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Best Practices to Mitigate Truck Emissions at International Land Ports of Entry

Juan Carlos Villa
Introduction

- Increased traffic at North American land ports of entry (POEs) associated with transportation of goods affects air quality in border communities and beyond.

- The Commission for Environmental Cooperation (CEC) has provided support for researching and developing viable, integrated options for the implementation of vehicle emission-reduction mechanisms at selected land POEs.

- As part of the *Greening Transportation at North American Land Ports of Entry* project, this research
  - reviewed previous work related to air emissions at land POEs on the US-Canada and US-Mexico borders
  - Highlighted various strategies that reduce air emissions from transportation in general, with discussion on applicability to land POEs
  - Presented recommendations for expanding best practices that deal with air emissions at North American borders.
Approach

• Two phases.
  – First phase objective: conduct a literature review of all work related to air emissions at POEs on the U.S.-Canada and U.S.-Mexico borders.
  – Second phase objective: identify and prioritize best practices implemented in North America and elsewhere to improve air quality, transportation flows, and border community and human health.
US/Mexico Border Crossings

CV crossings from Mexico into the United States

Number of Commercial Vehicles (Millions)

US/Mexico Border Crossings

POV crossings from Mexico into the United States

Number of Personal Vehicles (Million)

Number of Personal Vehicles (Million)
Proportion of CV crossings by POE at the U.S.-Mexico border

- Nuevo Laredo/Laredo, 35%
- Tijuana/Otay Mesa, 15%
- Ciudad Juárez/El Paso, 14%
- Reynosa/Hidalgo, 9%
- Otros, 26%
Strategies to Reduce Air Emissions from Transportation

- Smart/Sustainable Growth
- System Optimization/Operation Efficiency
- Fuel Technologies
- Vehicle Technologies
Fuel Technologies

- One positive step would be to reduce dependence on highly polluting fossil fuels and develop alternatives.

- Shift towards low carbon fuels.

- Application to the border:
  
  - Low-emitting fuel stations could be installed along POEs and upstream along major freight corridors
Vehicle Technologies

- Air emissions associated with commercial vehicles (CVs) or privately-owned vehicles (POVs) can be reduced by one or a combination of the following types of measures:
  
  1. **Reducing loads** (weight, rolling and air resistance, and accessory loads) on the vehicle, thus reducing the work needed to operate it.
  
  2. **Increasing the efficiency** of converting the fuel energy to work, by improving drive train efficiency and recapturing energy losses.
  
  3. Reducing emissions from vehicle exhaust and climate controls.
System Optimization

- System efficiency can be achieved through operational strategies that change the way vehicles are used, either within each modal system or across two or more modal systems.
  - i.e. **reducing idling** at origins, destinations, and intermediate points
- **Intelligent Transportation Systems (ITS)** and Global Positioning Satellites (GPS) can aid in the implementation of these strategies.
  - Provide information at alternative crossings for shippers to select.
- USDOT is conducting research-based pilot projects of Freight Advanced Traveler Information System (FRATIS) at marine ports.
Smart/Sustainable Growth

- Activity reduction refers to direct or indirect reduction in vehicle-miles traveled.
- Reducing overall congestion can achieve overall air emission reductions.
- This requires integrated planning between the two nations
  - Many stakeholders including federal, state, and local governments, as well as the private sector.
## Air Emission Reduction Best Practices at POEs

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# Air Emission Reduction Best Practices at POEs

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<td>System Optimization/Operation Efficiencies</td>
<td>Washington State and British Columbia initiatives to reduce GHG emissions in the Cascade Gateway, Anti-idling program</td>
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<td>Truck stop electrification</td>
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<td>Implemented and operational</td>
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<td>Piloted</td>
<td>Border environment</td>
<td>Mainly trucks</td>
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Retrofit: Strategies to Reduce Particulate Matter at the Laredo/Nuevo Laredo Border Crossing

- Analysis of various truck retrofit technologies to reduce (PM) from drayage trucks at the U.S./Mexico border.
- Two technologies were analyzed:
  - Diesel oxidation catalysts
  - Diesel Particulate Filters
- Diesel Oxidation Catalysts:
  - Typically reduce emissions of PM by 20-40% or more and gaseous emissions by 50-70%.
- Diesel Particulate Filters:
  - Have been used as pollution control devices for both vehicles since 1980s.
- Findings:
  - DOC was best solution for US-Mexico Border

DOC: Diesel oxidation catalysts
San Diego-Tijuana Diesel Emissions Reduction Demonstration Project

- Otay Mesa is the largest POE along the California/Mexico border and serves the San Diego/Tijuana region.

- Diesel engines contribute to unhealthy levels of ozone, air toxics, and PM.

- EPA funded a study to evaluate costs and effectiveness of emission-control retrofit technologies on Mexican heavy-duty diesel vehicles operating in this region.

- Implementation involved retrofitting approx. 127 Mexico-domiciled heavy-duty diesel trucks operating in the border region:
  - 117 with diesel oxidation catalysts
  - 10 with diesel particulate crankcase filtration systems
Smartway and Transporte Limpio

- All three North American countries have implemented a version of Smartway®

- U.S.- Program was launched in 2004 by the EPA and aimed to reduce transportation-related emissions by creating incentives to improve supply-chain fuel efficiency.

- Public-Private initiative between the EPA, trucking companies, logistics companies, commercial manufacturers, retailers, and other federal and state agencies.

- Primarily aimed for long-haul trucking and not short-haul that is found in border drayage vehicles.
SmartWay and *Transporte Limpio*: Applied to the Border

- TTI analyzed SmartWay technologies for border drayage trucks at the El Paso / Ciudad Juárez POE (TTI 2009).
- Tested applicability of three SmartWay strategies in border drayage operations:
  - Use of lighter trailers
  - Modified driving behavior (Eco-driving)
  - Use of diesel oxidation catalysts
- Results:
  - DOC and lightweight trailers were found to decrease CO and THC emissions.
  - Eco-driving appeared to have reduced CO\(_2\) emission, fuel consumption and NO\(_x\) emissions.
  - All reduced PM emissions
Washington St. & BC Initiative to Reduce Greenhouse Gas Emissions

- Leaders from Washington and BC signed a memorandum on “greening the border”, focused on reducing idling at the border.

- Key elements:

  - Air Pollution: An idling vehicle emits air toxics, chemicals, gases, and PM into the air.

  - Health: Breathing in exhaust can aggravate asthma, allergies, and cardiovascular disease.

  - Fuel Economy: For each hour spent idling, a typical truck burns approx. one gallon of diesel fuel, and a typical car wastes 1/5 of a gallon of gasoline.
Washington State and British Columbia Initiative to Reduce Greenhouse Gas Emissions

- One effort to reduce idling: The Peace Arch Border Crossing Anti-Idling Initiative
  - Implemented with a traffic signal that would indicate when motorists should turn off idling engines.
  - Estimated that this will result in a reduction of 639 billion kilograms of GHG emissions annually.
Port Anti-idling Program

- The EPA, through SmartWay, launched Emodal Port Community System for Drayage.
  - Reduces the amount of time trucks spend waiting in queues at terminal gates by establishing terminal appointments.

- PierPass peak-pricing program:
  - Addresses similar concerns at off-peak hours.

- These have not been implemented at land POEs.
Truck Stop Electrification

- Electrified parking spaces that provide power to systems such as heating, AC, or appliances.
- US requires drivers to stop and rest for a designated amount of time each day.
  - Truck drivers will leave trucks idling.
  - Typical tractor-trailer idles between 1,800 and 2,400 hours per year (burning approx. one gallon of diesel an hour).
- Application to land POE
  - Space constraint
Border Trusted-Traveler Program

- U.S. Department of Homeland Security has several trusted-traveler programs that improves system-wide efficiencies and enhances security.
  - **Global Entry:** A CBP program that allows expedited clearance for pre-approved, low-risk travelers.
  - **SENTRI:** This program is similar to NEXUS, but is applied to the US-Mexico border.
  - **FAST:** This is a pre-clearance program for known low-risk shipments entering the US from Canada and Mexico. Members are able to access FAST vehicle lanes that allow for a more expedited processing during the border crossing.
Eco-Drivering

- Eco-driving is a driving style that significantly reduces fuel consumption and emissions.

- Takes into consideration ecological and economic benefits that include:
  - Health Benefits: Positive impact on human health, and reduces health care costs.
  - Environmental Benefits: Vehicles produce emissions that adversely affect human health and contribute to climate change.
  - Economic Benefits: Simply by changing driving habits, fuel consumption can be cut by up to 25 percent.

- Monitoring driving performance and including incentives for drivers who reduce fuel consumption would sustain the program.

- Using driver operating patterns from electronic engine monitoring and use this to benchmark performance over time.
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<th>Region</th>
<th>Pollutants Analyzed</th>
<th>Methodology/Observations</th>
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<tr>
<td>Environmental Assessment of NAFTA by the Commission for Environmental Cooperation: An Assessment of the Practice and Results to Date (Aguilar et al. 2011)</td>
<td>POV, CV, bus, rail, airplane</td>
<td>North America (Canada-U.S.-Mexico major land POEs)</td>
<td>N/A</td>
<td>Environmental assessment covering the social and economic effects of NAFTA/air quality impact analysis (no specific pollutant was measured).</td>
</tr>
<tr>
<td>Greening Transportation at the Border (FHWA 2011)</td>
<td>POV, CV, bus, rail, airplane</td>
<td>North America (Canada-U.S.-Mexico major land POEs)</td>
<td>N/A</td>
<td>Implementation of sustainable transportation options toward reduction of environmental impacts while improving air quality, public health, and wildlife and habitat connectivity/air quality impact analysis (no specific pollutants were measured).</td>
</tr>
<tr>
<td>Developing an Emissions Estimation Tool for El Paso Border Crossings. Draft (Farzaneh 2013)</td>
<td>POV, CV, bus</td>
<td>United States-Mexico (El Paso region)</td>
<td>THC, CO₂, CO, NOₓ, PM, PM-EC</td>
<td>Methodology to specifically estimate the emissions produced at border crossings using MOVES model to develop the emissions rates and construct a tool.</td>
</tr>
<tr>
<td>U.S.-Mexico Border Region Greenhouse Gas Inventories and Policy (Ross and Associates 2009)</td>
<td>POV, CV, bus</td>
<td>United States-Mexico (border region states: CA, AZ, NM, TX, Baja Calif., Son, Chih, Coah, N. Leon and Tamps.)</td>
<td>GHG</td>
<td>Measuring levels of pollution (GHG) using monitoring facilities and reports on both sides of the border.</td>
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<td><strong>Greenhouse Gas Emissions due to Vehicle Delays at the San Diego-Tijuana Border Crossings</strong> (Barzee 2010)</td>
<td>POV, CV, bus</td>
<td>United States-Mexico (San Diego County POEs: San Ysidro, Otay Mesa, Tecate)</td>
<td>GHG</td>
<td>Emission factors for each lane category (passenger, commercial, and bus) were obtained by running the EPA MOVES2010 project level model. Input parameters included vehicle age profiles and three second-by-second speed profiles. Data input for MOVES model were obtained using 2009 estimations. 2009 estimations are considered atypical due to economic recession and escalated violence in Mexico.</td>
</tr>
<tr>
<td>“Black Carbon and Polycyclic Aromatic Hydrocarbon Emissions from Vehicles in the United States-Mexico Border Region: Pilot Study” (Kerry et al. 2006)</td>
<td>POV, CV, bus</td>
<td>United States-Mexico (Calexico, Mexicali, El Paso, Ciudad Juarez POEs)</td>
<td>BC, CO&lt;sub&gt;2&lt;/sub&gt;, PAH</td>
<td>Innovative method by implementing measurement systems along the roadsides, monitoring vehicle emissions, and calculating a fuel-based emission factor.</td>
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<tr>
<td><strong>Mitigating Cross-Border Air Pollution: The Power of a Network</strong> (Cresswell et al. 2009)</td>
<td>POV, CV</td>
<td>United States-Mexico (Ciudad Juarez, Chihuahua/El Paso, Texas/Doña Ana County, New Mexico Air Basin region)</td>
<td>N/A</td>
<td>Exploration of best practices to mitigate air pollution/air quality impact analysis (no specific pollutant was measured).</td>
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<tr>
<td><strong>Mariposa Port of Entry Bottleneck Study (Nogales Sonora-Nogales Arizona)</strong> (Golob et al. 2008)</td>
<td>POV, CV</td>
<td>United States-Mexico (Mariposa POE: Nogales AZ-Nogales Sonora)</td>
<td>N/A</td>
<td>Bottleneck identification at the POE’s surrounding areas. Authors recommend a set of actions to improve congestion mitigation strategies.</td>
</tr>
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<td><strong>U.S.-Mexico Border 2020 (EPA 2014)</strong></td>
<td>POV, CV, bus, rail, airplane</td>
<td>United States-Mexico (border region states: CA, AZ, NM, TX, Baja California, Sonora, Chihuahua, Coahuila, Nuevo Leon, Tamaulipas)</td>
<td>N/A</td>
<td>Development of guiding principles to support the mission statement of the Border 2020 binational program/air quality impact analysis (no specific pollutant was measured).</td>
</tr>
<tr>
<td>Developing a Strategy to Reduce Particulate Matter as Part of the “Transporte Limpio” Program (TTI 2013)</td>
<td>CV</td>
<td>United States-Mexico (Laredo/Nuevo Laredo region)</td>
<td>PM</td>
<td>Analyzed CV fleet and trip characteristics, and prepared a cost/benefit analysis to recommend technologies to reduce PM emissions. Diesel oxidation catalysts were recommended, and an implementation plan was developed.</td>
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<td>Quantification of Selected Sources for Emission Inventory Improvement in El Paso, Texas (Yang et al. 2012)</td>
<td>POV, CV, bus, rail, airplane</td>
<td>United States-Mexico (All four El Paso-Ciudad Juarez POEs)</td>
<td>CO, NOx, PM, VOC,</td>
<td>Emission factors by hour of the day were developed using the U.S. EPA’s MOVES 2010b.</td>
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<tr>
<td>Impactos en la Salud de los Cruces Fronterizos En México—Estados Unidos Puertos de Entrada: Deficiencias, Necesidades y Recomendaciones para Acciones (EPA-SCERP 2012)</td>
<td>POV, CV, bus, rail</td>
<td>United States-Mexico</td>
<td>PM$<em>{10}$, PM$</em>{2.5}$, BC, NO$_2$, SO$_2$, VOC, CO, UFP</td>
<td>Summarizes recommendations and findings regarding health impacts along the U.S.-Mexico border and communities near the POEs after a two-day meeting in San Ysidro, California, in May 2012.</td>
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</tbody>
</table>
| Interim Report: Phase 1 of the Air Quality Study of the Impact of the Peace Bridge Plaza on the Surrounding Neighborhood (New York State Department of Environmental Conservation 2013) | CV            | Canada-United States (Peace Bridge Plaza POE) | PM$_{2.5}$, BC       | Data collection at two different monitoring locations near the Peace Bridge Plaza and surrounding areas. Results indicated that, on average, there is no significant source of PM$_{2.5}$, and concentrations of BC were relatively small. National Ambient Air Quality Standards for Particulate Matter was used to measure PM$_{2.5}$.
| Greening the Border. Climate Action at the Peace Arch Border Crossing (British Columbia Ministry of Transportation and Infrastructure 2013) | POV, CV       | Canada-United States (British Columbia/ Washington State, Peace Arch Border Crossing) | GHG                 | The initiative includes installation of traffic signals to move waiting traffic in a series of pulses (vehicle coordinated platoon movements), allowing motorists to turn off their engines while waiting for traffic ahead to clear. |
| Air Toxics Exposure from Vehicle Emissions at a U.S. Border Crossing: Buffalo Peace Bridge Study (Spengler et al. 2011) | POV, CV, bus  | Canada-United States (Buffalo Peace Bridge) | VOC, PAH, NPAH       | Measurements of a large number of compounds caused by diesel and gasoline vehicles. |
| Understanding Pacific Highway Commercial Vehicle Operations to Support Emissions Reduction Programs (Godchild and Klein 2011) | CV            | Canada-United States (Pacific Highway POE)  | N/A                 | The logistic study (policy, border crossing procedures, and other factors considered in the research) was based on data collection and data analysis (including statistical). No air quality assessment was directly performed. |
| Preliminary Air Quality Assessment Related to Traffic Congestion at Windsor’s Ambassador Bridge (Diamond and Parker 2004) | CV            | Canada-United States (Ambassador Bridge POE, Windsor, Ontario) | PM$_{10}$, PM$_{2.5}$, VOC | Researchers used short-term air quality surveys using a portable particulate monitor and VOC cartridge sampler. Data collection and analysis were performed in 2002 and 2003. |
Findings

- EPA’s emission analysis procedures are typically originated and implemented in the United States and then adopted first by Canada and second by Mexico.

- Difficulties were found in data integration and data collection (monitoring equipment) on the Mexican side of the border at U.S.-Mexico POEs.

- In general terms, studies and technical reports along the U.S.-Mexico border were more common than along the U.S.-Canada border, and the only health studies were done at the Canadian border.

- Every POE has different characteristics in terms of layout, traffic volumes and mix, geography, etc. Therefore, it would be difficult to replicate interventions without a detailed analysis of the specific characteristics of each POE.
Recommendations

• To ensure unified North American approach, collection methods should be presented on CEC website.

• Joint monitoring procedures, data collection, data inventories, and environmental planning at selected border regions to ensure high data quality.

• Verify POE characteristics with border agencies, provinces/states and local stakeholders to confirm the feasibility of implementing best practices and procedures, and potential adaptation processes.
Recommendations for Expanding Best Practices on North American Borders

- Few best practices were found that have been implemented in the international border environment in North America and most of the initiatives that were identified are general recommendations.

- A model that could be followed to expand best practices on North American borders is to create a network similar to the BEST Urban Freight Solutions (BESTUFS) that was created by the European Union.

- BESTUFS is funded by the European Commission (DG Transport and Energy) and was active from 2000 to 2008. The main objective of the BESTUFS is to identify, describe, and disseminate best practices, success criteria, and bottlenecks of urban freight transport solutions.
Thanks

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