Understanding the Transportation Emissions Reduction Challenge

Presentation by Peter Boag
The Pathways Initiative Workshop
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Canadian industries, including manufacturing, agriculture, fishing, forestry, energy, retail and tourism rely on transportation.

Transportation is integral to our export-driven economy.

Transportation meets all our personal needs for travel to and from work, school, recreation activities, shopping and social events.
How we get around today

Transportation Energy Use by Fuel (2012)

- Electricity: 53%
- Natural Gas: 32%
- Gasoline: 3%
- Diesel Fuel: 3%
- Ethanol: 8%
- Heavy Fuel Oil: 1%
- Aviation Jet: 0%
- Propane: 0%

Source: Natural Resources Canada

Transportation Energy Use by Mode (2012)

- Cars/Light Trucks: 47%
- Medium/Heavy Trucks: 31%
- Bus/Transit: 8%
- Air: 2%
- Rail: 4%
- Marine: 4%
- Offroad/Other: 4%

• Petroleum fuels deliver unprecedented mobility that is the foundation of our prosperity.

• They provide efficient, affordable, reliable energy that makes our modern, urbanized society possible.
• Transportation emissions account for 28 per cent of total emissions (IPCC sector).
• Road transportation accounts for 2/3. (19% of overall total).
• Transportation emissions are 40% above 1990 level.
• An 80% reduction in road transportation emissions by 2050 would require an 86% decrease (118 Mt CO₂e) from 2013 level.
Canada's GHG Emissions Breakdown by IPCC Sector (2013)

Source: Environment Canada, National Inventory Report, 1990-2013, Greenhouse Gas Sources and Sinks in Canada
Note: Totals may not add up due to rounding
Examined road transport in the context of the 80% reduction from 1990 by 2050 aspiration.

Identified significant practical and economic challenges and barriers.

Achieving this aspiration will require Canadians to make significant adjustments, including attitudinal and behavioural changes.

Abatements costs are typically in excess of $100 per tonne – many pathways are much higher.
Emissions Drivers

GHG emissions intensity has decreased, yet total emissions have increased

Population = Passenger kms

GDP = Tonne kms
Passenger vehicles shifting away from sedans

Share of Fleet

Source: Natural Resources Canada, The Conference Board of Canada.
Freight is the biggest challenge

Source: Natural Resources Canada, The Conference Board of Canada.
The 2050 Challenge As Seen By the Conference Board of Canada

The Reference Case

- Assuming long term trends for population, GDP, vehicle stock, forthcoming new emission standards and 1% per year reduction in VKT (vehicle kilometres traveled).
- By 2026, emissions start increasing again.
- By 2050, emissions would be 24% above 1990

Source: The Conference Board of Canada
• All of above + additional improvements in truck emissions (US regulations) and improvement in emissions intensity by all vehicles (1% per year) from 2026/2028 through 2050.

• By 2050, emissions would be 12% below 1990
Additional GHG Mitigation Measures/Market Penetration Case

Penetration rates and GHG impact assumptions for a range of technology and other options:

• Plug in electric LDVs – cars and trucks
• Gasoline or Diesel Hybrid electric
• CNG LDVs
• LNG HDVs
• Freight Vehicle Streamlining
• Mode shifts – away from single occupancy vehicles – active transport and transit
• Congestion reduction measures

Outcomes were emission levels that were 22% – 27% below the 1990 level.
## Potential Contributions to GHG Reductions

<table>
<thead>
<tr>
<th>Initiative</th>
<th>Minimum Potential</th>
<th>Maximum Potential</th>
<th>Emissions Reduction in 2050 (Mt)</th>
<th>Unit Abatement Cost ($/tonne)</th>
<th>Cost ($Million)</th>
<th>Total Abatement Cost ($Million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plug-in electric cars</td>
<td>10 per cent share of new vehicle sales (7.28 per cent of total stock in 2050)</td>
<td>35 for 5, 25 for 10, then 15 per cent annual growth (20 per cent of total stock in 2050)</td>
<td>1.394 – 3.829</td>
<td>230</td>
<td></td>
<td>321 - 881</td>
</tr>
<tr>
<td>Plug-in electric passenger trucks</td>
<td>5 per cent share of new vehicle sales (3.67 per cent of total stock in 2050)</td>
<td>10 per cent share of new vehicle sales (7.3 per cent of total stock in 2050)</td>
<td>0.655 – 1.302</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Gasoline hybrid electric cars</td>
<td>Double current share of new sales from 3 to 6 per cent</td>
<td>Double current share of new sales from 3 to 6 per cent</td>
<td>0.15 - 0.30</td>
<td>171</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Passenger car CNGs</td>
<td>1 per cent share of new vehicle sales</td>
<td>3 per cent share of new vehicle sales</td>
<td>0.027 – 0.054</td>
<td>167</td>
<td>4.5 – 9.0</td>
<td></td>
</tr>
<tr>
<td>Mode shift</td>
<td>Growth of 5 percentage points in active transport share</td>
<td>Growth of 8 percentage points in active transport share</td>
<td>1.85 – 2.96</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Congestion Reduction</td>
<td>Improve commute time speed to 70 % of free flow</td>
<td>Improve commute time speed to 70 % of free flow</td>
<td>3.0</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>HDVs LNG</td>
<td>5 per cent of trucks in 2050 use LNG</td>
<td>8 per cent of trucks in 2050 use LNG</td>
<td>1.170 - 1.40</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Trailer Streamlining</td>
<td>All trailers in 2050 have side skirts</td>
<td>All trailers in 2050 have side skirts – 50% employ other measures</td>
<td>0.6 – 1.2</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Transit Ridership</td>
<td>Reduce public transit fuel intensity by 20 per cent through increased ridership</td>
<td>Reduce public transit fuel intensity by 40 per cent through increased ridership</td>
<td>0.48 – 0.96</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Source: The Conference Board of Canada.
# Light-Duty Vehicle Alternative Technologies

## Abatement Costs ($/Tonne CO\(_2\)e) Relative to Gasoline Vehicles

<table>
<thead>
<tr>
<th>Technology</th>
<th>Light Duty Passenger Cars</th>
<th>Light Duty Passenger Trucks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline HEV</td>
<td>222</td>
<td>509</td>
</tr>
<tr>
<td>Gasoline PHEV (85% of distance in CD mode)</td>
<td>168</td>
<td>N/A</td>
</tr>
<tr>
<td>BEV</td>
<td>209</td>
<td>N/A</td>
</tr>
<tr>
<td>Biodiesel (B20)</td>
<td>162</td>
<td></td>
</tr>
<tr>
<td>Ethanol (E85)</td>
<td>1,215</td>
<td>1,352</td>
</tr>
<tr>
<td>Propane</td>
<td>900</td>
<td>609</td>
</tr>
<tr>
<td>CNG</td>
<td>376</td>
<td>537</td>
</tr>
<tr>
<td>FCEV</td>
<td>195</td>
<td>203</td>
</tr>
</tbody>
</table>

Source: The Conference Board of Canada.
Light-Duty Vehicle Alternative Technologies

Penetration of new technology can be slow

<table>
<thead>
<tr>
<th>Percentage Electric Vehicle Sales</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Three Percent Electric Vehicle Sales</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric Vehicles on the road</td>
<td>160,255</td>
<td>309,878</td>
<td>402,124</td>
<td>485,728</td>
</tr>
<tr>
<td>Electric share of total vehicles</td>
<td>1.17%</td>
<td>1.91%</td>
<td>2.13%</td>
<td>2.2%</td>
</tr>
<tr>
<td>MT GHG reduction</td>
<td>0.378</td>
<td>0.419</td>
<td>0.428</td>
<td>0.421</td>
</tr>
<tr>
<td><strong>Five Percent Electric Vehicle Sales</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric Vehicles on the road</td>
<td>273,651</td>
<td>518,750</td>
<td>671,003</td>
<td>809,825</td>
</tr>
<tr>
<td>Electric share of total vehicles</td>
<td>2%</td>
<td>3.21%</td>
<td>3.55%</td>
<td>3.66%</td>
</tr>
<tr>
<td>MT GHG reduction</td>
<td>0.645</td>
<td>0.703</td>
<td>0.713</td>
<td>0.701</td>
</tr>
<tr>
<td><strong>Ten Percent Electric Vehicle Sales</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric Vehicles on the road</td>
<td>353,014</td>
<td>966,661</td>
<td>1,377,589</td>
<td>1,611,037</td>
</tr>
<tr>
<td>Electric share of total vehicles</td>
<td>2.57%</td>
<td>5.97%</td>
<td>7.07%</td>
<td>7.28%</td>
</tr>
<tr>
<td>MT GHG reduction</td>
<td>0.830</td>
<td>1.308</td>
<td>1.42</td>
<td>1.394</td>
</tr>
</tbody>
</table>

Source: The Conference Board of Canada.
Thoughts on the path to a lower carbon future for road transport

- Continue the focus on vehicle performance
- Focus more carefully on alternative vehicles
- Get people out of cars
- Focus on freight
- Address demand for transport

‘The most carbon-effective measures we can take are measures that reduce the demand for transportation…’

Conference Board of Canada
Reducing road transportation greenhouse gas emissions rests upon at least three fundamental questions:

• How much can technology accomplish?
• What will it cost?
• How much are we willing to change behaviour?