Experiences conducting port emissions inventories in Canada

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Unit conversion – USA vs. Canada

- 1 metric tonne = 1.0231 US (short) tons
- 1 kilometre = 0.6213 miles
- 1 hubble-barn = 3.45 gallons (or 13.1 litres)
Overview

• History - Port Emissions Inventories

• Framework for a Ports Emissions Inventory Model

• Experiences from Port Metro Vancouver Landside Emission Inventory

• Current and Future Works of Interest
What is a Port Emissions Inventory?

An activity-based EI of significant port sources:

- Marine vessels
- Rail
- Trucks
- Cargo handling equipment
- Admin
History – Port Emissions
Inventories in USA

Non-attainment in areas with major ports
Marine and port emissions were known major contributors of \( \text{SO}_2, \text{NO}_x, \text{PM} \)
First inventory conducted by Houston in 2000
EPA developed a guidance document in 2006, updated in 2009
History – Port Emissions

Inventories in Canada

gateway ports competing against S ports for containers and cruise:

- Metro Vancouver
- Montreal
- Prince Rupert

Early Canadian port EIs

- Metro Vancouver (2005)
- Montreal (2007, with funding from Transport Canada)
Framework – Canadian Ports Protocol

Protocol applies uniformly to all Canadian ports. Components include:

- Activity data collected.
- Methods of emissions calculations by source group
- Emission factors
- Port commodity and forecast data.

Written 2009, updated 2012.
TC Canadian Ports Model
## Ports Model Questionnaire

<table>
<thead>
<tr>
<th>Item</th>
<th>Vehicle type</th>
<th>Fleet age</th>
<th>Number of similar vehicles</th>
<th>Relative intensity of use</th>
<th>Fuel type (refer to Table 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Van / Pickup - small utility</td>
<td>2005 - 2009</td>
<td>5</td>
<td>3 - Medium (average)</td>
<td>1 - Gasoline</td>
</tr>
<tr>
<td>2</td>
<td>Heavy commercial truck</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Medium commercial truck</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td>Light commercial truck</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Bus (transit or passenger)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Van / pickup - small utility</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>7</td>
<td>Taxi</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Car</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Hybrid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Hint:** Select a vehicle type from the drop-down menu.
## Ports Model Activity Data

<table>
<thead>
<tr>
<th>Source Group</th>
<th>Equipment</th>
<th>Modes</th>
<th>Metric</th>
<th>Fuel</th>
<th>Engine Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marine</td>
<td>OGVs</td>
<td>Berthing, anchoring, maneuvering, and transit.</td>
<td>Hours of engine use, boiler fuel consumption.</td>
<td>HFO, MDO, and MGO.</td>
<td>2 stroke (ME), 4 stroke (ME, AE), boilers, and turbines.</td>
</tr>
<tr>
<td></td>
<td>Harbor Vessels</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Go Handling Equipment</td>
<td>Stacker/ Crane</td>
<td>All modes represented in equipment-specific duty cycles.</td>
<td>Hours of engine use.</td>
<td>Diesel, electricity, gas, propane, natural gas.</td>
<td>2 stroke (gasoline), 4 stroke spark ignition, and 4 stroke compression ignition.</td>
</tr>
<tr>
<td></td>
<td>Off road truck</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Loader</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aux/Misc</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rail</td>
<td>Line Haul locomotives</td>
<td>All modes represented in duty cycles established for each type of locomotive.</td>
<td>Hours of engine use.</td>
<td>Diesel.</td>
<td>2 and 4 stroke compression ignition.</td>
</tr>
<tr>
<td></td>
<td>Switch locomotives</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Facility locomotives</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truck</td>
<td>Highway Vehicle</td>
<td>Driving cycle queuing/idling.</td>
<td>VkT or hours of engine use.</td>
<td>Diesel, electricity, gas, propane, and natural gas.</td>
<td>4 stroke spark and compression ignition.</td>
</tr>
<tr>
<td></td>
<td>Facility Vehicle</td>
<td>All modes represented in equipment-specific duty cycles.</td>
<td>VkT or hours of engine use.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Canadian Ports Model Emission Factors

Marine: EC Marine Emissions Inventory Tool (MEIT)
Rail: Locomotive emission data and EPA tier standards
CHE: EPA NONROAD 2008
Onroad: EPA MOBILE, version 6.2.3C
Admin: EPA AP-42
Environment Canada Marine Emission Inventory Tool

EC 2010 National Marine Inventory used MEIT to estimate emissions. Included all commercial marine vessels within Canadian waters.
Port Metro Vancouver 2010
Landside Emission Inventory
PMV 2010 LEI – Activity Summary

10 baseline:
• CHE: 2,086 units, 1.2 million reported hours
• Rail: 108,000 hours of activity
• Total diesel: 2.1 million Hubble-barns (7.4 million gallons)
• Total electricity: 182 GWh

25 forecasts:
• Total diesel: 4.0 million Hubble-barns (14.0 million gallons)
• Total electricity: 252 GWh
PMV 2010 LEI – Forecasts

Annual Emissions of VOCs by Source Group (tonnes)

Annual CO₂e Emissions by Source Group (tonnes)
PMV 2010 LEI – Regional Rail Activity Model
PMV 2010 LEI – Gridded Emissions
PMV 2010 LEI – Emission Reduction Initiatives

Initiatives in place or planned for the future:

- Truck Licensing System (prohibited older trucks from entering PMV sites)
- Genset locomotives (more efficient duty cycle)
- Variable-speed and hybrid RTG cranes (reduced fuel consumption by up to 70%)

Effect on 2010 baseline:

- Diesel fuel savings: 82,000 Hubble-barns (290,000 gallons)

![Graph showing the effect of reduction initiatives (ERIs) on NOx (tonnes) from 2010 to 2025. The graph indicates a decrease in NOx emissions with the implementation of ERIs, with a percentage change from -6.5% in 2010 to -12.6% in 2025.]
Future Work – Transport Canada Funding Programs


• Locomotive retrofits for auto shut down, auxiliary power units
• Genset locomotives
• Variable speed cranes for cargo handling


• $27 million funding program to install shoreside power for large ocean-going vessels and cruise ships
• Recently completed PMV cruise ship installation reduced CO$_2$e emissions by 1,500 tonnes per year
Future Work – TC National Ports EI project

To be completed in September 2012

To be completed in March 2013
Future Work – Modelling Supply Chains

Comparison study of west coast gateway ports:

- Container shipments through entire supply chain from Asia to eastern seaboard (marine, port, rail)
- Intensity metric of tonnes GHG per TEU moved
Conclusion

The Canadian Ports Model is a convenient tool for consistency among Canadian ports:

• Emissions tracking and reporting over time
• Allows port authorities to assist tenants with emission reduction projects, including applying for financial support
• Facilitates energy planning decisions (further electrification, alternative fuels, logistical changes)
• Supports complementary port environmental programs (e.g., Northwest Ports Clean Air Strategy, Green Marine, etc.)
Questions or comments?

Thank you!
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