitigation perspective are sources that cause net positive radiative forcing, such as combustion of fossil fuels low in sulfur and deposition of black carbon on ice and snow surfaces. On-road heavy-duty diesel vehicles, off-road agricultural and construction equipment, residential coal combustion, and industrial brick kilns are generally net positive forcers. Open agricultural burning, residential biofuel burning and commercial shipping may be negative forcers, but these can be offset locally if there is black carbon deposition on snow and ice.

[47] International Council on Clean Transportation. Policy-relevant guidance on black carbon. The information is consistent with the *Fourth Assessment Report* of the Intergovernmental Panel on Climate Change (IPCC), published in 2007, and is further informed by the 2009 London International Workshop on Black Carbon and subsequent discussions with workshop participants, <http://pre2010.theicct.org/documents/BC_policy-relevant_summary_Final.pdf>.

Based on the research and consultations done for this study, we have identified seven challenges to achieving more sustainable freight transportation in North America:

1 Lack of internalization of external costs of freight transportation

2 Inadequate coordination among North American transportation agencies

3 Lack of integrated land-use and freight transportation planning

4 Extensive delays in truck freight movement across borders

5 Time needed for turnover of inefficient "legacy" truck fleet

6 Inadequate funding of transportation infrastructure

7 Absence of essential transportation data

Failure to address these challenges will mean accepting increasing freight transportation-related CO_2 emissions due to road congestion, excessive vehicle idling, empty vehicle backhauls, poor matching of freight transport modes, burning of high-carbon fuels, excessive trip lengths, inadequately trained drivers, and many other reasons for inefficiencies that lead to an increase in fossil fuel usage.

3.4.1 Lack of internalization of external costs of freight transportation

Freight transportation results in several types of "externalities" not priced in the market (e.g., air pollution, greenhouse gases, land use, and habitat loss), as well as other types of externality that need to be taken into account when new technologies are introduced to the market (see text box on new truck technologies). It is beyond the scope of this report to assess the pros and cons of all freight transportation externalities and different externality pricing and other mechanisms that might address them. We note, however, that freight transportation would be affected by these mechanisms if, as and when they are implemented in North America.

Indirect Effects and Externalities of New Truck Technologies[48]

A number of indirect effects and unintended consequences associated with regulations aimed at reducing fuel consumption in the trucking sector can be important. In particular, regulators should consider the following effects in the development of any regulatory proposals: rate of replacement of older vehicles (fleet turnover impacts), increased tonne-kilometers shipped due to the lower cost of shipping (rebound effect), purchasing one class of vehicle rather than another in response to a regulatory change (vehicle class shifting), environmental co-benefits and costs, congestion, safety, and incremental weight impacts.

Our focus in this report is on GHGs (primarily CO_2) as an externality.

It is also beyond the scope of this report to weigh the merits of various carbon-pricing instruments proposed to result in lower CO_2 emissions, but brief mention is made of carbon pricing as it is promoted by many advocates of sustainable transportation as potentially the most effective policy tool to accomplish GHG emissions reduction goals in this and other sectors.

Carbon pricing using a carbon tax or a market-established price on emissions in excess of a regulated cap can generate investment flows for low-carbon technologies and activities.[49] The carbon price that is established as a result of a tax or cap-and-trade system creates an incentive to reduce carbon emissions, either through increasing the efficiency of the use of an existing energy source or through substitution of low-/no-carbon emission sources. The expectation is that carbon pricing will generate investments in technologies or activities that have lower carbon emissions than business-as-usual.

An effective price on carbon emissions will promote investment in low-carbon freight transportation; however, many experts and freight transportation stakeholders also believe that a portfolio of policies is needed to attract the significant investments required to make the transformation to a low-carbon transportation system.

3.4.2 Inadequate coordination among North American transportation agencies

Attempts have been made in the past to establish a forum for routine meetings of Ministers of Transportation and senior officials of the three NAFTA countries. The Ministers last met in 2008 and issued a declaration committing to closer collaboration:

[48] National Research Council, Transportation Research Board, *Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles*, 2010, Committee to Assess Fuel Economy Technologies for Medium- and Heavy-Duty Vehicles, Summary, pp. 5–6.

[49] Note: Information for this section was drawn from: *Carbon Pricing, Investment, and the Low-Carbon Economy: Policy Brief*, Sustainable Prosperity, University of Ottawa, June 2010, <www.sustainableprosperity.ca>.

We, the Ministers responsible for transportation in North America, recognize that the challenges and opportunities of trade and transportation require our sustained attention in order that we may effectively anticipate future transportation needs, and assure North America's place in global trade. Our discussions at Meech Lake build on the close collaboration begun in Tucson, and we remain convinced that continuing cooperation and coordination among Ministers will bring benefits to our countries.

We commit to continuing our work together in a spirit of cooperation and goodwill.[50]

The Ministerial Declaration included a commitment to have officials from the three countries convene a trilateral meeting "to compare our evolving national policies and priorities for improving respective freight systems with the objective of assuring that our approaches are complementary and supported through coordination, information exchange, and other appropriate actions."

Unfortunately, Ministerial meetings have not been held since 2008 and officials have not convened the proposed trilateral meeting.

3.4.3 Lack of integrated land-use and freight transportation planning

Ensuring strong linkages between transportation and land-use planning is considered by many transportation stakeholders to be essential to a sustainable freight transportation system. This can be difficult to achieve, given the control of local land use by municipalities versus the various roles of provinces/states and federal governments in transportation corridors, but it is fundamental to reducing congestion and related GHG and air pollutants emissions due to idling. The Canadian Chamber of Commerce, for example, believes that enhanced linkages between the various passenger modes of transportation will encourage public use of transit, further reduce congestion on highways, and help to reduce the carbon footprint of the transportation network.[51]

In Mexico, the government is obliged under planning laws to create development plans and strategies. In response, Mexico has put structures in place for larger (i.e., meso) regions that have tried to integrate transportation and urban planning, but coordination at the local level, where land-use planning is done, has proven to be difficult. Thus, the ability to make and enforce integrated transportation and land-use plans has been irregular.

Calls have also been made in the United States for more integration between freight transportation and land-use planning. The National Surface Transportation Policy and Revenue Study Commission stated that more emphasis should be placed on transit and intercity passenger rail to make them a priority for the United States. The Commission went as far as saying that a cultural shift will need to take place across America to encourage citizens to take transit or passenger rail when the option is given, and that it is important to increase the market share for freight rail.[52]

3.4.4 Extensive delays in truck freight movement across borders

Border regions have become an increasing source of freight-related GHG and criteria pollutant emissions due to border delays and related truck idling. The Canadian Chamber of Commerce has expressed concerns that the Canada-US border is now a *de facto* barrier to trade, and that border restrictions and waiting costs threaten the integrated supply chain in manufacturing.[53]

Mexico has significant concerns about barriers to cross-border trucking and train delays. The cross-border trucking provisions within NAFTA aimed to sharply bring down the costs and border-crossing times to benefit consumers and transport industries in both nations, but to date these provisions have not been implemented, with US opponents citing alleged safety and other concerns about Mexican trucks.[54]

3.4.5 Time needed for turnover of inefficient "legacy" truck fleet

The number of commercial trucks (mostly diesel-powered) on US highways increased by nearly 40% between 1980 and 2002. The character of the fleet has also changed, as the number of combination trucks

[50] Concluding statements made in *Ministerial Declaration: Canada–United States–Mexico Trilateral Transportation Meeting*, Meech Lake, Quebec, Transport Canada, 10 June 2008.

[51] The Canadian Chamber of Commerce, *Transportation Strategy Series —Pillar #4: An Economically, Environmentally and Socially Sustainable Plan*, December 2009, <www.chamber.ca>, p. 5.

[52] National Surface Transportation Policy and Revenue Study Commission, *Transportation for Tomorrow, Report of the National Surface Transportation Policy and Revenue Study Commission*, Volume 1, Recommendations, December 2007, Washington, DC, <http://transportationfortomorrow.org/final_report/>.

[53] The Canadian Chamber of Commerce, *Transportation Strategy Series —Pillar #1: A North American Vision*, April 2009, <www.chamber.ca>.

[54] North America's SuperCorridor Coalition (NASCo), *The NASCo Report*, Volume II, Issue 6, 15 March 2010. See article: Mexico Tariffs Over Cross-border Trucking Hit Home across USA.

BORDER REGIONS HAVE BECOME AN INCREASING SOURCE OF FREIGHT-RELATED GHG AND CRITERIA POLLUTANT EMISSIONS DUE TO BORDER DELAYS AND RELATED TRUCK IDLING.

grew twice as fast as the number of single-unit trucks over this period. Of the millions of trucks on the road today, most of the engines are still pre-2007 (the first model year for trucks with new emission control technologies that make use of the EPA-mandated, ultra-low-sulfur diesel). Only about 200,000 new truck engines are sold every year, and the US EPA says it will likely take until 2030 for all the trucks on the road to have "green" engines.[55]

Turnover of inefficient rail technology also takes considerable time. The typical service life for American locomotives and freight cars is about 40 years.

3.4.6 Inadequate funding of transportation infrastructure

Policy makers are familiar with the job boost associated with transportation infrastructure investments. In the absence of a comprehensive vision and plan for sustainable transportation, stimulus funding may prompt the rebuilding of inefficient infrastructure, thus locking in a high fossil energy use transportation system for decades into the future.

The need for increased funding and new funding mechanisms has been advocated by the US National Surface Transportation Policy and Revenue Study Commission, which called for a significant increase in public funding to keep America competitive. The Commission called for pricing of the transportation system through road tolls, and for the use of policy tools that encourage more private investment. Chokepoints at major gateways and trade corridors were also recognized as environmental hotspots and potential trade barriers. Simply raising the federal fuel tax and putting more money into the same programs was not considered to be acceptable by the Commission.[56]

The challenge of an equitable policy solution to infrastructure financing will be exacerbated by ever-increasing fuel efficiency and

Truck Idling Emissions at the El Paso–Ciudad Juárez Border Location[57]

The El Paso region continues to face serious air quality challenges, particularly due to the large number of trucks that circulate between Ciudad Juárez and El Paso. Following the implementation of the North American Free Trade Agreement (NAFTA), trade between the United States and Mexico increased substantially. Northbound truck movements through Ciudad Juárez–El Paso gateways grew from fewer than 600,000 per year in 1994 to more than 700,000 per year in 2004, and the number of trucks crossing the US-Mexico border is expected to continue growing, creating higher congestion levels and increased emissions. The northbound movements of trucks (import into the United States) in particular create long waiting times in the border locations due to several security and safety inspections that occur during the process.

The analysis of the creep idling and idling times leads to the conclusion that Section 1 of the northbound trip, which includes travel trough Mexico Customs and the actual bridge crossing, resulted in approximately 50% of the time that trucks idle or move at a very low speed. In the second portion of the trip (Section 2), on average more than 75% of the trip is spent idling or creep idling due to low speeds as a result of congestion and various inspections. Section 3 involves the state safety inspection process, which resulted in just over 40% of creep idling and idling occurring at the BOTA (Bridge of the Americas) crossing.

Note: Normal idling occurs when the vehicle is at a total standstill, whereas creep idling occurs when the vehicle is moving at a speed less than 5 mph and has an acceleration or deceleration less than 0.5 mph/sec.

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55 Stephen Blank and Barry E. Prentice, Greening North America's Trade Corridors, slide deck presentation at the 43rd Annual Conference of the Canadian Transportation Research Forum, 2009.

56 Transportation for Tomorrow, *Report of the National Surface Transportation Policy and Revenue Study Commission*, Volume 1, Recommendations, December 2007, <http://transportationfortomorrow.org/final_report/>, p. 1.

57 Josias Zietsman, Juan Carlos Villa, Timothy L. Forrest, and John M. Storey, *Mexican Truck Idling Emissions at the El Paso–Ciudad Juárez Border Location*, Texas Transportation Institute, November 2005, Executive Summary, pp. vii–viii.

North American Transportation Statistics Interchange (NATS-Interchange)[58]

The Interchange is a forum established in 1991 for the exchange of information and the initiation of collaborative activities among the transportation and statistical federal agencies in Canada, Mexico, and the United States. Its mission is to raise the general awareness of and improve the quality, relevance, and comparability of transportation data and information in North America. The overarching goal of the Interchange is to promote and develop high-quality, relevant, comparable data and analysis that provide information necessary for an efficient and fully integrated transportation system for North America.

One of the key results of the Interchange was the trilateral development and release of the *North American Transportation in Figures* report in 2000. Canada, Mexico, and the United States have updated this information as inputs to the North American Transportation Statistics Database, which supplies public access to relevant, timely, and comparable transportation indicators for North America, released in September of 2004. The lead agencies for the Interchange are the US Census Bureau, US Army Corp of Engineers, US Department of Transportation's (DOT) Bureau of Transportation Statistics (BTS), Ministry of Communications and Transport (MX), Mexican Institute of Transport, National Institute of Geography and Statistics (INEGI), Statistics Canada, and Transport Canada.

There are four working groups as part of the Interchange:

- **North American Transportation Statistics** working group—developing a core set of comparable and timely transportation performance measures for North America and the inclusion of these in an online database developed by Mexico.
- **Maritime and Trade** working group—dealing with vessel and port classification issues and consistency in these for North America, customs issues, trade data reconciliation, and support of maritime data needed for the online database.
- **Environment and Energy** working group—developing a comparable set of indicators in environment and energy as they relate to transportation across North America, and the exchange of best practice and program updates.
- **Surface Transportation** working group—freight surveys and collection approaches in North America, and the expansion of these across all three countries; measurement of border delays and efficiencies, hazmat freight issues, North American geospatial data, and North American passenger travel data.

the uneven impacts of heavy-duty trucks versus passenger vehicles on road maintenance. To the extent that broad-based gas taxes are currently dedicated to road maintenance in the US, a response to continuing fuel conservation measures, including vehicle electrification, may be to *increase* such taxes and fees, elevating the debate on the subsidization by personal vehicles of infrastructure maintenance.

Rail freight infrastructure investments are predominantly determined by private corporations and, as illustrated previously in Figure 8, for the US, capacity constraints may occur in the near future if significant additional investments are not made.

The challenge of financing new transportation infrastructure investment is daunting. A paper issued by the National Chamber Foundation of the US Chamber of Commerce estimated that by 2015, the cost just to maintain US pavements, bridges, and transit infrastructure would amount to $295 billion. To improve these systems would cost $356 billion. The report concluded that the total cost to improve the entire transportation system for the period from 2005 to 2015 would be $3.4 trillion, but that total revenue would only be $2.4 trillion, leaving a cumulative gap of approximately $1.0 trillion.[59]

3.4.7 Lack of essential freight transportation data

Transportation is one of the major contributors to GHG emissions in North America. However, the proportion of emissions that can be attributed to the movement of freight is not accurately documented. The absence of sufficient evidence to support policy making has hindered progress towards mitigation of emissions from freight transportation modes.[60]

[58] See <www.bts.gov/programs/international/north_american_transportation_statistics_interchange/>.

[59] Stephen Blank, with Malcolm Cairns, *Drivers of Change: Envisioning North America's Freight Transportation System in 2030*, Working Paper No. 7, North American Transportation Competitiveness Research Council, August 2008.

[60] Juan C. Villa and Annie Protopapas, *Sustainability and Freight Transportation in North America: Foundation Paper*, Texas Transportation Institute, The Texas A&M University System, College Station, Texas, March 2010.

Better-quality data, evaluation frameworks, and indicators are required to develop and shape policies, as well as to analyze impacts, assess strategic initiatives, and make informed decisions. Currently, the only coordinated effort to collect and disseminate transportation information at a North American level is being carried out by the North American Transportation Statistics Interchange (NATS-Interchange). NATS-Interchange is a coordinated effort to share information on how each country collects, analyzes, and publishes transportation data. The Interchange product is an online database that contains data already collected and published by government agencies in each of the countries, and that are comparable for publication (including technical notes to explain differences in methodology).

This study observes that statistics prepared by NATS-Interchange do not cover with sufficient detail the information required on freight transportation's broader impacts on society, such as pollutant emissions, GHG emissions, and sustainability in general. Data-gathering authorities are focused on national priorities, and the tables and indicators provided by the Interchange are built from different methodologies and definitions. As a result, there are limitations on the comparability of the data, as well as on the type of trilateral tables and/or indicators that can be made available.

The US National Surface Transportation Policy and Revenue Study Commission strongly supported the need for improving transportation-related data, saying that data collection is needed for good transportation decision making at all levels of government. Data on household travel behavior, freight movement, vehicle use, infrastructure condition, and operational performance were considered to be critical to identifying emerging trends, supporting transportation research, and evaluating the effectiveness of transportation programs.[61] Data on tonne-kilometers of freight moved for all transportation modes, in particular, are needed to better assess fuel consumption and GHG emissions.

The US Department of Transportation has stated that the lack of complete data on US international freight hampers research and analysis of trends in international freight movement and its impact on transportation activity within the United States. Fully understanding trends in the movement of goods and having reliable forecasts for transportation decision making require consistent and comparable data on both the weight and the value of internationally traded goods. In particular, the lack of weight data for land exports remains a problem for transportation freight analysis. The US Census Bureau—the agency in charge of reporting US merchandise trade data—does not collect shipment weight data for exports transported by truck, rail, and pipeline. Another data gap for international freight transportation analysis is the lack of comprehensive outbound border-crossing information from official US government sources. Data are only collected for incoming trucks and trains, as well as the containers they carry. This data gap continues to limit analysis of transportation activity at the land border gateways, including analyzing issues such as capacity needs, congestion management, traffic delays, and safety.[62]

In order to facilitate a North American perspective on freight transportation for planning, policy and impact assessment, it is vital that NATS-Interchange become a mandatory component of cooperation among the NAFTA partners. This could be achieved through a memorandum of understanding (MOU) signed by the lead agencies for the Interchange. The MOU should include provisions that facilitate the collection of data that foster a North American transportation statistical profile, by creating congruency in the collection of data before important national surveys and other data collection methodologies are initiated.

The following section of this report presents key findings on actions that need to be taken to reduce CO_2 emissions from freight transportation.

[61] National Surface Transportation Policy and Revenue Study Commission, *Transportation for Tomorrow, Report of the National Surface Transportation Policy and Revenue Study Commission*, Volume 1, Recommendations, December 2007, Washington, DC, <http://transportationfortomorrow.org/final_report/>, pp. 31–32.

[62] US Department of Transportation, *America's Freight Transportation Gateways*, November 2009, Research and Innovative Technology Administration, Bureau of Transportation Statistics, <www.bts.gov>, p. 17.

Mexico-US Cross-border Trucking and "Drayage"[63]

NAFTA provisions on cross-border trucking specified that restrictions on the movement of Mexican trucks beyond a narrow commercial zone extending 3 to 20 miles into the United States were to be phased out between 1995 and 2000. Enactment of this timetable was postponed in the face of opposition in the United States that centered on an alleged inability of Mexico's regulatory regime to address environmental concerns and safety issues related to commercial drivers and carriers. A demonstration cross-border program that allowed a limited number of Mexican domiciled trucks to haul goods into the US was halted in 2009, after 18 months of operation. In response, the Mexican government imposed retaliatory tariffs on US exports to Mexico.

The lack of an agreement between the US and Mexico to allow commercial vehicles to circulate in these countries, as was stipulated in NAFTA, generates a large movement of transfer, or *drayage*, trucks along the US-Mexican border. These trucks are generally older than the long-haul trucks used in North America. Drayage trucks pick up northbound trailers on the Mexico side of the border and shuttle them into the US commercial zone where they are transferred to US carriers that deliver them to the final destination.

The drayage movement and the customs broker requirements generate additional empty trips to reposition tractors and trailers on both sides of the border. The drayage practice generates, in addition to safety and security inspections and the concentration of truck movements in a few ports-of-entry, congestion and related truck idling that is a major source of GHG and criteria pollutant emissions.

Should the truck border crossing process be simplified and more efficient, motor carriers will be encouraged to select between drayage or long-haul transportation as a complementary system to travel beyond the commercial zone to deliver and pick up loads. A more efficient and prompt system for truck crossings at the border should reduce inefficiencies, crossing time, and congestion. This would substantially reduce the number of trips being made to reposition equipment, and would also reduce congestion (and thus GHG and criteria pollutant emissions).

The benefits of a more efficient truck border crossing process go beyond the reduction of transaction costs, as the impact on the environment of a newer truck fleet making long-haul trips having shorter crossing times and making fewer trips would be substantial on both sides of the border.

[63] Information provided by Juan Carlos Villa, Texas Transportation Institute, 15 April 2010.

4

KEY FINDINGS

The research and consultations conducted for this study revealed eleven areas in which actions need to be taken:

1. Pricing carbon
2. Reducing border delays and enhancing security
3. Integrating transportation and land-use planning
4. Shifting to more-efficient transportation modes
5. Shifting to lower-carbon fuels
6. Increasing the use and efficiency of transportation technologies
7. Funding transportation infra-structure and pricing its use
8. Greening supply chains and implementing best practices
9. Acquiring data and developing performance metrics
10. Reducing inefficient freight transportation demand
11. Improving freight trans-portation governance and stakeholder networking

4.1 PRICING CARBON

An effective price on carbon—sufficient to incentivize behavioral changes—would encourage freight shippers to use less high-carbon fuel or switch to lower-carbon technologies or modes. Results could include modal shifts, increased efficiency of existing modes, and an overall lowering of the carbon intensity of transporting goods. They could also mean higher prices for consumers; however, allowing the market to determine reduction strategies can also spur innovation that leads to lower costs of consumption.

Given the high-level policy attention that is being given to cap-and-trade systems and carbon taxes in many countries, the three NAFTA countries and key freight transportation stakeholders should actively research the benefits and costs of different carbon pricing mechanisms on the sustainability of the North American freight transportation system. Potential impacts on freight technologies, fuels, modal shifts, supply chain management, and other aspects of sustainable freight transportation should be assessed, and North America should be prepared to deal with any future policy developments.

4.2 REDUCING BORDER DELAYS AND ENHANCING SECURITY

The United States, Mexico, and Canada share concerns about border security and related effects on economic competitiveness. Calls have been made for aligning border and transportation policies and implementing uniform freight shipment reporting systems. Calls have also been made to bring together departments and agencies involved in transportation and border policies at the most senior levels of government.[64] The North American Center for Transborder Studies (NACTS) has recommended the designation of a North America/Borders authority to coordinate sustainable security, with a senior deputy at the US National Security Council to be appointed to resolve the competing, complementary, and overlapping border management, national security, law enforcement, commerce, transportation, environment, water, regional development, and other infrastructure and political issues that comprise today's border area realities. NACTS has stated that a singular focus on traditional security will not address all of the critical functions of the borders.[65]

Border security also could be enhanced by putting in place secure and interoperable customs systems to improve risk modeling and border predictability for truck (and rail) freight movement.[66]

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[64] The Canadian Chamber of Commerce, *Transportation Strategy Series —Pillar #1: A North American Vision*, April 2009, <www.chamber.ca>, p. 2.
[65] North American Center for Transborder Studies, *North America Next: A Report to President Obama on Building Sustainable Security and Competitiveness*, Arizona State University, 2009.
[66] The Canadian Chamber of Commerce, *Transportation Strategy Series —Pillar #1: A North American Vision*, April 2009, <www.chamber.ca>.

4.3 INTEGRATING TRANSPORTATION AND LAND-USE PLANNING

Inadequate attention is paid to integrating transportation and land-use planning in many urban areas. Integrated planning is required to ensure the smooth movement of freight through congested urban areas or to bypass these areas, thus reducing freight-related GHG emissions.

Senate Bill 375 in California is an example of attempt to deal with this issue. SB 375 is California state legislation that became law effective 1 January 2009. It prompts California regions to work together to reduce greenhouse gas emissions from transportation. The new law will achieve this objective by requiring integration of planning processes for transportation, land-use, and housing. The Bill offers local governments regulatory and other incentives to encourage more compact new development and transportation alternatives.[67] According to California's Air Resources Board, SB 375 will account for 3% of state-wide GHG emission reduction goals, reduce vehicle-miles traveled by about 4% over the next decade, and result in an annual cost savings of $1.6 billion.[68]

The Canadian Chamber of Commerce also supports enhanced linkages among passenger modes of transportation, as this would encourage public transit use and reduce congestion on highways. Minimizing traffic bottlenecks, maintaining infrastructure, and updating public transportation require increased coordination among transportation planners.[69]

In Mexico, coordination at the local level where land-use planning is done has proven to be difficult. Hence, the ability to make and enforce integrated transportation and land-use plans has been irregular.

Calls have been made in the United States for more integration between freight transportation and land-use planning. The National Surface Transportation Policy and Revenue Study Commission noted that urban areas generate 60% of the value of US goods and services. The efficient movement of citizens and goods within these areas is critical to their productivity, and by extension to the economic productivity of the United States. The Commission advocated for more emphasis on transit and intercity passenger rail to make them priorities for the US, and stated that it is important to increase the market share for freight rail and make significant increases in highway investment, as part of developing a robust surface transportation network.[70]

4.4 SHIFTING TO MORE-EFFICIENT TRANSPORTATION MODES

Modal shifting of freight from road to rail or to waterways is often promoted as a solution to reducing GHG emissions. While CO_2 reduction gains can be made by shifting freight transportation from high energy/high CO_2–emitting modes to more-efficient modes, this has proven to be difficult to accomplish in practice.[71] To date, GHG emissions reductions due to modal shifts have had mixed results compared to other policies. For example, an OECD report has noted that modal-shift policies tend to achieve only a third of the impact of a fuel efficiency policy and three quarters of the impact of a carbon intensity policy."[72] Many countries in the European Union have tried to implement pro-active policies to shift freight from trucks to rail to trucks;

[67] Adapted from: What is SB 375?—Senate Bill 375 Fact Sheet, Southern California Association of Governments, 2009, <www.scag.ca.gov>.

[68] See <www.arb.ca.gov/cc/scopingplan/document/appendices_volume1.pdf>.

[69] The Canadian Chamber of Commerce, *Transportation Strategy Series —Pillar #4: An Economically, Environmentally and Socially Sustainable Plan*, December 2009, <www.chamber.ca>, p. 5.

[70] National Surface Transportation Policy and Revenue Study Commission, *Transportation for Tomorrow, Report of the National Surface Transportation Policy and Revenue Study Commission*, Volume 1, Recommendations, December 2007, Washington, DC, <http://transportationfortomorrow.org/final_report/>.

[71] It should be noted, however, that modal shares are not determined directly by public authorities—they are the result of choices made by shippers in response to public policies. It has been argued that European countries have largely failed to liberalize the freight rail sector; hence, this sector is unable to effectively compete with road transport. Per Nils Axel Braathen, Principal Administrator, National Policies Division, Environment Directorate, OECD.

[72] OECD, *Reducing Transport Greenhouse Gas Emissions: Trends and Data*, 2010, International Transport Forum, p. 78.

however, rail has remained stable or, more often, lost share to trucks.[73]

Europe is continuing to push for modal shifts, with the Marco Polo program being the centerpiece of the European Union's initiative. Marco Polo has an annual budget for grants of about €60 million to provide financial support in the crucial start-up phase of a modal-shift project before it pays its way to viability. Intermodal projects combining road, rail, and waterborne transport are also eligible for funding support. The Marco Polo I program aims to have fewer freight trucks on the road and less congestion, less pollution, and more-reliable and efficient transport of goods.[74] The European efforts, however, have succeeded in achieving a better modal balance only in certain short sea shipping routes among certain well-established markets and container hub-and-spoke ports traditionally served by inland barging. The initiatives are still far from achieving the original goal of displacing trucking as the dominant mode for trans-European freight movements. Reasons include jurisdictional boundaries among the member states, administrative and funding issues, rail network capacity largely occupied by passenger rail, and the unwillingness of shippers to divert freight from trucks.[75]

In the United States, by contrast, rail represents approximately half of all tonne-kilometers and is gaining share relative to road transport or inland waterways. This trend is linked to the long travel distances and type of goods in the national freight mix (with an important representation of heavy bulk goods, such as coal, ore, and grain), as well as to the lack of passenger rail services competing for the same rail network.[76] However, since public investment in rail infrastructure in the US lacks a supportive institutional framework, it is considered by some stakeholders to be a missed opportunity in terms of building a more efficient freight transportation system. Large sums of money have been invested in rail bottleneck areas, such as the Middle Atlantic Region, California, and Chicago, but these investments, on their own, have not solved the problems.[77]

North American rail cross-border traffic has also increased substantially in recent years due to efficiencies gained after rail privatization in Mexico and the creation of new North American marketing and operation alliances that have resulted from the integration of the railroad system. Deregulation in the US allowed railroads to negotiate directly with shippers for services, to more readily set rates, and to have more freedom to enter and exit markets. Mexico's rail privatization program resulted in an increase in freight rail volumes, gaining a small market share against truck. After several years of operations of the Mexican privatized railroads, however, the truck-rail market share has shown no significant change.[78]

A recent study by the Texas Transportation Institute identified many obstacles to the US Marine Highways program, including service/marketing issues, operating cost issues, infrastructure and equipment issues, government/regulatory issues, operational constraints, and vessel-related issues.[79]

4.5 SHIFTING TO LOWER-CARBON FUELS

The transport sector is currently almost totally dependent on fossil fuels, particularly gasoline and diesel fuel. The foundation paper prepared for this study notes that

73 Ibid., p. 55.
74 European Commission Energy & Transport, Marco Polo, <http://ec.europa.eu/transport/marcopolo/home/home_en.htm>, p. 4.
75 Juan C. Villa and Annie Protopapas, *Sustainability and Freight Transportation in North America: Foundation Paper*, Texas Transportation Institute, The Texas A&M University System, College Station, Texas, March 2010, pp. 10, 87.
76 Ibid., p. 55.
77 Source: Discussions with federal and state officials.
78 Juan C. Villa and Annie Protopapas, *Sustainability and Freight Transportation in North America: Foundation Paper*, Texas Transportation Institute, The Texas A&M University System, College Station, Texas, March 2010, p. 10.
79 Kruse, C.J., and N. Hutson, NCFRP 17: *North American Marine Highways*, TRB, National Research Council, Washington DC, September 2009.

CARBON REPORTING COULD ULTIMATELY DRIVE LOGISTICS AND TRANSPORT COMPANIES TO UNDERTAKE CARBON REDUCTION STRATEGIES AIMED AT REDUCING THE CARBON INTENSITY OF THEIR OPERATIONS, INCLUDING THE USE OF LOWER-CARBON FUELS.

petroleum-based fuels are forecasted to remain the main source for energy in the transportation sector in the next 20–25 years, with petroleum consumption increasing.

The US has set a Renewable Fuels Standard, under the Energy Independence and Security Act (2007), that requires 36 billion gallons of renewable fuels to be provided by 2022.[80] Fuel categories include conventional biofuel (i.e., ethanol derived from corn starch), advanced biofuel (i.e., ethanol from biomass other than starch or sugar), biomass-based diesel, and cellulosic biofuel. Each category of fuel must meet a defined lifecycle GHG emissions threshold (e.g., 60% threshold for cellulosic biofuel). Commitments to renewable fuels have also been made in Canada and Mexico; however, in the short term (i.e., the next 10–15 years), petroleum-based fuels are projected to continue to dominate fuel use for freight transportation.

One initial step to achieving lower-carbon transportation that was suggested during this study was to develop carbon reporting for freight transportation companies. Reporting could become a tool for differentiation within the logistics and transport industry, but it would require companies to report under a common set of standards. Carbon reporting could ultimately drive logistics and transport companies to undertake carbon reduction strategies aimed at reducing the carbon intensity of their operations, including the use of lower-carbon fuels.

Another major step towards lower-carbon fuels could be to electrify freight transportation (depending on the life-cycle emissions of doing so). Currently, rail is the only mode in which off-the-shelf technology exists for electrification. It was noted that more than 80% of the primary rail routes in Europe and Russia are electrified, and China is electrifying its primary rail routes at a pace of 2,000 km/yr.[81]

4.6 INCREASING THE USE AND EFFICIENCY OF TRANSPORTATION TECHNOLOGIES

There are substantial gains to be made in the use and efficiency of freight transportation technologies. For example, according to a report by Sustainable Development Technology Canada (SDTC), industrial freight transportation comprises approximately 19% of Canada's total GHG emissions and is among the fastest-growing sources of emissions in the country. After studying the potential to reduce these emissions, the following vision was articulated: The vision for the Industrial Transportation sector as a whole is that GHG emissions can be reduced by 48.8% to approximately 77.5 Mt CO_2eq less than in the business-as-usual scenario, through efficiency measures alone.[82]

Similarly to SDTC, Rocky Mountain Institute (RMI) has argued that great gains in truck efficiency can be made, but to do so requires an understanding of the trucking industry, and a number of "cultural" barriers will have to be addressed. RMI notes that the trucking industry is not concentrated, nor is it cohesive (e.g., the top fifty companies account for only 30% of the market). The market is also fragmented, with many stakeholder types involved in portions of production or operations, and it suffers from poor communications and collaboration among stakeholder groups and specific companies. The market's fragmentation has embedded system-wide inefficiencies, such as empty backhauls, fleet and owner/operators who decide against efficiency improvements and drivers who idle trucks overnight to stay warm. RMI asserts that doubling trucking efficiency through the use of smart technology and better coordination is possible, but it will require an in-depth understanding of the trucking industry and its stakeholders as they form the basis for many efficiency drivers and barriers.[83]

RMI further notes that within the trucking industry, long-haul heavy-duty (Classes 7 and 8) trucks offer great efficiency potential. Classes 7 and 8 trucks account for almost 80% of all trucks' fuel consumption in the US. Their size, speed, and poor aerodynamics mean that Classes 7 and 8 trucks are laden with "low-hanging fruit" (i.e., cost-effective efficiency and retrofitting opportunities). However, the industry has found efficiency improvements difficult to invest in, and when OEMs (original equipment manufacturers), fleets, and owner-operators have been able to improve efficiency, they have been reluctant to do so because they don't trust efficiency data (or projected paybacks).[84]

The RMI report identified ten key barriers to the successful distribution and adoption of efficiency technologies, grouped into four types: customer requirements, information, regulations and infrastructure, and technology. These barriers were

[80] The net GHG impacts of renewable fuels is debatable, as assessed by Crutzen, Mosier, Smith, and Winiwarter: N_2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels, in *Atmospheric Chemistry and Physics* 8, pp. 389–395, <www.atmos-chem-phys.net/8/389/2008/>.
[81] Information provided during the study by Mariana Chew-Sánchez, Sierra Club, US.
[82] Development Technology Canada, *Transportation—Industrial Freight Transportation: SD Business Case*, abridged version, November 2009, <www.sdtc.ca>.
[83] Rocky Mountain Institute, *Transformational Trucking Initiative Report*, June 2009, p. 5.
[84] Ibid., p. 1.

Heavy-duty Long-haul Combination Trucks Can Achieve Substantial, Cost-effective Reductions in CO_2 Emissions[85]

A recent assessment of available and emerging technologies that could be used to reduce CO_2 emissions and lower fuel consumption from new heavy-duty long-haul combination trucks in the United States concluded that:

> Existing and emerging vehicle, engine, and transmission technologies can achieve substantial and cost-effective reductions in heavy-duty vehicle CO_2 emissions and fuel consumption in the 2012 to 2017 timeframe. Coupled with operational measures, the benefits could even be larger. Specifically, CO_2 and fuel consumption emissions from heavy-duty vehicles can be reduced up to 50% in this timeframe. Over a three-year period and with a diesel fuel price of $2.50 per gallon, this study found that five of the technology packages would result in a net cost savings to the truck owner, taking into account both incremental technology costs and fuel savings. The analysis shows that most of the technology combinations that provide the greatest reductions would not be adopted into the fleet assuming a three-year payback requirement. This indicates that given the short payback period demanded by the trucking industry, a number of these technologies will not be adopted into the US fleet absent regulation. With a longer payback period of 15 years estimated lifetime net savings are between $30,000 and $42,000 for owners of vehicles achieving CO_2 and fuel consumption reductions of up to 50%.
>
> Introduction of all the technologies and strategies modeled in this study into the US heavy-duty long haul fleet between now and 2030 would lead to an estimated 8 billion gallons of diesel fuel saved annually beginning in 2030, with lesser reductions being achieved as soon as 2012. The 8 billion gallons of fuel saved annually represents approximately 44% of the total projected business as usual fuel consumption in the heavy-duty long haul fleet. Cumulative fuel savings between now and 2030 would equal approximately 90 billion gallons of diesel fuel. Approximately 97 million metric tons of annual CO_2 emissions would be reduced beginning in 2030. This would be equivalent to a 44% reduction in annual CO_2 emissions beginning in 2030 from business as usual projections. Cumulative CO_2 emissions avoided between now and 2030 would equal approximately 1.1 billion metric tons.

considered to be primarily cultural barriers stemming from the industry's fragmentation and small profit margins. The report also identifies important regulatory barriers to efficiency, including inconsistent regulations between states. The report states that these and other cultural barriers have prevented any significant fuel economy improvement within the trucking industry for the past 30 years. This occurred despite the commercial availability of many after-market efficiency products.

While fuel economy is a critically important aspect of freight transportation, it should be noted that complete life-cycle analysis is an essential tool to estimate overall fuel savings and GHG emissions reductions. Life-cycle data relevant to freight transportation are needed, including data on vehicles, infrastructure, fuel production, and supply chains, among other factors. Decisions made on partial data can be misleading. Non-operational components of the life-cycle may even dominate total emissions.[86] For instance, within the freight transportation life cycle, transportation technologies can be made more efficient by the use of lighter materials, such as aluminum, in aircraft, cars, trucks, trains, containers, and various packaging and building materials. Less weight means less energy use per unit of freight moved. Aluminum rail cars are approximately two-thirds lighter than equivalent steel cars. However, a complete life-cycle analysis is required to make appropriate overall comparisons.[87]

[85] Northeast States Center for a Clean Air Future, *Reducing Heavy-duty Long Haul Truck Fuel Consumption and CO_2 Emissions, Final Report*, October 2009, International Council on Clean Transportation, Southwest Research Institute, Executive Summary, pp. 1–2.

[86] See, for example, Mikhail V. Chester and Arpad Horvath, Environmental assessment of passenger transportation should include infrastructure and supply chains, *Environmental Research Letters* 4 (2009). The authors found that total life-cycle energy inputs and GHG emissions contribute an additional 63% for on-road, 155% for rail, and 31% for air transport systems over passenger vehicle tailpipe operation.

[87] See Aluminum Association of Canada, *The Future Builds on Aluminum*, brief presented as part of the consultation for a study on sustainable freight transportation undertaken by the Secretariat of the Commission for Environmental Cooperation, 28 May 2010.

Progress and Commitments Made on Criteria Pollutants and GHG Emissions Reductions

While the emphasis in this report is on reducing CO_2 emissions, it should be noted that NAFTA countries are already working on reducing air quality–related transportation emissions through regulatory and voluntary means. For example, a report prepared for the CEC in 2001 estimated the air pollution emissions associated with cross-border trade.[88] The report found that cross-border freight was responsible for 3–11% of all mobile-source nitrogen oxide (NO_X) emissions and 5–16% of all mobile-source PM_{10} emissions in five corridor regions (i.e., Vancouver-Seattle, Winnipeg-Fargo, Toronto-Detroit, San Antonio–Monterrey, and Tucson-Hermosillo). Trade forecasts were used to project an increase in CO_2 emissions of 2.4 to 4 times over 2001 levels in the five corridors. But by 2010, as a result of regulations, newer truck engines had drastically reduced particulate emissions and released about 80% less nitrogen oxide than older technologies. Going forward, 2010 engines should reduce NO_X emissions essentially to zero.

On 21 May 2010, President Obama announced that the US would establish GHG emissions standards for commercial medium- and heavy-duty vehicles, beginning with model year 2016. The announcement noted that large tractor-trailers emit half of all GHG emissions from the commercial trucking sector. Existing technologies can reduce these emissions by as much as 20% and increase their fuel efficiency by as much as 25%.[89] Canada has also announced that it will adopt the US standards, with appropriate adjustments for Canadian conditions.[90]

The use of intelligent transportation system (ITS) technologies[91] is another promising area of development for freight transportation. NAFTA truck traffic, in particular, is dominated by large companies that have adopted relatively high levels of communications, computer, and software technologies. These companies are good candidates for using ITS technologies to reduce border crossing delays without compromising the interdiction and law enforcement processes required by government agencies. Thus, binational links between the US-Canada and the US-Mexico could be further developed to improve both security and system efficiency.[92]

Table 2 contains a summary of truck and rail GHG mitigation strategies, demonstrating the wide range of actions that can be taken to reduce GHG emissions from these transportation modes.

[88] Jeffrey Ang-Olson and Bill Cowart, "Freight Activity and Air Quality Impacts in Selected NAFTA Trade Corridors," paper submitted for publication in the *Transportation Research Record*, ICF Consulting, 2001, <www.icfi.com/Markets/Transportation/doc_files/air-quality-freight.pdf>.
[89] Presidential memorandum "Regarding Fuel Efficiency Standards," 21 May 2010, <www.whitehouse.gov/the-press-office/presidential-memorandum-regarding-fuel-efficiency-standards>.
[90] Environment Canada, <www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=2D7A8979-B4F4-4A06-87E0-C76237F5E803>.
[91] An intelligent transportation system (ITS) adds information technology to transportation infrastructure and vehicles. It aims to manage vehicles, loads, and routes to improve safety and reduce vehicle wear, transportation times and fuel costs.
[92] Brian Bochner, Bill Stockton, Dock Burke, and Robert Harrison, "A Prototype Southern Border Facility to Expedite NAFTA Trucks Entering the United States," paper number 01-0406, presented at the 80th Annual Meeting of the Transportation Research Board, Washington, DC, 2001.

TABLE 2: SUMMARY OF TRUCK AND RAIL GHG MITIGATION STRATEGIES

Strategy	Truck	Rail
Fuel Technologies	• Low-carbon fuel • Compressed natural gas (limited applications) • Plug-in hybrids (future potential)	• Ultra-low-sulfur diesel (with caution) • Electrification • Low-carbon fuel • Compressed natural gas
Vehicle Technologies	**Fuel Efficiency**	
	• Auto tire inflation systems • Wide & low–rolling resistance tires • Aerodynamic improvements • Low-viscosity lubricants • Lighter tractors and trailers • Improved AC systems & waste heat recovery	• Track lubricants • Low-friction bearings • Lightweight cars • Lubrication improvement • Aerodynamic improvements
	Idle Reduction	
	• Bunker heaters & auxiliary power units • Thermal storage units • Automatic shut-down/start-up systems • Electrified truck stops • Idle reduction policies	• Auxiliary power units • Diesel heat system • Automatic engine start/stop • Switchyard idle reduction programs • Plug-in units
	Retrofit/Replacement*	
	• Diesel oxidation catalysts & particulate filters • Selective catalytic reduction systems • Engine upgrade/replacement, e.g., direct injection, reduced engine friction, waste heat recovery • Truck replacement with newer or hybrid vehicles	• Locomotive replacement with newer cleaner units • Locomotive remanufacturing • Hybrid rail yard switchers • Switchyard idling reduction measures
System Optimization/ Operational Efficiency	• Movement optimization: decentralization of supply chains, reduced excess packaging & shipment frequency, pick-up & delivery idling reduction measures, drive-by weigh stations, electronic tolling, advance clearance, port access improvements, congestion mitigation measures, arterial signal synchronization, real-time traffic information, reduced empty mileage & circuitous routes, real-time parking/truck stop management • Longer/heavier combination trucks • Speed restrictions • Grade crossing separation • Advanced technology and logistics • Improved local distribution • Intermodalism & mode shift to water or rail • Eco-driving technology & driver education	• Movement optimization: rail congestion mitigation measures, reduced empty mileage & circuitous routes • Longer & double stacked trains • Line-haul speed restrictions • Advanced technology and logistics • Port access improvements • Train clearance improvement • Electric movement of containers from ports to inland distribution centers • Intermodalism & mode shift to water (with caution)
Smart/ Sustainable Growth	• Smart/sustainable growth through improved and integrated transportation planning that accounts better for freight movements	
Market-based Mechanisms (Future)	• Emissions controls; e.g., cap-and-trade • Emissions pricing; e.g., carbon tax • Pricing emissions will offset cost of abatement and achieve emissions reductions	

* Emission control retrofit devices can only reduce non-CO_2 GHG emissions

Adapted from H.C. Frey and P.Y. Kuo, *Potential Best Practices for Reducing Greenhouse Gas Emissions in Freight Transportation*. Paper no. 2007-AWMA-443, Proceedings, 100th Annual Meeting of the Air & Waste Management Association, Pittsburgh, PA. June 2007.

When looking at freight transportation from a North American perspective, it should be noted that there are often differences among Mexican, Canadian, and US technologies and practices that have to be taken into account or resolved; for example:

1. Canada and Mexico allow heavier trucks than those in the United States (e.g., US weight allowances are restricted to 80,000 lbs on federal highways);

2. Canada is moving towards allowing long-combination vehicles, while there has been no movement on this or expansion of their use in the US since the early 1990s;

3. the US only allows single-wide tires on lighter trucks, whereas in Canada, trucks up to 80,000 lbs can have single-wide tires, and some provinces with stronger roads have no weight limits (e.g., Ontario and Quebec);

4. Canada has restrictions on tractor length (i.e., 6.25-meter wheelbase) while the US and Mexico have no such restrictions (and hence can provide more room for drivers to sleep in cabs, etc.); and

5. with respect to aerodynamics, the US allows boat tails up to five feet long on trucks while Canada only allows two feet (but is currently studying this issue).[93]

In closing this subsection, we note that Canada and the US have adopted a work plan to collaborate on vehicle and engine emission controls.[94] The work plan consists of four elements:

- development of national and international standards;
- vehicle and engine compliance programs;
- greenhouse gas emissions from vehicles and fuels; and
- innovative programs to reduce emissions—retrofit programs.

4.7 FUNDING TRANSPORTATION INFRASTRUCTURE AND PRICING ITS USE

There is broad industry recognition that transportation user prices that incorporate the cost of environmental and other externalities have a key role to play in sustainable freight transportation. The European Union, in particular, has explored several fiscal mechanisms that focus on reducing GHG emissions. Options examined by the European Commission include a CO_2 tax on fossil fuels, the inclusion of road freight transport in the European emissions trading scheme (ETS), and the creation of a system that would charge different fees for road use based on the level of CO_2 produced. The EU aim is to "make the polluter pay"—that is, to internalize the external costs of freight transport. Confronting users with external costs by imposing charges on infrastructure would ensure more-efficient transportation use while addressing some of its negative consequences.

The need for increased funding and new funding mechanisms is advocated by the US National Surface Transportation Policy and Revenue Study Commission. The Commission stated that given the strong Federal interest in freight movement, Congress will need to make available a variety of funding sources to meet the needs of the Freight Transportation program. At the Federal level, these include increased gas tax revenues, tax credits, a portion of Customs duties revenues, and a Federal freight fee. The Commission also anticipated that highway tolling and public-private partnerships would play an important role. In effect, a full range of financing options will be needed to deal with transportation funding needs.[95]

4.8 GREENING SUPPLY CHAINS AND IMPLEMENTING BEST PRACTICES

Sustainable freight transportation must include a comprehensive focus on the goods movement supply chain. The North American freight supply chain crosses ports and borders, using multiple modes of transport in a complex network of freight carriers, logistics providers, and freight shippers. Thus, cooperation and partnerships between governments and the private sector are essential.

The US EPA SmartWay Transport Partnership is considered to be the leading example of a successful market-based initiative and public/private partnership that supports the greening of freight transportation supply chains.[96] The EPA launched SmartWay in 2004 as an innovative brand that represents environmentally cleaner, more fuel-efficient transportation options. Through SmartWay, the EPA promotes the adoption of advanced fuel-saving technologies and operational practices that reduce CO_2, NO_x and PM. In a span of five years, SmartWay has grown to more than 2,600 partners, representing a diverse group of the US' largest freight shippers, carriers and logistics providers. Since 2004, these partners have collectively saved 1.5 billion gallons of fuel ($3.6 billion dollars in fuel costs saved). This equates to 14.7 million metric tons of CO_2 reductions—the equivalent of taking 2.88 million cars off the road. Additionally, SmartWay partners have saved 215,000 tons of NO_x and 8,000 tons PM emissions.

[93] At 70 mph, overcoming aerodynamic drag represents about 65% of the total energy expenditure for a typical heavy truck.
[94] Based on slide presentation by John Guy, US Environmental Protection Agency, for Green Transportation Initiatives: National and Governmental Advisory Committees, 27 April 2009.
[95] National Surface Transportation Policy and Revenue Study Commission, *Transportation for Tomorrow, Report of the National Surface Transportation Policy and Revenue Study Commission*, Volume 1, Recommendations, December 2007, Washington, DC, <http://transportationfortomorrow.org/final_report/>.
[96] US Environmental Protection Agency, SmartWay: Basic Information, <www.epa.gov/smartway/basic-information/index.htm> (last updated 5 February 2010).

Companies that join the SmartWay Transport Partnership submit key freight performance and logistics data to EPA for scoring and benchmarking, while committing to annual efficiency improvements. Carriers gain a competitive advantage as preferred providers for participating shippers while shippers gain a better understanding of their supply chain carbon footprint and can better work to optimize performance. All partners gain from enhanced visibility of their environmental leadership. Additionally, partners that demonstrate superior performance earn the right to display the SmartWay Transport logo as a mark of environmental excellence. Logistics providers and industry affiliates are also eligible to participate in the program.[97]

4.9 ACQUIRING DATA AND DEVELOPING PERFORMANCE METRICS

Freight transportation data related to energy and the environment affect the private interests of various industry stakeholders and communities. Their collection and dissemination is the responsibility of various domestic agencies: statistical, transportation, energy and the environment. Data collection is costly, and data dissemination is challenging.

It is important for each NAFTA country to identify the transportation data that are currently available, as well as where data weaknesses or gaps exist—for example: the absence of data linking transport activity and movements to fuel consumption; differentiating transportation activities, fuel use, and emissions by technological characteristics; and distinguishing transportation service types and the use of domestic versus international services. Following this assessment, priorities can be set and weaknesses and gaps can be addressed, allowing for greater clarity of purpose and the implementation of programs to collect new data. A similar lack of quality comparable data exists in other environmental domains and often frustrates efforts to optimize environmental performance in the three NAFTA countries.

Each country will have different gaps and may undertake different approaches to address them. However, given the integrated nature of North America's transportation system and the need for better coordination of policy decisions to minimize disruptive competitiveness impacts, comparable data and assessment tools should be sought. As well, in areas where there are common data weaknesses or gaps, a collaborative approach reflecting continental integration would be appropriate, to address the gaps.

The American Council for an Energy-efficient Economy (ACEEE) released a report titled *Where Have All the Data Gone? The Crisis of Missing Energy Efficiency Data*, which outlines the consequences of reduced data collection and the need to improve on this area. One of the ACEEE's recommendations is to restore the Vehicle Inventory and Use Survey. This survey collected data on heavy-duty truck

[97] Edgar Blanco and Kwan Chong Tan, *EPA SmartWay Transport Partnership*, Massachusetts Institute of Technology Center for Transportation and Logistics, 1 June 2009.

Canada/US Memorandum of Understanding on Fuel Efficiency and Emissions Reduction

Natural Resources Canada (NRCan) and the US EPA have signed a memorandum of understanding (MOU) on "fuel efficiency and emissions reduction in freight operations,"[98] extracted below:

Under this Memorandum of Understanding (MOU), the Participants intend to:

- Play a leadership role in energy efficiency and reducing carbon dioxide, particulate matter, and oxides of nitrogen emissions; and
- Complement and expand their respective current activities by engaging the freight industries in the United States of America (USA) and Canada to undertake voluntary actions which can lead to measurable fuel savings and verifiable carbon dioxide, particulate matter, and oxides of nitrogen reductions.

The overall objective of the MOU is for Participants to work together within their respective authorities and jurisdictions to support and enhance partnership arrangements with other government Departments and agencies of Canada and the USA, wherever appropriate, on matters related to the implementation of the MOU.

The Participants intend to:

1. Share and expand FleetSmart's "SmartDriver" training program for professional drivers through accessible media (on-site workshops, e-learning, self-study), to reach as wide an audience as possible;
2. Share and expand the SmartWay Fleet Logistics Energy and Environmental Tracking (FLEET) Model for the capture of baseline data for Canadian operations; collaborate on a Canada- and US-wide program that will include aspects of both the FleetSmart and the SmartWay Partnerships;
3. Collaborate to develop promotional campaigns to raise awareness of the shared goal of fuel efficiency and emissions reductions throughout Canada and the US, such as by expanding NRCan's successful "Idle-Free–Quiet Zone" idling campaign at truck stops in Canada en route to the US;
4. Develop service packages composed of communication tools and techniques for FleetSmart members and SmartWay partners to facilitate their energy efficiency initiatives and assist information-sharing with respect to achieved energy efficiency and energy savings;
5. Support activities related to market studies, model development and new technologies, aimed at improving the efficient use of energy in the fleet sector;
6. Recognize energy efficiency leaders in the freight sector through public celebrations, including promoting the accomplishments of carriers and shippers in furthering the adoption of energy efficiency within Canada and the US;
7. Collaborate on other programs and/or initiatives that involve reducing fuel usage and/or reducing carbon dioxide, particulate matter, and oxides of nitrogen emissions in the freight sector; and
8. Collaborate through this MOU to further the objectives and goals of the Agreement between the Government of Canada and the Government of the United States of America on Air Quality signed in Ottawa on 13 March 1991, as amended by the Protocol between the Government of Canada and the Government of the United States of America amending the Agreement between the Government of Canada and the Government of the United States of America on Air Quality signed in Washington on 7 December 2000, and the North American Agreement on Environmental Cooperation signed in Ottawa on 14 September 1993, as they relate to protection of human health and ecosystems through control of air pollution and the efficient use of energy.

[98] See NRCan, <http://oee.nrcan.gc.ca/transportation/business/fleetsmart/smartway/mou.cfm?attr=16>.

activity in the United States, but was discontinued in 2006. A resumption of this survey would result in the collection of vital data needed to effectively use freight transportation evaluation frameworks and to better analyze and make informed decisions.

In addition to data improvements, stronger evaluation frameworks, such as well-formulated benefit-cost analysis incorporating valuation of environmental impacts, are necessary to allow for good policy analysis and decision making. In this context, the International Energy Agency has developed a conceptual framework for modeling emissions that helps to clarify data requirements and gaps. The framework has four key elements:

- The nature and structure of trips/activity—often measured in tonne-kilometers
- Modal share and modal structure—measured as a share of tonne-kilometers and activity per type of vehicle and technological characteristics
- Modal energy intensity—measured by fuel per unit of activity
- Carbon content of fuels—measured by emission intensities or emission factors arising from fuel consumption

During the development of the foundation paper for this study, it was evident that there is a lack of freight transportation information that can aid in the development of a reliable measurement system for the environmental sustainability of freight transportation in North America. This point was brought up by several CEC Secretariat Advisory Group members. To resolve this issue, a corridor-level performance monitoring system for freight movement is needed. Such a system should combine different aspects of a sustainable freight transportation system, including freight movement quality as perceived by system operators and users, and it should also encompass broader impacts on society and the environment. A freight monitoring system that includes some form of a "freight sustainability index" should be developed that combines multiple performance measures and takes into account the goals and objectives of different stakeholders.

In developing a performance measurement system, a combined top-down and bottom-up approach should be followed. In the top-down approach, the performance measures would be based on goals identified by stakeholders. In the bottom-up approach, performance measures would be determined based on the availability of data. For this project, a combined approach is proposed that looks at goals, as well as available and easily obtainable data. For example, at a minimum, it would be important to establish mechanisms in each country to collect the following data elements to estimate pollutant emissions and greenhouse gases at the corridor level:

Truck and Rail Activity
Trucking activity is usually described in terms of the volume of trucks or the total volume/weight of cargo. Based on current emissions estimation methods, rail activity could be measured in tonnage (ton-miles or tonne-kilometers). Volume of trucks and rail tonnage are the main inputs for estimating the running emissions at a corridor level.

Network and Routing Data
Data for highway and rail networks describing the characteristics of each corridor are needed to calculate emissions at the corridor level. Network information includes average speeds on each link of the network for each mode, as well as bottlenecks or changes in speed along the corridor.

Vehicle Fleet Characteristics
It is important to have a reliable database on truck and locomotive fleets that operate along each corridor. This includes aspects such as make, model, year, class, and fuel type.

Truck and Locomotive Emissions Rates
Emissions rates for trucks and locomotives for different average speeds are needed to calculate emissions at the corridor level.

These data elements should be collected in a systematic way, to have a reliable source of data that could be used to calculate freight transportation emissions along freight corridors. Consistency in data formats and a common platform and methodology for collecting data could make data collection efforts more efficient.

In conjunction with a data collection plan, it will be important to develop a plan for engaging transportation stakeholders in identifying the key goals to be evaluated. Finally, it will necessary to develop a methodology for tracking the measures and combining them into a Sustainability Index. A mapping tool should be developed as a way to disseminate this information.

This study argues that a North American Freight Data Collection and Dissemination Plan should be developed. Transportation departments should play a lead role in overseeing and coordinating transport emission data-gathering efforts for their governments.

4.10 REDUCING INEFFICIENT FREIGHT TRANSPORTATION DEMAND

Given the projected growth in population and per capita incomes in all three NAFTA countries, the expectation is strong that trade volumes will increase commensurately. So, too, will CO_2 emissions increase as the transition to low-carbon fuels is not expected to make significant inroads into the fossil fuel market in the next decade or two. Thus, if CO_2 emissions are to be reduced, addressing inefficient freight transportation demand is another option to be considered. Inefficient demand includes both "empty miles" and "duplicate miles."

Tools to reduce freight transportation demand include shortening supply chains (see section 4.8). This can be promoted through the networking of parties along freight transportation corridors, to promote efficient and effective interchange between and among modes. Research and development (R&D) is also required, that demonstrates the feasibility of optimally combining rail, road, and waterborne transport along a set of green transportation corridors.

Freight rates are another demand management tool. There is evidence that elevated freight rates are already affecting China's trade with the US. Moreover, road-use pricing can also serve as a demand management tool, especially with respect to reducing passenger vehicle use in congested urban areas.[99] For example, the City of London's congestion pricing program reduced average delays by 30% and increased average speeds by 37%. Stockholm's road pricing program reduced peak-hour traffic by 25% and increased public transit ridership by 8%. And Singapore's road pricing program reduced traffic by 13% during peak hours and resulted in a 20% increase in average road speed.[100]

4.11 IMPROVING FREIGHT TRANSPORTATION GOVERNANCE AND STAKEHOLDER NETWORKING

This study also identified three key governance needs underpinning a sustainable freight transportation system for North America:

1. need for a North American vision of sustainable freight transportation;
2. need for better coordination of transportation policies, programs, and initiatives; and
3. need for enhanced networking among transportation stakeholders, institutions, and governments.

4.11.1 Need for a North American vision of sustainable freight transportation

> **"No vision exists of what a North American continental, multi-modal transportation system might look like. What is needed desperately is a continent-wide discourse on possible scenarios for the next, say 25 or 30 years. What are the options for a mid-21st century North American freight transportation system and how will corridors and metro regions fit into these models?"[101]**

Other trading blocs (and nations) have articulated a vision of their transportation systems designed to move them into global leadership positions. One example is China's plan to transform its surface road and rail network into a continental-scale grid, and its seaports into highly efficient freight and passenger facilities, by 2020.[102]

A second example is the European Union's Marco Polo program. This program aims at improving the environmental performance of European freight transportation by freeing the roads of an annual volume of 20 billion tonne-kilometers of freight. It is also built on the recognition that Europe's roads are overused and congested while rail, sea, and inland waterways often have spare capacity. The first Marco Polo program ran from 2003 to 2006. Marco Polo II runs from 2007 to 2013. The European Union has also initiated a "Motorways of the Sea" concept that aims at introducing new intermodal maritime-based logistics chains in Europe, making fuller use of maritime transportation resources, as well as rail and inland waterways, as part of an integrated transportation chain. The concept is still in its early stages and has not yet been sufficient to create a paradigm shift in modal choice.[103]

4.11.2 Need for better coordination of transportation policies, programs, and initiatives

All three NAFTA countries face difficulties in coordinating transportation policies and programs. The United States, in particular, has been scrutinized in a number of major commissions and studies that have resulted in calls for fundamental restructuring of transportation programs and agencies. It is beyond the scope of this study to cover the studies in depth, but note is made of three appeals for a new approach.

A. National Transportation Policy Project:[104]
This project calls for a new vision for US transportation policy and recommends a set of national goals and performance metrics, as well as a comprehensive consolidation and restructuring of current programs and a fundamentally new approach to transportation funding that targets federal funds towards investments most needed to preserve the national transportation system.

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[99] Road-use pricing could also have a strong impact on heavy-duty truck traffic, as shown by the Swiss Heavy Vehicle Fee initiated in 2001, <www.rapp-trans.ch/media/trans/schweiz/Presentations/2003/mr_swisslsvarapp.pdf>.
[100] Stephen Blank and Barry E. Prentice, Greening North America's Trade Corridors, slide deck presentation, 2008.
[101] Stephen Blank, Trade Corridors and North American Competitiveness, *Occasional Papers on Public Policy Series*, Vol. 1, no. 4, Association for Canadian Studies in the United States, <www.acsus.org>.
[102] *The US Freight Transportation System in the Global Economy: Anchored in the Past—Adrift in the Future*. The Big Picture Panel at the Transportation Vision and Strategy for the 21st Century Summit, April 22–23, 2007, p. 2.
[103] Juan C. Villa and Annie Protopapas, *Sustainability and Freight Transportation in North America: Foundation Paper*, Texas Transportation Institute, The Texas A&M University System, College Station, Texas, March 2010.
[104] Bipartisan Policy Center, *Performance Driven: A New Vision for US Transportation Policy*, National Transportation Policy Project, 9 June 2009.

B. *Transportation for Tomorrow—Report of the National Surface Transportation Policy and Revenue Study Commission:*[105] The Commission advocates that the Federal government return to its historic role of ensuring that the transportation needs of interstate commerce are met. The Commission supports the creation and funding of a national freight transportation program that would, in conjunction with States and metropolitan areas and consistent with a national freight transportation plan, implement highway, rail, and other improvements that eliminate chokepoints and increase throughput. The US Department of Transport (DOT) would take a strong role in formulating the plan by establishing a set of performance standards related to efficient management of increasing freight volumes. Project funding should be merit-based and grantees should be accountable for meeting freight mobility performance standards, consistent with national environmental and energy goals.

C. Transportation for America—Blueprint for a 21st Century Federal Transportation Program:[106] Transportation for America (T4 America) has called for a bold vision for the nation's transportation infrastructure investments that promotes maximum economic benefits, access to opportunity, public health, and environmental sustainability for people living in urban, suburban and rural communities. The T4 coalition offered four recommendations for the upcoming US transportation authorization bill. The recommendations include developing a national transportation vision; restructuring federal transportation programs and funding; reforming transportation agencies; and revising transportation finances to ensure that needed investments can be made.

These proposals, among others,[107] highlight the depth of concern that exists about the current lack of program coordination and funding of the US transportation system. Comparable initiatives were not found for Mexico and Canada; however, better coordination of transportation policies, programs, and initiatives in all three NAFTA countries is needed.

4.11.3 Need for enhanced networking among transportation stakeholders, institutions, and governments

The importance of networking among and between governments and key freight transportation stakeholders and institutions cannot be overstated. There is a need to build a constituency that understands the issues involved in creating an efficient and secure North American freight transportation infrastructure and that is prepared and able to work with policy makers to initiate the process of building this system. Arguments have been made that we must establish a network that connects key transportation associations, transportation user and provider firms, corridor and border groups, and research centers, that can represent the spectrum of interests that must be considered in potential freight transportation solutions.

[105] National Surface Transportation Policy and Revenue Study Commission, Transportation for Tomorrow, *Report of the National Surface Transportation Policy and Revenue Study Commission*, Volume 1, Recommendations, December 2007, Washington, DC, <http://transportationfortomorrow.org/final_report/>, pp. 31–32.

[106] Transportation for America, *The Route to Reform: Blueprint for a 21st Century Federal Transportation Program*, <http://t4america.org/docs/blueprint_full.pdf>.

[107] For example, *Freight Transportation Improvement Principles: A Consensus Document Prepared by a Working Group of Freight Industry, Environmental, Environmental Justice, and Transportation Planning Agency Representatives*, March 2010.

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CONCLUSIONS AND RECOMMENDATIONS

As a consequence of inadequate attention to the continental freight transportation system, North America risks falling behind other areas of the world. Many industry leaders, academics, civil society organizations, and government-initiated studies and commissions have called for a freight transportation vision supported by appropriate policies, programs, and governance structures. These calls have been bolstered by pleas for new and innovative transportation-funding mechanisms—ones that raise sufficient capital. Pricing should also reflect the full marginal social costs and benefits of freight transportation.

Greenhouse gas emissions from North America's freight transportation sector will increase steadily over the next two decades. This will be a major hurdle to the United States, Canada, and Mexico in achieving their climate change goals, in the absence of concerted action by governments at all levels and full cooperation by the freight transportation industry and other key transportation stakeholders. With the right approach to improving the environmental performance of the freight sector, North America stands to reap significant benefits in terms of the efficiency, competitiveness, and overall security of our transportation sector. The costs of inaction include significant impacts on North America's competitiveness as other regions and countries build more efficient and integrated freight transportation systems. In addition, our highways and urban areas will suffer further congestion.

In our research, consultation, and analysis of the findings of this study, we reached a number of conclusions:

- Addressing the flow of freight between NAFTA countries is an essential part of creating a more secure and environmentally sustainable freight transportation system for North America.
- Mexico, Canada, and the United States should better integrate freight transportation, infrastructure, and land-use planning, particularly in congested border areas or where border-crossing capacity is being strained, such as at the Windsor-Detroit bridge.
- Gains can be made in modal shifts in selected areas; however, shifting freight transportation modes is a complicated undertaking. More research and policy analysis is needed by governments, academics, and transportation providers in this area. More pilot programs and initiatives to shift freight from truck to rail and marine modes are also required.

- Further research and policy development in the area of low-carbon fuels is necessary, backed up by rigorous life-cycle assessments. In addition, carbon reporting will be an important step towards achieving lower-carbon transportation.
- Significant GHG emissions reductions can be obtained from improved freight transportation technologies and operations. This will require the full cooperation of the trucking and rail industries.
- Sustainable freight transportation should be a major consideration when broader funding mechanisms and carbon pricing strategies are being designed by governments. In particular, a significant price on carbon will eventually be needed to support the development of an environmentally sustainable transportation sector.
- The successful uptake of new technologies and practices will depend upon skilled and dedicated workers. Accordingly, the transportation sector should continue to be a source of quality jobs that offer career advancement opportunities, workplace rights, legal protection, and job stability. The freight transportation sector should also bring intelligent transportation systems engineering and associated knowledge-based skills to the full spectrum of transportation planning, management, and logistics.
- Freight prices should incorporate marginal social costs, including estimates of externality costs, such as the cost of GHG emissions.
- Any economy-wide GHG emission mitigation scheme, whether via a carbon tax or cap-and-trade system or other mechanism, should return an appropriate share of revenues to the freight transportation system to ensure modernization and sustainability.
- Improvements needed to North American transportation infrastructure to meet competitiveness, efficiency, security, and environmental requirements are large and will require significant financial investment from both the public and private sectors.
- NAFTA countries should strive to be world leaders in implementing policies and programs that green the goods movement supply chain. The countries should support and harmonize the SmartWay, FleetSmart, and *Transporte Limpio* programs, to ensure the widespread dissemination of best practices, advanced fuel-saving technologies and other innovations in the North American supply chain. The countries should work to collect and share freight data and performance data in order to maximize program effectiveness continent-wide.
- To lower carbon emissions across the supply chain, a unified trinational "top-runner" operating standard should be developed for diesel trucks and locomotives. Shippers and ports should also utilize state-of-the-art GPS and other technologies to modernize container dispatch processes and thus reduce idling time and resulting diesel emissions. Also, drivers should be appropriately trained to operate trucks in a fuel-efficient manner.
- Support is required to increase networking and cooperation among transportation operators to reduce unnecessary freight transportation, and to encourage further study and experimentation with road pricing initiatives in and around urban centers.
- Networking among governments, industry, academic institutions, and civil society organizations is an essential part of a vision for sustainable freight transportation in North America.
- The environmental impact of freight movement has a significant human dimension. Priority should be given to projects that reduce GHG emissions and black carbon, as well as criteria pollutants that have a direct negative impact on human health.

RECOMMENDATIONS

The CEC Secretariat's Sustainable Freight Transportation Advisory Group provides the following recommendations to help Canada, Mexico, and the United States to foster a more efficient, competitive, secure, and environmentally sustainable freight transportation system in North America:

Coordination and Networking

- A North American Transportation Forum should be established, in which transportation and environmental ministers (or equivalent) and a working group of officials maintain an ongoing dialogue on the efficiency and sustainability of our freight transportation system. The Forum should lead an initiative to develop a long-term vision of low-carbon, low-emissions, sustainable freight transportation for North America, and to communicate policy-relevant findings to governments.
  Lead action: Transportation and environmental ministers in Canada, Mexico and the United States.
  Timeline: Forum established in 2011 and holds a first meeting in 2011. Vision process initiated and completed before a second meeting of the Forum in 2012. Forum is to meet on an annual basis.
- In parallel with the North American Transportation Forum, a network should be created to facilitate collaboration on a continental basis among freight industry, transportation experts, and stakeholders. This network should maintain a dialogue with the Forum, as well as share information on best practices and innovations in freight transportation.
  Lead action: Working group of the transportation and environmental ministries, industry, and experts.
  Timeline: 2011
- Existing public/private partnerships, such as FleetSmart (Canada), *Transporte Limpio* (Mexico), and SmartWay (US) should be strengthened and harmonized to enable the collection and sharing of freight performance data and emission factors among the three countries, such that freight policies and programs can be enhanced to ensure maximum effectiveness.
  Lead action: Transportation ministries in Canada, Mexico and the United States, in cooperation with environment ministries and key transportation stakeholders involved in the networking structure.
  Timeline: Immediately and ongoing. Progress to be reported to North American Transportation Forum annual meetings.

Carbon Pricing and System Efficiency Strategies

All three nations need a portfolio of policies to attract the significant investments required to make the transition to a low-carbon transportation system, including the establishment of an effective price on carbon emissions that would create incentives to use and generate less CO_2 in freight transportation.

- A cooperative study should be conducted on the potential for carbon pricing to contribute to a dedicated North American multi- and intermodal transport infrastructure fund to minimize congestion and security-related bottlenecks along trade corridors and at borders and ports of entry.
  Lead action: Environment and transportation ministries in Canada, Mexico and the United States.

Timeline: Study completed by 2011 and presented to the North American Transportation Forum at its first meeting.

- CO_2 emissions and other environmental externalities should be major considerations when pricing strategies are developed to address freight transport. A trinational study should be undertaken to align the freight-related GHG mitigation potential with transportation-specific carbon-pricing components.
  Lead action: Transportation ministries in Canada, Mexico and the United States.
  Timeline: Study completed by 2011 and presented to the North American Transportation Forum at its first meeting.

Investments to Improve the Efficiency of the Freight Transportation System and Promote Advanced Technologies

- Adequate sources of funding for major freight transportation infrastructure investments should be created. In particular, investments are required to support reducing the carbon intensity of moving goods, recognizing that modal shifts from high-carbon to low-carbon transportation modes and greater use of technology are needed.
  Lead action: Transportation ministries in Canada, Mexico and the United States.
  Timeline: Study to be completed before the second meeting of the Forum in 2012 (and linked to carbon pricing/revenues study).
- All three nations should provide meaningful incentives to support the development and deployment of advanced fuel-saving technologies and freight transportation operational strategies, including intelligent transportation systems. Incentives include pricing *negatives*, such as CO_2 emissions, as well as incenting *positives*, such as research and development.
  Lead action: Transportation ministries in Canada, Mexico and the United States, in cooperation with key transportation stakeholders.
  Timeline: Review of existing incentives and fuel-saving technologies/operational strategies to be completed before the second meeting of the Forum, in 2012.

Supply-Chain Management

- A trinational collaboration on supply-chain carbon accounting and reporting should be developed for diesel trucks, locomotives, marine vessels, and airplanes to help the freight sector lower fuel use and GHG emissions, thus reducing costs across the supply chain and improving competitiveness.
  Lead action: Environment and Transportation ministries in Canada, Mexico and the United States.
  Timeline: Collaboration to be set up by March 2011 and progress report prepared by December 2011.

Training Eco-Drivers

- Truck drivers should be trained in eco-driving practices, including the use of intelligent transportation systems, to operate trucks (and other transportation equipment) in the most fuel-efficient manner. A North American Green Driver Certification program should be developed to train and certify drivers for the North American supply chain. Eco-driving training should be coupled with safety and maintenance training to ensure marketable job skills for this vulnerable sector.
  Lead action: Environment and Transportation ministries in Canada, Mexico and the United States.
  Timeline: Review of existing programs to be completed in 2011.

Gathering and Sharing Data

- Transportation, environmental and statistical agencies in the United States, Canada, and Mexico should enable the North American Transportation Statistics Interchange (NATS-Interchange) to develop a comprehensive North American Freight Data Collection and Dissemination Plan, that ensures comparability, interoperability, and consistency in data and data formats and that provides a common platform and methodology for collecting transport-related information, including data that measure environmental impacts. A memorandum of understanding should be signed that makes NATS-Interchange a mandatory component of cooperation among the NAFTA countries, and that facilitates the collection and sharing of freight transportation data.

  Transportation stakeholders should be engaged in identifying the key performance goals to be evaluated, and should be involved in discussions on the feasibility of developing a *freight sustainability index* that combines multiple performance measures.
  Lead action: North American Transportation Statistics Interchange (NATS-Interchange).
  Timeline: Timelines to be established in consultation with NATS-Interchange and transportation and environment ministries in Canada, Mexico and the United States.

GLOSSARY[108]

Backhaul – The process of a transportation vehicle (typically a truck) returning from the original destination point to the point of origin. A backhaul can be with a full or partially loaded trailer.

Barge – The cargo-carrying vehicle that inland water carriers primarily use. Basic barges have open tops, but there are covered barges for both dry and liquid cargoes.

Bottleneck – A section of a highway or rail network that experiences operational problems such as congestion. Bottlenecks may result from factors such as reduced roadway width or steep freeway grades that can slow trucks.

Boxcar – An enclosed railcar, typically 40 or more feet long, used for packaged freight and some bulk commodities.

Bulk Cargo – Cargo that is unbound as loaded; it is without count in a loose unpackaged form. Examples of bulk cargo include coal, grain, and petroleum products.

Cabotage – A national law that requires coastal and intercoastal traffic to be carried in its own nationally registered, and sometimes built, and crewed ships.

Carrier – A firm which transports goods or people via land, sea or air.

Class I Carrier – US classification of regulated carriers, based upon adjusted annual operating revenues (US$): motor carriers of property, revenue of $10 million or greater; motor carriers of passengers, $5 million or greater; railroads, $250 million or greater.

Class II Carrier – US classification of regulated carriers, based upon adjusted annual operating revenues (US$): motor carriers of property, revenue of $3–10 million; motor carriers of passengers, less than $5 million; railroads, $20–250 million.

Class III Carrier – US classification of regulated carriers, based upon adjusted annual operating revenues (US$): motor carriers of property, revenue of less than $3 million; railroads, $0–20 million (no Class III for passenger motor carriers).

Coastal Shipping – Also known as short-sea or coastwise shipping, describes marine shipping operations between ports along a single coast or involving a short sea crossing.

Commodity – An item that is traded in commerce. The term usually implies an undifferentiated product competing primarily on price and availability.

Common Carrier – Any carrier engaged in the interstate transportation of persons/property on a regular schedule, at published rates, whose services are for hire to the general public.

Consignee – The receiver of a freight shipment, usually the buyer.

Consignor – The sender of a freight shipment, usually the seller.

Container – A "box"' typically ten to forty feet long, which is used primarily for ocean freight shipment. For travel to and from ports, containers are loaded onto truck chassis or railroad flatcars.

Container on Flatcar (COFC) – Container resting on railway flatcar, without a chassis underneath.

Containerization – A shipment method in which commodities are placed in containers, and after initial loading, the commodities per se are not re-handled in shipment until they are unloaded at destination.

Containerized Cargo – Cargo that is transported in containers that can be transferred easily from one mode of transportation to another.

Contract Carrier – Carrier engaged in interstate transportation of persons/property by motor vehicle on a for-hire basis, but under continuing contract with one or a limited number of customers to meet specific needs.

Deadhead – The return of an empty transportation container back to a transportation facility. Commonly-used description of an empty backhaul.

Drayage – Transporting of rail or ocean freight by truck to an intermediate or final destination; also, typically a charge for pickup/delivery of goods moving short distances (e.g., from marine terminal to warehouse).

Durable Goods – Generally, any goods whose continuous serviceability is likely to exceed three years.

Flatbed – A trailer without sides, used for hauling machinery or other bulky items.

For-hire Carrier – Carrier that provides transportation service to the public on a fee basis.

Gross Vehicle Weight Rating (GVWR) – A safety standard set by the vehicle manufacturer, the GVWR is the weight of the vehicle, including all of its fluids and maximum hauling capacity, taking into account the capacities of its engine, transmission, brakes, axles, and tires, which should never be exceeded by its Gross Vehicle Weight (GVW—the actual, fully loaded weight of the vehicle, including all cargo, fluids, passengers and all equipment).

[108] Based on selected definitions taken from the US Federal Highway Administration, <http://ops.fhwa.dot.gov/freight/fpd/glossary/>.

Hub – A common connection point for devices in a network. Referenced for a transportation network as in "hub and spoke," which is common in the airline and trucking industry.

Intermodal Terminal – A location where links between different transportation modes and networks connect; a terminal connecting more than one mode of transportation in moving persons and goods. For example, a shipment moved over 1000 miles (1600 km) could travel by truck for one portion of the trip, and then transfer to rail at a designated terminal.

Just-in-Time (JIT) – Cargo or components that must be at a destination at the exact time needed. The container or vehicle is the movable warehouse.

Line Haul – The movement of freight over the road/rail from origin terminal to destination terminal, usually over long distances.

Liquid Bulk Cargo – A type of bulk cargo that consists of liquid items, such as petroleum, water, or liquid natural gas.

Logistics – All activities involved in the management of product movement; delivering the right product from the right origin to the right destination, with the right quality and quantity, at the right schedule and price.

Megaton (Mt) – 1 Mt = one million metric tons (mmt), or 1 teragram (Tg, 10^{12} g).

Node – A fixed point in a firm's logistics system where goods come to rest; includes plants, warehouses, supply sources, and markets.

Outbound Logistics – The process related to the movement and storage of products from the end of the production line to the end user.

Owner-operator – Trucking operation in which the owner of the truck is also the driver.

Piggyback – A rail/truck service. A shipper loads a highway trailer, and a carrier drives it to a rail terminal and loads it on a flatcar; the railroad moves the trailer-on-flatcar combination to the destination terminal, where the carrier offloads the trailer and delivers it to the consignee.

Port Authority – State or local government that owns, operates, or otherwise provides wharf, dock, and other terminal investments at ports.

Private Carrier – A carrier that provides transportation service to the firm that owns or leases the vehicles and does not charge a fee.

Radiative Forcing – The difference between the radiation energy coming into the Earth's atmosphere (mostly from the sun) and the outgoing radiation energy reflected out through the atmosphere from the Earth's surface. Generally, the year 1750 is taken as the base year for pre-industrial conditions. Greenhouse gases and black carbon on snow are examples of agents that cause positive radiative forcing and climate change.

Reliability – Refers to the degree of certainty and predictability in travel times in the transportation system. Reliable transportation systems offer some assurance of attaining a given destination within a reasonable range of an expected time. An unreliable transportation system is subject to unexpected delays, increasing costs for system users.

Shipper – Party that tenders goods for transportation.

Short Line Railroad – Freight railroads which are not Class I or Regional Railroads, and which operate less than 350 miles (560 km) of track and earn less than $40 million.

Short-sea Shipping – Also known as coastal or coastwise shipping, describes marine shipping operations between ports along a single coast or involving a short sea crossing.

Strategic Rail Corridor Network (Stracnet) – An interconnected and continuous rail-line network consisting of over 38,000 miles (>61,000 km) of track serving over 170 defense installations.

Supply Chain – All the links in the production of a product, starting with unprocessed raw materials and ending with the final customer using the finished goods.

TEU – Twenty-foot equivalent unit (see below), a standard-size intermodal container.

Throughput – Total amount of freight imported or exported through a seaport, measured in tons or TEUs.

Ton-mile/tonne-kilometer – A measure of output for freight transportation; reflects weight of shipment and the distance it is hauled; a multiplication of short tons (US) or metric tons (CA/MX) hauled times the distance traveled in miles or kilometers. One ton-mile equals approx. 1.46 tonne-kms.

Transit time – The total time that elapses between a shipment's delivery and pickup.

Transloading – Transferring bulk shipments from the vehicle/container of one mode to that of another at a terminal interchange point.

Truckload (TL) – Quantity of freight required to fill a truck, or at a minimum, the amount required to qualify for a truckload rate.

Twenty-foot Equivalent Unit (TEU) – The 8-foot by 8-foot by 20-foot intermodal container is used as a basic measure in many statistics and is the standard measure used for containerized cargo.

Unit Train – A train of a specified number of railcars handling a single commodity type which remain as a unit for a designated destination or until a change in routing is made.

Vehicle Miles Traveled (VMT) – A unit to measure vehicle travel made by a private vehicle, such as an automobile, van, pickup truck, or motorcycle.

APPENDIX A

SCENARIO WORKSHOP RESULTS

The CEC Secretariat conducted a scenario planning exercise to inform and support key components of the sustainable freight transportation report. Scenario planning was chosen as a way to deal with the complex and dynamic state of freight transportation in North America. The focal question that anchored the scenario development process was: *Looking out to 2030, how do we achieve an environmentally sustainable, efficient, secure, and competitive freight transportation system in North America?*

Scenario Development Workshop participants (see Appendix B) developed a roster of driving forces that will shape the future of the North American freight transportation system to 2030, as depicted in Figure 18. After confirming critical uncertainties, participants developed four scenarios on the future of the North American freight transportation system. The final results of the policy pathways work and the strategic thrusts and recommendations made as a result of this work are presented below.

A discussion of strategic thrusts helped scenario workshop participants identify the key elements of a policy pathway for sustainable freight transportation. Five strategic thrusts were identified:

1 Foster integrated planning processes in North America

2 Establish effective carbon disclosure and pricing mechanisms

3 Ensure adequate infrastructure funding and effective pricing mechanisms

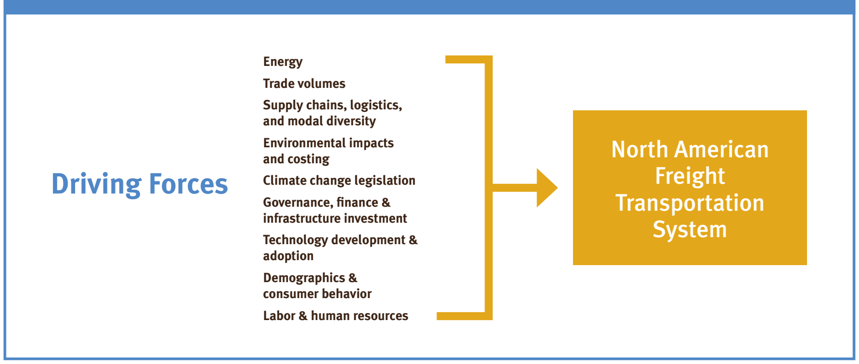
4 Foster innovation in new technology development and deployment

5 Gather data and provide timely and relevant information

Drawing on the strategic thrusts discussion, the following policy pathway elements were identified by scenario workshop participants:

- Establish an effective carbon pricing mechanism (e.g., cap-and-trade, carbon tax or fuel tax) that attaches a transparent price to carbon
- Implement complementary programs and regulations for heavy-duty and off-road vehicles
- Incent the deployment and adoption of existing efficiency technologies (i.e., capital stock turnover)
- Invest in and incent the development and adoption of new fuels, new equipment and vehicles, and other transportation technologies
- Design more-intelligent and efficient transportation systems by making smart investments in new infrastructure, logistics, and intelligent transportation systems (ITSs) that also provide the opportunity to price use appropriately (e.g., internalize social and environmental externalities)
- Create and collect the data needed to support sound analysis, advance science, make informed policy decisions, and develop best practices and standards for freight transportation
- Advocate for an integrated planning mechanism to coordinate and enhance existing North American transportation planning networks and structures (e.g., transportation, land use, and energy planning)
- Educate and engage the public—build awareness and capacity through the dissemination of information as part of the shift from a resource-intensive economy to a knowledge-intensive economy and a low-carbon freight transportation system

FIGURE 18 DRIVING FORCES FOR FREIGHT TRANSPORTATION IN NORTH AMERICA



Source: CEC Article 13 Scenario Development Workshop, College Station, Texas, December 2009.

Participants stressed that the most important driver to achieve freight sustainability would be an effective carbon-pricing signal. Unless this condition is in place, assertions were made that complementary measures would likely have a limited impact on changing consumer behavior and driving innovation and technology adoption.

Participants also indicated that if a greenhouse gas cap-and-trade regime is implemented, GH G permits should be auctioned to generate the funds needed to support sustainable transportation programs.

KEY STRATEGIES IDENTIFIED

The vision adopted by participants in the final scenario workshop was: *An environmentally sustainable, efficient, secure, and competitive North American freight transportation system by 2030.*

Five key strategies were identified for more-detailed discussion by scenario workshop participants and by the Advisory Group:

1 Foster Integrated Planning Processes in North America

- Set priorities across North America to make the North American freight transportation system more sustainable, and champion process improvements at borders, ports, and intermodal facilities, as well as in urban areas and along strategic north-south transportation corridors
- Evaluate and focus on a mix of immediate (e.g., borders) and longer-term (e.g., intelligent transportation systems) issues
- Ensure ongoing review and alignment of complementary policies
- Coordinate investment, policies, and regulations across jurisdictions

2 Establish Effective Carbon Disclosure and Pricing Mechanisms

- Implement disclosure and carbon-pricing mechanisms that work "with" the markets (i.e., critical to changing decisions and behavior in the system)
- Recognize that transparent price signals are critical to changing operator, customer, and consumer behaviors, and to introducing new technologies

3 Ensure Adequate Infrastructure Funding and Effective Pricing Mechanisms

- Adequately fund freight transportation infrastructure in performance-driven decision-making institutions
- Price infrastructure use to recover costs, drive efficiency, and internalize the social and environmental externalities of transportation
- Price road use to ensure that users bear the full marginal social cost of their activity (e.g., a cost that reflects marginal infrastructure costs plus the marginal external costs that are imposed on others through environmental impact, congestion, etc.)
- Design infrastructure planning and spending to create an integrated and efficient transportation system

4 Foster Innovation in New Technology Development and Deployment

- Fund essential science, research, and development to promote technology adaptability and innovation
- Provide incentives to accelerate low-carbon and alternative fuels and energy diversity (based on life-cycle assessments)
- Advance work on equipment and vehicle technologies related to electrification

5 Gather Data and Provide Timely and Relevant Information

- Harmonize data collection to support more-informed and integrated decisions (e.g., North American statistics standardization and interchange)
- Gather and communicate specific information, such as carbon data, emissions per vehicle mile traveled (VMT), empty-mile reductions, carbon labeling, and lifecycle GHG emissions
- Develop performance measures and indicators to assess success and inform freight industry associations, operators, customers, and consumers, as well as government policy makers
- Provide information needed to support integrated economic, environmental, and social decision making

APPENDIX B

PARTICIPANTS IN THE WORKSHOPS AND CONSULTATIONS

Workshops in Scenario Development (Cuernavaca, Mexico), Scenario Implications (College Station, Texas, United States), and Policy Pathway (Vancouver, Canada) were held in the course of developing this Article 13 study. In addition to the members of the Advisory Group, the following individuals took part in these workshops.

Participant	Organization	Country
Roberto Aguerrebere	Instituto Mexicano del Transporte	Mexico
Stephen Blank	North American Transportation Competitiveness Research Council	United States
Arden Brummell	Scenarios to Strategy, Inc.	Canada
Jorge Luis Chavez	Meridian 100	United States
Mikhail Chester	University of California, Berkeley	United States
Francisco Conde	North America's SuperCorridor Coalition, Inc.	United States
Linda Fernández	University of California	United States
James Gosnell	West Coast Corridor Coalition	United States
Marie-Hélène Lévesque	Transport Canada	Canada
Evan Lloyd	Commission for Environmental Cooperation	Canada
Gregory MacGillivray	Scenarios to Strategy, Inc.	United States
Pierre Marin	Transport Canada	Canada
Kenneth Ogilvie	Ogilvie Consulting	Canada
Buddy Polovick	US Environmental Protection Agency	United States
Patrick Sherry	National Center for Intermodal Transportation—University of Denver	United States
Mark Stehly	BNSF Railway Co.	United States
Benjamin Teitelbaum	Commission for Environmental Cooperation	Canada
Rick Van Schoik	North American Center, ASU	United States
Juan Carlos Villa	Texas Transportation Institute	United States
Richard Yeselson	Change to Win	United States
Josias Zietsman	Texas Transportation Institute	United States

GOVERNMENT CONSULTATION PARTICIPANTS

- As part of this study, the CEC Secretariat consulted federal, provincial, and state government officials from Canada, and Mexico and the United States. The consultations were notable for the strong cooperative spirit that prevailed, the officials showing a common interest in working together to develop strategic objectives that could improve the sustainability of freight transportation in North America.

Canadian Federal and Provincial Officials

Environment Canada

- Stephanie Johnson, Director, Latin and South America
- Dean Knudson, Director General, America's Directorate
- Don Stewart, Chief, Analysis and Policy, Environmental Stewardship Branch

Transport Canada

- Patrick Gosselin, Senior Policy Advisor
- Bruno Jacques, Director General, Economic Analysis
- Jeff Johnson, Climate Change Manager
- Neil Koschlar, Director General, Technology and Innovations in Transportation
- Marie-Hélène Lévesque, Director, Environmental Policy Framework and Integration
- Pierre Marin, Director General, Environmental Policy
- Kathy Palko, Policy Analyst, Environmental Policy
- Jacques Rochon, Executive Director, Freight Integration and Motor Carrier Policy

Canadian Border Services Agency

- Kara Kolkman, Environmental Analyst, Environmental Operations
- Daniel Lagacé, Manager, Infrastructure Coordination

Natural Resources Canada

- Jennifer Tuthill, Senior Manager, Office of Energy Efficiency

Alberta Department of Infrastructure/Transportation

- Peter Dzikowski, Senior Policy Advisor, Strategic Policy Branch

Manitoba Department of Infrastructure and Transportation

- Ted Nestor, Policy Consultant, Transportation and Surface Development Branch
- Steven Pratt, Policy Coordination Consultant, Transportation Policy Division

New Brunswick Department of Transportation

- Nancy Lynch, Director, Policy Branch
- John Weatherhead, Senior Policy Advisor, Strategic Development

Nova Scotia Dept. of Transportation and Infrastructure Renewal

- Christine Almon, Environmental Analyst
- Brian Gallivan, Director, Policy and Planning

Ontario Ministry of Transportation

- Reg Clarke, Senior Policy Analyst, Goods Movement Office
- Linda McAusland, Director, Transportation Policy
- James Perttula, Manager, Goods Movement Office

Quebec Ministry of Transportation

- Joanne Laberge, Head of Sustainable Development
- Évangéline Lévesque, Head, Office of Continental Gateway / Quebec-Ontario Business Corridor

Mexican Federal and State Officials

Semarnat

- Édgar del Villar, Coordinador de Asesores

Secretaría de Comunicaciones y Transporte, SCT

- Miguel Elizalde, titular, Dirección General de Autotransporte Federal (DGAF-SCT)
- Juan González Cáserez, director general adjunto de Normas del Autotransporte, DGAF
- Irma Flores Herrera, subdirectora de Normas del Autotransporte de Materiales y Residuos Peligrosos, DGAF
- Carlos López Juárez, subdirector de Asuntos Internacionales, DGAF
- Jesús Pablo Mercado Díaz, subdirector de Desarrollo Tecnológico y Seguridad, DGAF
- Salvador Monroy Andrade, director de Autotransporte México-Estados Unidos, DGAF
- Ángel Pérez Collantes, director de Normas, DGAF
- Francisco Luis Quintero, director general adjunto de Supervisión, DGAF
- Beatriz Robles L., directora de Relaciones Institucionales, Coordinación de Asesores, Subsecretaría de Transporte
- Javier Santillán, director de Regulación Económica y Estadística, Dirección General de Transporte Ferroviario y Multimodal

Secretaría de Comunicaciones y Transporte , SCT (By conference call)

- Marco Antonio García, subdirector de Transporte del Centro SCT, Tamaulipas
- Guadalupe Bautista, regidor del Ayuntamiento de Nuevo Laredo, Tamaulipas
- Víctor Galindo, jefe del Departamento de Autotransporte de Nuevo Laredo, Tamaulipas

Instituto Mexicano del Transporte, IMT

- Roberto Aguerrebere Salido, director general
- Carlos Daniel Martner Peyrelongue, jefe de la Unidad de Análisis

United States Federal Officials

US Environmental Protection Agency

- Cheryl Bynum, Program Manager, SmartWay Transport Partnership
- Roxanne Johnson, Environmental Specialist, EPA Region 9
- Buddy Polovick, Environmental Protection Specialist, SmartWay Transport Partnership
- Sue Stendebach, International Liaison, Office of Air and Radiation

US Environmental Protection Agency (via conference call)

- Sarah Dunham, Director, Transportation and Climate Division, Office of Transportation & Air Quality (OTAQ)
- Chris Grundler, Deputy Director, OTAQ

US Department of Transportation

- Fred Eberhart, Senior International Transportation Specialist, Office of International Transportation and Trade
- Linda Lawson, Director, Office of Safety, Energy and Environment (OSEE)
- Camille Mittelholtz, Environmental Policies Team Leader, OSEE, Office of Assistant Secretary for Transportation Policy

Federal Highway Administration

- Tony Furst, Director, Office of Freight Management and Operations
- Roger Petzold, Team Leader, Interstate, Border, and GIS Team
- Robert Ritter, Team Leader, Sustainable Transport & Climate Change, Office of Human and Natural Environment

National Highway Traffic Safety Administration

- Peter Prout, Environmental Protection Specialist, Fuel Economy Division

US Department of Commerce

- Richard Boll, Energy Services (Supply Chain projects)
- David Long, Director, Office of Services Industries
- David Olsen, International Trade Specialist
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COMMISSION FOR ENVIRONMENTAL COOPERATION

- Benjamin Teitelbaum, Project Coordinator

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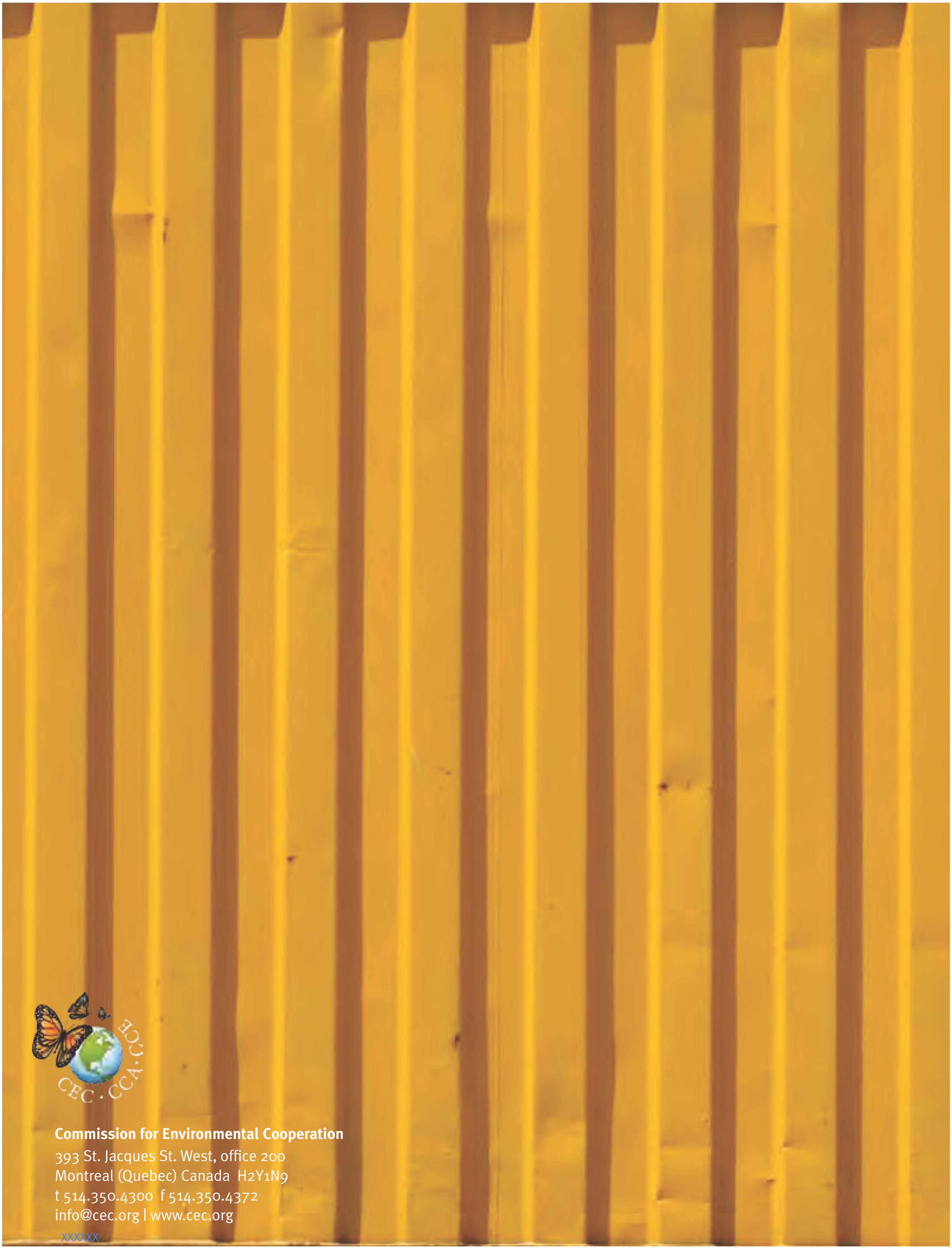
NASCO / Photos courtesy of North America's Corridor Coalition (NASCO): *pp. 3, 11, 20, 35, 41, 45, 52, 53* (*right*)

Container City / Photo by Daniel Molina, courtesy of Container City, Cholula, Pue., Mexico (*this page*)

Concept and Design:

Green Communication Design inc., www.greencom.ca

Shipping containers can have a life beyond moving goods from place to place. Inventive uses for them—from seasonal swimming pools to building blocks in modular construction projects—are increasingly found all around the world. This photo shows an innovative development in Cholula, Mexico, that uses containers to house restaurants, art galleries and even sleeping quarters.



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