GREENING NORTH AMERICA'S TRADE CORRIDORS

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INTRODUCTION

Environmental concerns about North American trade corridors and borders bring together an interesting mix of issues and players. The desire to increase trade and reduce environmental impact can create a conflict of goals. Several narratives are involved in the policy discussion of economic and technological mitigation strategies. The breadth of this topic ranges from the consideration of the environment within the North American Free Trade Agreement (NAFTA) to industry-led green supply chains.

The purpose of this paper is to explore the transportation strategies that can decrease the environmental impact of trade. The analysis begins with the examination of environmental policy within NAFTA. Subsequently, an economic framework is presented and mitigation strategies are discussed. The mitigation strategies consider technological change, green supply chains and regulatory reforms.

ENVIRONMENT AND NAFTA

The North American economy is best visualized in the early 21st century as a deeply integrated continental system of supply chains structured by networks that link production centers and distribution hubs across the continent. These supply chains depend on an efficient and secure physical infrastructure of rails, roads and bridges, pipelines and wires, ports and border crossings. NAFTA provides a coherent and consistent system of regulations that affect the transport of individuals, machines, firms and goods across North American borders.

The degree of collaboration and complementarity between the NAFTA countries is unprecedented. Envisioning NAFTA as a trade bloc is not a productive way of imaging the substance of the North American economic system. The NAFTA countries are partners in complex, cross-border production systems. For example, 25 percent of the goods that cross the US-Canada-Mexico borders daily are automotive. Cars and parts flow back and forth across the borders of an integrated North American manufacturing industry.

Continental supply chains are deeply integrated. As a recent report jointly produced by the U.S. Center for Strategic and International Studies and Canada's Fraser Institute observes:

> The supply chains that span the U.S.-Canada border are unique in the global context. They are heavily reliant on land transportation that travels primarily through just a handful of key border crossings. Major shipments are routinely timed for delivery within hours, and sometimes to the minute.[1]

North American trade corridors are more than just physical roads and rails or superhighways or even super-corridor highways. One thoughtful commentator describes trade corridors as

> ... streams of products, services, and information moving within and through communities in geographic patterns.[2]

We can best understand trade corridors as strategies developed by groups of business and municipal government leaders to attract to particular regions some of the increased flow of materials generated by deepening North American economic integration.

The transport of all these goods creates significant environmental impacts. The debate that took place during the birth of NAFTA resulted in side agreements on labour and the environment. After the initial NAFTA debate, however, major U.S. environmental leaders seem to have lost interest.

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[1] Joel Webber, *Network-Centric Security For Canada-U.S. Supply Chains* (Fraser Institute, CSIS) 2005, p. vii

[2] Michael Van Pelt, "Moving Trade: An Introduction to Trade Corridors" (Work Research Foundation, May 2003)

> None of the large U.S. groups has devoted significant sustained attention to limiting the environmental costs of the North American integration process after NAFTA's passage in the U.S. Congress.[3]

Instead, border organizations have taken the point on environmental issues:

> After the NAFTA vote, when U.S. national environmental NGO agendas moved on, the task fell primarily to border groups to encourage the promised Border Environment Cooperation Commission (BECC) and the North American Development Bank (NADBank) to begin to fulfill their mandates.[4]

Interest in the impact of transportation and the environment continues in international bodies like the Commission on Environmental Cooperation (CEC), but NAFTA leaders are not spending much political capital on reducing pollution associated with trade. What has been building is the scientific knowledge of the impact of air pollution and evidence of climate change[5]. The Greenhouse Gas (GHG) emissions caused by traffic delays and congestion at the border bottlenecks and trade corridors are measurable. If the full costs of pollution were incorporated into the price of transportation, it would have a significant negative impact on trade volumes.

ENVIRONMENT AND TRANSPORTATION ECONOMICS

The economic impact of pollution on trade volumes can be examined as the derived demand for transportation between countries. Figure

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[3] David Brooks and Jonathan Fox, "NAFTA: Ten Years of Cross-Border Dialogue," Americas Program (Silver City, NM: Interhemispheric Resource Center, March 2004

[4] Brooks and Fox, op. cit.

[5] "North American Trade and Transportation Corridors: Environmental Impacts and Mitigation Strategies," Prepared for the North American Commission for Environmental Cooperation, Prepared by ICF Consulting, 21 February 2001 The corridors studied were Vancouver-Seattle, Winnipeg-Fargo, Toronto-Detroit, San Antonio-Monterrey and Tucson-Hermosillo.

1a presents the reduced form trade demand model in terms of marginal social costs (MSC) and benefits (MSB). Firms produce negative externalities, like pollution, as an unintended consequence of their operations. They only consider their marginal private costs (MPC).

The market in Figure 1a operates at Q volume of trade and P price levels if transport is determined by only private cost, MPC[6]. The social costs, MSC, include the negative externality of pollution created by transport as well as the operating costs of transport vehicles. The optimal level of trade, if the full costs of transportation are covered (including negative externalities), is at Q* and P*, (where MSC = MSB).

Figure 1b illustrates the impact of environmental mitigation strategies. Air pollution created by transportation can be reduced by technological improvements, new infrastructure, leaner supply chains and regulatory reforms. The reduction of pollution externalities shifts the marginal social costs down from MSC to MSC' and permit the expansion of trade from Q* to Q'.

Changes that reduce pollution and lower the physical costs of transportation shift the MPC down to MPC'. This is illustrated in Figure 1c. The new optimal is found where MSC shifts to MSC". Consequently, trade flow expands from Q* to Q".

If effective pollution mitigation strategies are put in place to reduce transportation's footprint, it may be possible to retain the current level of trade sustainability. Environmental mitigation strategies that offer a means to cut carrier costs, too, are likely to have a greater impact because there will be more enthusiasm for implementation.

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[6] Demand (D) is assumed equal to the Marginal Social Benefits (MSB) because the positive externalities of trade are already incorporated into the primary demand.

Figure 1a Full Costs of Transportation, and Impacts of Greening Corridors

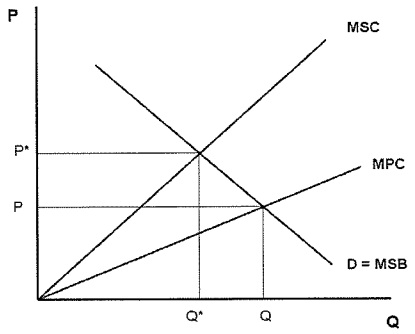


Figure 1b Full Costs of Transportation, and Impacts of Greening Corridors

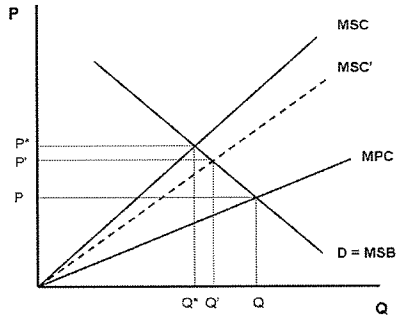
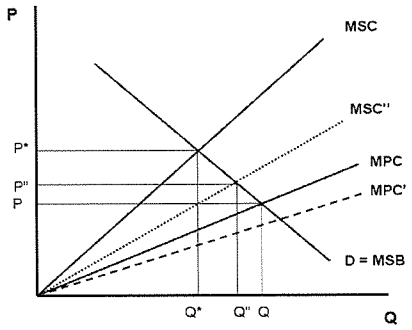


Figure 1c Full Costs of Transportation, and Impacts of Greening Corridors



ENVIRONMENTAL MITIGATION STRATEGIES

The transportation sector is one of the most prolific producers of greenhouse gases (now producing close to a third of all GHG in developed nations) and also one of the fastest growing sources of emissions. In the absence of policies to reduce GHG emissions from transportation, the transportation sector is expected to continue to show the most rapid growth between now and 2030.

Technology

The technological leading edge of the transport industry is making significant improvements in fuel consumption and air pollution emissions. Freight transportation is becoming more fuel efficient in terms of fuel use per ton-mile of freight moved.[7] Leading truck operators have already made a lot of progress by employing many small innovations that reduce energy use, such as auxiliary engines, stream-lining and operational improvements[8]. New truck engines have big particulate filters that reduce particulate emissions to almost nothing. They release about 80% less nitrogen oxide – and the new generation of 2010 engines should reduce this to zero. However, the shift to more environmentally friendly technology takes time. Only about 200,000 new truck engines are sold per year. At this rate, it could take until 2030 for the millions of trucks on the road to have the "green" engines.

The decline in per vehicle emission rates is being offset by the increasing number of vehicles involved in trade movements.[9] The number of commercial trucks (most of which are powered by diesel engines) on US highways increased by nearly 40% between 1980 and 2002. Forecasts suggest that US Interstate highway travel demand measured through vehicle miles traveled will increase from 690

[7] Trucks certified under EPA's SmartWay program use 10 to 20 percent less fuel than older models, a saving per truck of some 2,000 to 4,000 gallons of diesel a year. Betty Beard, "Keep on truckin', but 'greener,'" The Arizona Republic (Mar. 27, 2008)
[8] Bison Transport is a good example, www.bisontransport.com
[9] Materials in the next paragraphs is drawn from Federal Highway Administration, Assessing the Effects of Freight Movement on Air Quality at the National and Regional Level, Final Report, April 2005

billion in 2002 to 1.3 trillion by 2026. This means that trucks will continue to contribute a growing share of the some pollutants.

Attention has been focused increasingly on the impact of carbon on climate change. Transportation, including on-road and non-road vehicles, accounted for about 28 percent of US GHG emissions in 2005 and trade-related emissions of greenhouse gases and carbon monoxide would not be reduced under new emission standards.

A report issued by the Union of Concerned Scientists notes:

> each gallon of diesel fuel burned in a diesel truck engine results in emissions of 22.8 pounds of carbon and other heat-trapping gases. An additional 5.4 pounds of heat-trapping gases result from the production and delivery of each gallon.... Nationally, heavy trucks emit nearly 400 million metric tons of heat-trapping gases annually, accounting for about 6 percent of US carbon emissions.[10]

Carbon emissions are expected to rise substantially by 2020. The U.S. Energy Information Administration projects a 40 percent increase in carbon dioxide emissions from transportation over that period.[11]

Mitigation strategies to reduce transportation emissions have caused a closer examination of technology and fuel use. The development of electric-based technologies has been expanding since the 1990s. Hybrid vehicles are increasingly used in urban areas, where they can generate electric-based power from the frequent braking actions of vehicles. Hybrid vehicles have the advantage of using the existing infrastructure of petroleum-based fuels. Environmental Defense and FedEx Express report that they have been working together since March 2000 to develop advanced trucks. Their "Future Vehicle Project" began as a request to manufacturers to build a far cleaner

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[10] Jason Mark and Candace Morey, Rolling Smokestacks: America's Trucks and Buses (Union of Concerned Scientists, October 2000) p. 6

[11] "The Role of TDM and Other Transportation Strategies in State Climate Action Plans," Frank Gallivan, Jeffrey Ang-Olson, William Schroeer, and Frank Mongioi, Jr., ICF International TDM Review (Issue 2, 2007)

truck, specifying the environmental performance standards but not dictating what technology could be used.

> The hybrid electric technology that resulted is ideally suited to the delivery business, because it captures energy from braking during stop-and-go driving and provides improved acceleration at lower speeds. Its electric motor and advanced batteries reduce fuel use and pollution, and a special trap reduces emissions of the small particles that form soot. Readily available today, it is a powerful bridge to future fuel-cell vehicle technology.[12]

Improvements in electric batteries and the use of alternative fuels could have positive impact on emission reduction. The railways have adopted battery-based shunting locomotives (Green Goats) to reduce emissions and fuel costs.[13] A widespread deployment of battery technology could lead to commercially viable midsize battery-electricity trucks capable of achieving 70 to 80 mpg by 2020. Plug-in electric hybrid cars are already coming to the market that will make lithium batteries more available.

The environmental impact of airplanes is also gaining attention. A report on aviation and the global atmosphere prepared by the Intergovernmental Panel on Climate Change in collaboration with the Scientific Assessment Panel to the Montreal Protocol on Substances that Deplete the Ozone Layer underlined that

> aircraft emit gases and particles, which alter the atmospheric concentration of greenhouse gases, trigger the formation of condensation trails and may increase cirrus cloudiness, all of which contribute to climate change and that aircraft are estimated to contribute about 3.5 per cent of the total radiative forcing (a measure of change in climate) by all human activities and that this percentage, which excludes the

[12] www.environmentaldefense.org/documents/3605_FedExBrochure.pdf
[13]The BNSF is also experimenting with a fuel cell powered shunting locomotive http://www.railwaygazette.com/news_view/article/2009/03/9305/bnsf_explores_the_fuel_cell.html

> effects of possible changes in cirrus clouds, was projected to grow.[14]

Fixed-wing aircraft are dependent on liquid fuels; however few freight shipments have to travel at 500 miles per hour. A new generation of slower, but more fuel efficient hybrid aircraft could greatly reduce GHG emissions from air freight transport. The principles of lighter-than-air transport were all proven in the 1930s; it is just a matter of applying modern materials and engineering. New hybrid designs are in development that mesh airship, airplane and hovercraft technology[15]. They could operate on alternative fuels and provide long distance transport. Solar collectors for auxiliary power are also possible because lighter-than-air vehicles have such large surface areas. The goal of a zero emissions airship is not beyond the reach of existing technology[16].

Cargo ships have the lowest GHG impact per ton-mile. But ships are beginning to be seen as the source of major environmental problems – atmospheric pollution (cargo ships burn the dirtiest grades of fuel), oil spills and the transport of invasive species (in ballast water). One former shipping industry executive wrote in the New York Times:

> A single cargo ship coming into New York Harbor can release as much pollution as 350,000 current-model-year cars in an hour.[17]

Another specialist on ship construction tells us that an ordinary handysize bulk vessels produces about half its weight (i.e. displacement weight) a year in air pollution.[18]

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[14] "Aircraft Engine Emissions," Special Report on Aviation and the Global Atmosphere, International Civil Aviation Organization Air Transport Bureau (1999) www.icao.int/icao/en/env/aee.htm

[15] Hybrid Air Vehicles in England and Lockheed-Martin (Skunkworks) in the U.S.A. are the leading developers. A piloted flight test of a scaled prototype can be viewed on You Tube, under the heading P-791.

[16] www.airshipzprize.org provides background information on airships and a proposal to create an international competition to accelerate airship development.

[17] Russell Long, "Cargo Ships: Where There's Smoke, There's Pollution," New York Times February 21 2004 www.mindfully.org/Air/2004/Cargo-Ships-Pollution21feb04.htm

[18] Geoffrey Uttmark, TransTechMarine Company, private conversation with S. Blank.

Shifting transportation from more polluting to less polluting modes is promoted as a means of "greening" trade corridors. The transfer of long haul freight from trucks to rail is often suggested as a way to reduce GHG emissions. But trucks carry about 70% of freight in North America and the railways have little remaining excess capacity to take much more of the burden off the highways.

Shifting air transport to hybrid airships, truck transport to rail and land transport to marine could help reduce pollution emissions. It is important to recognize however that the decision on which mode of transport to use lies with the shippers. Consequently, interest in the development of "green supply chains" is a welcome trend.

Green Supply Chains

The globalization of supply chains and lean logistics systems improved the efficiency of many industry sectors. Just-in-time practices reduced the cost to consumers of a wide array of goods, but higher speeds increase the environmental impact. The conflict between environmental sustainability and logistics cost is not lost on business. Companies, says a recent Forbes magazine article, increasingly "measure and manage their social and environmental impact."[19]

There is growing concern in the business community about achieving "sustainable mobility." Evidence is provided by the work of the World Business Council for Sustainable Development:

> Promoting mobility is a key part of our companies' business. We seek to do this in ways that satisfy the widespread desire for affordable and safe transport, reduce the impact transport has on the environment and utilize the most appropriate technologies as they are developed.[20]

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[19] "Green Supply Chains", April 7, 2007 – Forbes.com, http://www.forbes.com/logistics/2007/04/20/green-supply-chains-logistics-cx_sho_0420amr.html

[20] World Business Council for Sustainable Development, "Mobility 2030: Meeting the challenges to sustainability," The Sustainable Mobility Project, Full Report 2004

Corporations are moving to reduce the environmental impact of their supply chains by ensuring that the manufacturing and supply process is as clean as possible. The Forbes article mentioned earlier describes several cases of efforts by major firms to green their supply chains:

- $92 billion computer maker Hewlett-Packard reported it would eliminate 30,000 cubic feet of polystyrene computer packaging and more than 6 million pounds of PVC packaging from its inkjet printer business. The company will also reduce its carbon footprint by 20% by 2010.
- $15 billion footwear manufacturer Nike decided to remove a toxic compound from its core "Air" shock absorption technology. The company says the environmental innovation did more than reduce waste; it was fundamental to a breakthrough alternative that allowed designers to insert full-sole-length Air in its new shoe, the AirMax 360.
- Through its Zero Waste initiative, $312 billion retailer Wal-Mart has so far saved 478.1 million gallons of water, 20.7 million gallons of diesel fuel and millions of pounds of solid waste. Through its 100% Renewable Energy program, the company expects to reduce energy consumption by 30% at all of its new stores in seven years.
- $1.5 billion footwear and apparel maker Timberland says it will achieve carbon neutrality in all of its retail and production facilities by 2010. The company has chosen to convert to renewable sources of energy, use green building techniques and establish carbon offsets by planting trees in equatorial regions--where carbon is more readily absorbed by the vegetation.

Companies everywhere are jumping on the green bandwagon, but they are barely touching the greatest source of GHG emissions that are derived from transportation. Extended supply chains reduce the cost of final products but add more transportation to the mix. Bunker-fueled container ships and freight carrying airplanes have become vastly more important in corporate supply chains. Limiting inventory and JIT delivery schedules demand more truck traffic. Flexible

delivery systems consume more space, more energy and produce more emissions.[21]

Better supply chain management – for example, running fewer empty trucks – would lower all pollutant emissions from trade. The CEC report says that reducing the fraction of empty trucks in the Toronto-Detroit corridor from 15% to 10% would eliminate over 0.5 metric tons of nitrogen oxide and 600 metric tons of carbon dioxide per day in 2020 (5% of the trade related truck total)[22].

The growing interest of shippers in green supply chains is a positive force for reducing GHG emissions. Their attention has focused on packaging and operations, but inevitably the environment costs of inventory/transportation trade-offs are going to attract more interest.

Regulations

Congestion delay is an unnecessary expense for the transportation industry, as well as an avoidable environmental burden. Continued failure to harmonize regulations on many dimensions of freight transport inhibits transportation integration and reduces efficiency. Delayed maintenance and infrastructure bottlenecks also slow traffic and increase idling. Rising levels of congestion at ports of entry, border crossings and critical highway/rail bottlenecks leads to more fuel consumption and GHG emissions.

Differences in regulations cause delay at borders and impede efficiency. The CEC report notes that reducing delay at border crossing would significantly improve air quality. When the report was drafted – before 9-11 – commercial vehicles faced an average delay of

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[21] See Jean-Paul Rodrigue, Brian Slack and Claude Comtois (2001) "Green Logistics" in *Handbook of Logistics and Supply-Chain Management* (Eds. A. M. Brewer, K. J. Button and D. A. Hensher)

[22] "North American Trade and Transportation Corridors: Environmental Impacts and Mitigation Strategies," Prepared for the North American Commission for Environmental Cooperation, Prepared by ICF Consulting, 21 February 2001 The corridors studied were Vancouver-Seattle, Winnipeg-Fargo, Toronto-Detroit, San Antonio-Monterrey and Tucson-Hermosillo.

up to one hour to cross Canada-U.S. and U.S.-Mexico borders. Policy changes and investments could cut this delay in half, resulting in a reduction of 0.2 to 0.6 metric tons of carbon monoxide per day (1.6% to 2.5% of trade related). Post 9-11 delay is much worse than could have been anticipated when report was drafted. For now at least, security not only trumps trade but environmental quality as well.

Good environmental policies and sound economics are often complementary. Changes in regulations that permit longer, heavier and fewer trucks could reduce their environmental impact. This implies significant changes in highway configuration with, for example, dedicated truck lanes to accommodate new truck "trains" with one cab pulling several trailers.

The initial NAFTA agenda of regulatory harmonization needs to be advanced with an eye to GHG emission reductions. Some see "SSS" – short sea shipping – as a key to reducing congestion on highways. Would a sea route "O-95" take traffic away from I-95 along the East Coast? One problem is the restrictions on cabotage that prevent competition between transport carriers of the NAFTA partners in each others' coastal waters. Cabotage restrictions make routing more difficult or uneconomic. This inflates freight rates and deters switching from high emissions land modes to less polluting marine transport.

Another regulatory anomaly is the difference between the use of international containers in Canada and the U.S. The 2009 Canadian budget proposes to harmonize Canadian regulations with the more liberal U.S. cabotage rules for containers. This should help integrate the NAFTA container market and reduce empty container moves.

Political Action

Green initiatives must engage business and community leaders in metro-regions and cities along trade corridors, together with local and state government officials. These are the people who can best see the impact of environmental degradation in urban centers on North America's borders and on the corridors and, as well, the people who

understand best the power of efficient transportation in creating jobs and building competitiveness.

Some of this is underway. Policymakers at the state and local levels are increasingly turning their attentions to finding ways to reduce GHG emissions.

> As of June 2007, over 500 U.S. mayors had signed the U.S. Conference of Mayors Climate Protection Agreement, which commits to reducing emissions in their cities to seven percent below 1990 levels by 2012 by promoting alternative modes of transportation to single occupant vehicles reducing sprawl, increasing energy efficiency, increasing recycling rates, and planting trees. Similarly, 36 states have completed, or are developing, climate action plans to analyze steps they can take to reduce their contribution to climate change. Action at the state and local level has the potential to effect substantial change, by reducing emissions, and by moving forward national and even global climate policy. [23]

What is just beneath the surface is a growing view that to achieve change in environmental policy, attention cannot be directed only to the national level. Climate change and how to respond to it remains a profoundly divisive issue among political core constituencies whose voices are loudest in Washington. So the subtext here is a shift of attention away from national leadership and international agreements, toward local and regional entities where action can be more direct.

Thinking on green corridors must build on two key assumptions. One is the need to show community leaders that greener is more competitive. Leverage is more likely to be gained by emphasizing competitiveness – and therefore jobs – rather than just good works. Second is the need to identify entrepreneurial opportunities for local businesses in developing and providing hardware, maintenance and services associated with greening corridors. Doing business to

[23] Frank Gallivan, Jeffrey Ang-Olson, William Schroeer, and Frank Mongioi, Jr., "The Role of TDM and Other Transportation Strategies in State Climate Action Plans," ICF International TDM Review (Issue 2, 2007)

enhance environmental sustainability is one key that will lead to greener trade corridors.

CONCLUSION

The external costs of trade movements are concentrated at the borders and transportation corridors. Trucks are becoming less environmentally harmful, but greater in number. Concerns are also growing about fixed-wing aircraft and ocean ships as significant sources of air pollution. What is the environmental impact of more trade and, more traffic going to be? Shifting modes – more rail, short sea shipping, and potentially hybrid airships – could help, but additional capacity in these other modes is not free. Moreover, shippers may not enjoy the comparable reliability of their current supply chains if they use slower, less polluting means of transport.

Many strategies can be designed to mitigate the impact of transport-generated emissions. Some strategies involve technology (fuels and engine design), some focus on operations (improving supply chain management), and some address regulations (restrictions on speed and idling, relaxation of weight and cabotage limits). What is lacking are effective strategies for implementation, for building coalitions of transport stakeholders and citizen/community groups to develop coherent, effective and practical mitigation strategies. NAFTA was conceived as a means of increasing trade, with only a side agreement on the environment. As the impact of trade-related GHGs gain more attention, this may be a mechanism to bring forward coordinated strategies to green the trade corridors.