



**Environment  
Northeast**

# **Analysis and Recommendations for a Program for Energy Efficient Trucks (PEET)**

By

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ENE (Environment Northeast) is a regional non-profit organization that researches and advocates innovative environmental policies. ENE is at the forefront of efforts to combat global warming with solutions that promote clean energy and transportation, clean air, healthy forests, and a sustainable economy.

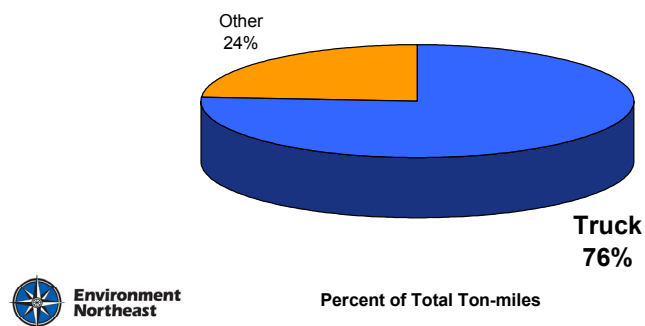
## Summary

ENE (Environment Northeast) recommends the establishment of a Program for Energy Efficient Trucks (PEET). The principal purpose of this program is to provide financial incentives for energy efficiency retrofits and upgrades to heavy-duty freight hauling trucks operating on the roads of New England and Eastern Canada. The benefit of PEET is that it will cost-effectively help truck owners reduce their operating costs and lower greenhouse gas emissions in the region.

## Introduction

In New England, trucking accounts for approximately 76 percent of total freight transportation output. In 2002, there were more than 86,000 heavy-duty trucks on New England highways, traveling over 2.3 billion miles and consuming approximately 400 million gallons of fuel.<sup>1</sup>

### Freight Truck Share of Freight Transportation Output in New England (2002)



In Canada, freight trucking held a 19 percent share of total freight transportation output in 1990. By 2005, freight trucking was responsible for 31 percent of total tonne-kilometers.<sup>2</sup> In eastern Canada, which relies more heavily on trucks to move freight than the country as a whole, more than 57,000 heavy-duty trucks were registered in 2005, traveling over 5.1 billion kilometers (3.2 billion miles), and consuming approximately 2.1 billion liters of fuel (555 million gallons).<sup>3</sup>

In both New England and Eastern Canada (NE-EC) freight trucking is expected to increase significantly over the next thirty years. It is projected that the total tonnage moved by freight in the United States will double between 2005 and 2035 and that, absent aggressive policies to increase mode shifting, 80 percent of freight will be moved by truck.<sup>4</sup> The high demand for trucking is in part due to the industrial mix which favors this mode.<sup>5</sup> *Canada's Energy Outlook 2006* forecasts road freight kilometers traveled to double by 2020 and freight truck energy use is expected to increase by 35 percent over the same time period (2005-2020).

<sup>1</sup> US Census Bureau, *2002 State Vehicle Inventory and Use Survey* data, and ENE analysis.

<sup>2</sup> NRCan – *Freight Transportation Secondary Energy Use* table by Energy Source and Transportation Mode.

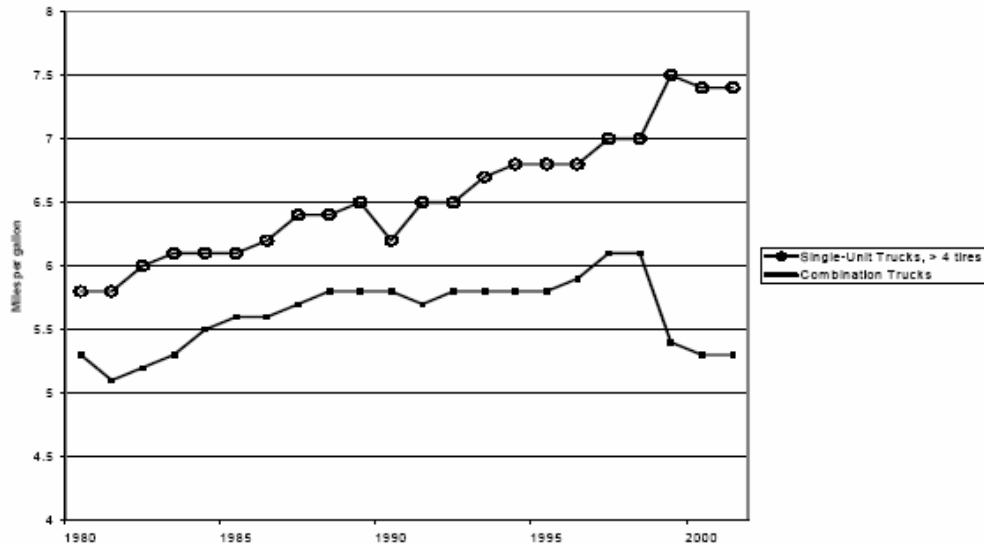
<sup>3</sup> Transport Canada, *Annual Report 2006*, and ENE analysis.

<sup>4</sup> American Association of State Highway Transportation Officials (2007), *Transportation Invest in Our Future: Surface Transportation Policy Recommendations for the National Surface Transportation Policy and Revenue Study Commission*, p59.

<sup>5</sup> National Surface Transportation Policy and Revenue Study Commission briefing paper 4B-04 – *Impacts of Changes in Business Practices and Industrial Locations on Freight Movement, Modal Demand, and Transport Industry Structure*. Prepared by Global Insight, Inc., January 2007.

The Energy Information Administration’s 2006 Annual Energy Outlook predicts that from 2005 to 2030, the fuel efficiency of the U.S. heavy truck fleet will increase from 6 miles per gallon (mpg) to 6.8 mpg.

**Figure 2**  
**Fuel Economy of Freight Trucks, 1980-2001**

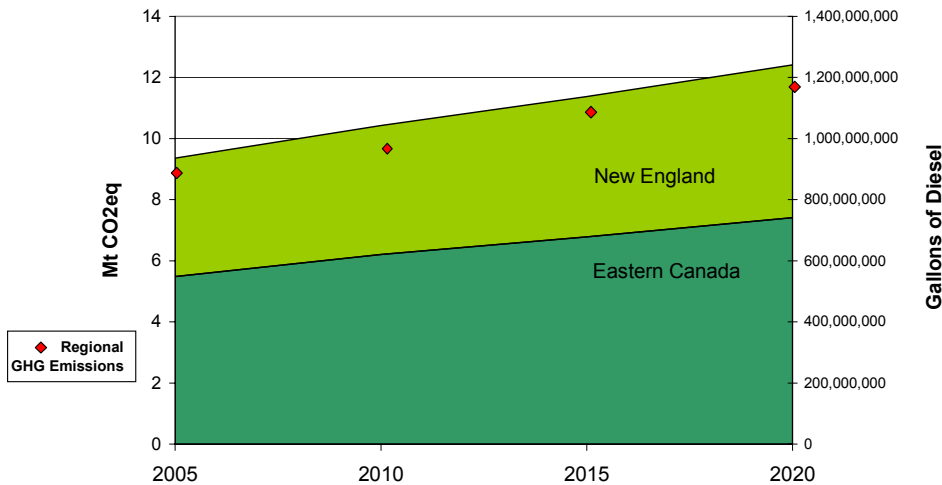


Source: ACEEE (2004) *Energy Savings Through Increased Fuel Economy for Heavy-Duty Trucks*

With respect to greenhouse gas (GHG) emissions, in 2005, emissions from freight trucking in NE-EC totaled approximately 8.86 million metric tons of carbon dioxide equivalence (Mt CO<sub>2</sub>eq).<sup>6</sup> This is equivalent to 2.5 percent of the region’s total emissions in 2000.<sup>7</sup> Using historic data as a guide, ENE projects that GHG emissions from road freight transportation will grow to approximately 11.72 Mt CO<sub>2</sub>eq by 2020 absent any mitigating intervention.



**Actual and Projected Freight Truck Energy Use and GHG Emissions in New England & Eastern Canada, 2005-2020**



<sup>6</sup> Environment Canada, National Inventory Report 2005 and ENE analysis.

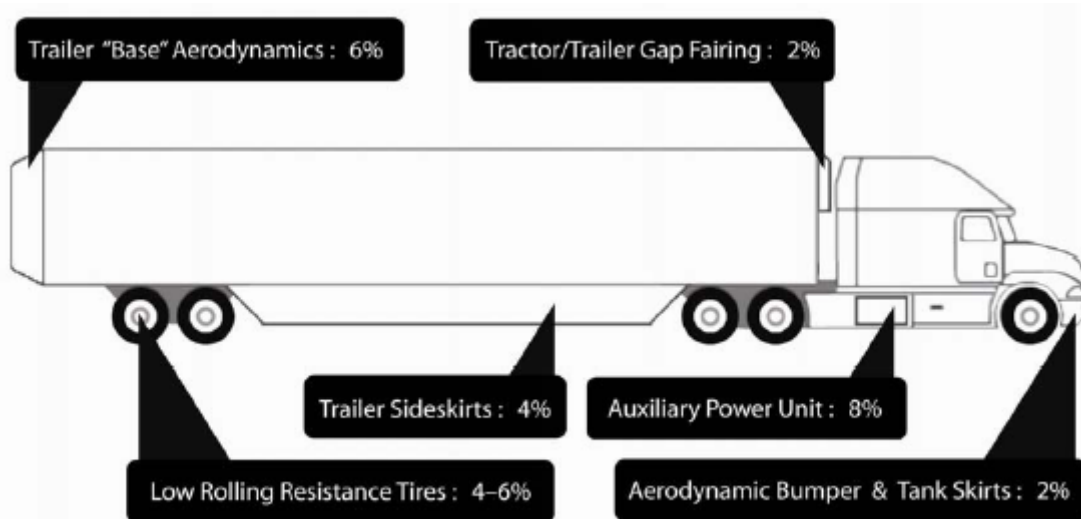
<sup>7</sup> In 2000, NE-EC emissions were approximately 345 million metric tons of CO<sub>2</sub> equivalent. See ENE, *Climate Change Roadmap for New England and Eastern Canada* (2006).

## Road Freight End-Use Energy Efficiency

Employing cost-effective energy efficiency measures that improve fuel economy and reduce emissions will help improve the economic and environmental performance of the region's freight trucking sector. As outlined by the Rocky Mountain Institute (RMI), a significant amount of energy is lost in trucking due to inefficiency, such as idling, resistance, drag, etc.

“In the average long-haul trucking operation, only about 6.5% of the energy in each litre of diesel fuel is used to move the cargo and only 4.5% is used to move the tractor-trailer. The remaining 89% is lost along the way: 56% to thermodynamic effects in the engine, 12% due to idling, 2% to driveline and transmission drag, 19% to overcome aerodynamic forces, and 11% to tire rolling resistance.”<sup>8</sup>

Not surprisingly, there is significant energy savings potential from measures that improve the fuel efficiency of trucks and tractors both when they are moving and stationary. The following diagram illustrates some of the end-use energy efficiency measures that can be incorporated in new and retrofit heavy-duty trucks.



Source: RMI (2007), *Truck Efficiency and GHG Reduction Opportunities in the Canadian Truck Fleet*

A program for heavy-duty road freight to improve the energy efficiency of existing and new trucks would save trucking companies millions of dollars annually and help the region meet its GHG emission reduction goals.


This 'vehicle approach' to reducing freight energy demand and emissions is essential considering the share of trucks used to move freight and the projected increase in trucks and truck miles/kilometers traveled. A vehicle approach will complement other strategies such as modal shifts and increasing inter-modal transportation, improved logistics planning, and reducing vehicle miles/kilometers traveled.

<sup>8</sup> Ogburn, M. J., L.A. Ramroth (2007), *Truck Efficiency and GHG Reduction Opportunities in the Canadian Truck Fleet*, page 4. Rocky Mountain Institute. [www.rmi.org](http://www.rmi.org)

## Road Freight End-Use Energy Efficiency – Benefits

The following tables outline the energy savings and emissions reduction potential of a selection of efficiency measures. These measures were assessed in a U.S. national study by ICF Consulting and are included in the US EPA SmartWay program.<sup>9</sup> ENE estimates that in the NE-EC region total fuel savings from this menu could reach over 150 million gallons (570 million litres) of diesel fuel from existing trucks annually. A total of 1.5 Mt CO<sub>2</sub>eq emissions could be reduced and avoided annually which is equivalent to approximately 14 tonnes CO<sub>2</sub>eq per truck per year. The estimated fuel savings and emissions reduction equal 13 percent of projected regional fuel consumption and emissions in 2015.

These estimates are conservative. For comparison, the RMI study found a fuel and emissions savings potential of 22 percent and thus a reduction of 39 tonnes per truck per year. A study by ACEEE (2004) projected a possible 29 percent fuel economy improvement using cost-effective technologies available as of 2008.<sup>10</sup> (Note, the RMI study included a higher km/yr assumption and the package of technologies analyzed in the ACEEE report differed from the following list.)

 Environment Northeast					
<b>Eastern Canada: Summary of Benefits from Freight Truck Fuel and Emission Savings Measures</b>					
Measure	Estimated Fuel Savings	Current Market Penetration	Estimated Achievable Penetration	Annual Reduction in Fuel Use (million litres)	Annual Reduction in Emissions (tonnes CO <sub>2</sub> )
Tractor Aerodynamics (Van Trailer)	3.6%	52%	65%	6.007	14,200
Tractor Aerodynamics (Non-Van Trailer)	3.5%	18%	35%	7.637	18,100
Trailer Aerodynamics	3.8%	0%	65%	31.702	75,100
Wide-Base Tires	2.6%	5%	100%	31.702	75,100
Automatic Tire Inflation System	0.6%	5%	100%	7.316	17,300
Tare Weight Reduction	1.8%	14%	64%	11.552	27,400
Low-Friction Engine Lubricants	1.5%	10%	100%	17.327	41,000
Low-Friction Drive Train Lubricants	1.5%	70%	100%	5.776	13,700
Direct-Fire Heater (Idle)	3.4%	5%	63%	25.311	59,900
APU (Idle)	8.9%	0%	63%	71.966	170,000
Automatic Engine Idle	5.9%	8%	63%	41.650	147,000
Speed Reduction (70 to 65 mph)	6.0%	49%	62%	10.011	23,7000
Speed Reduction (65 to 60 mph)	7.6%	10%	62%	50.724	120,000
Driver Training and Monitoring	3.8%	32%	74%	20.485	48,500
<b>TOTAL*</b>	-	-	-	<b>339.17</b>	<b>851,000</b>

\* Of the three idling measures, only the auxiliary power unit (APU) is included in the total.  
 Note: A 50 percent participation rate is used to represent actual uptake of the measures.  
 Sources: Transport Canada and Natural Resources Canada data; Analysis based on methodology included in an ICF Consulting report – *Energy Efficiency Strategies for Freight Trucking: Potential Impact on Fuel Use and Greenhouse Gas Emissions* (2003).

<sup>9</sup> Ang-Olson, J., W. Schroeer (2003), *Energy Efficiency Strategies for Freight Trucking: Potential Impact on Fuel Use and Greenhouse Gas Emissions*, ICF Consulting. See Appendix B for more information on the ICF Consulting study.

<sup>10</sup> Ogburn, M. J., L.A. Ramroth (2007), *Truck Efficiency and GHG Reduction Opportunities in the Canadian Truck Fleet*, Rocky Mountain Institute; Langer, Therese (2004), *Energy Savings Through Increased Fuel Economy For Heavy-Duty Trucks*. Prepared by the American Council for an Energy-Efficiency Economy for the National Commission on Energy Policy.

**New England: Summary of Impacts from Freight Truck Fuel and Emission Savings Measures**


Measure	Estimated Fuel Savings	Current Market Penetration	Estimated Achievable Penetration	Annual Reduction in Fuel Use (million gallons)	Annual Reduction in Emissions (tonnes CO <sub>2</sub> )
Tractor Aerodynamics (Van Trailer)	3.6%	52%	65%	1.075	10,900
Tractor Aerodynamics (Non-Van Trailer)	3.5%	18%	35%	1.367	13,900
Trailer Aerodynamics	3.8%	0%	65%	5.674	57,600
Wide-Base Tires	2.6%	5%	100%	5.674	57,600
Automatic Tire Inflation System	0.6%	5%	100%	1.309	13,300
Tare Weight Reduction	1.8%	14%	64%	2.067	21,000
Low-Friction Engine Lubricants	1.5%	10%	100%	3.101	31,500
Low-Friction Drive Train Lubricants	1.5%	70%	100%	1.034	10,500
Direct-Fire Heater (Idle)	3.4%	5%	63%	4.529	45,900
APU (Idle)	8.9%	0%	63%	12.88	131,000
Automatic Engine Idle	5.9%	8%	63%	7.454	75,600
Speed Reduction (70 to 65 mph)	6.0%	49%	62%	1.792	18,200
Speed Reduction (65 to 60 mph)	7.6%	10%	62%	9.078	92,100
Driver Training and Monitoring	3.8%	32%	74%	3.666	37,200
<b>TOTAL*</b>	-	-	-	<b>60.7</b>	<b>616,000</b>

\* Of the three idling measures, only the auxiliary power unit (APU) is included in the total.

Note: A 50 percent participation rate is used to represent actual uptake of the measures.

Sources: US Census Bureau 2002 Vehicle Inventory and Use Survey and EIA Annual Energy Outlook 2008; Analysis based on methodology included in an ICF Consulting report – *Energy Efficiency Strategies for Freight Trucking: Potential Impact on Fuel Use and Greenhouse Gas Emissions* (2003).

## Recommendations

ENE has analyzed the potential fuel and emissions savings from a menu of truck energy efficiency measures and has reviewed the EPA SmartWay program and other state incentive programs. Based on this analysis, ENE has crafted the following recommendations for improving the end-use energy efficiency of road freight transportation in New England and Eastern Canada.

The objective of these recommendations is to establish an energy efficiency investment program among the region's provincial and state governments that would help truckers save money on fuel while reducing their emissions of greenhouse gases. The proposed program is called PEET – Program for Energy Efficient Trucks.


ENE recommends that provincial and state governments:

- Increase awareness of fuel and emissions savings potentials from investing in freight truck energy efficiency measures;
- Establish a program of financial incentives to promote the purchase and installation of equipment that improves the end-use energy efficiency of heavy-duty freight trucks.

By implementing PEET – a program that combines two components, (1) the Top 5 Retrofit Measures and (2) the Efficient New Truck measures – the regional annual fuel and emissions savings could total 9.5 percent of projected demand/emissions in 2015. An annual reduction of 1,000,000 tonnes of CO<sub>2</sub>eq (retrofit and new truck/trailer programs) is approximately equal to taking 5,600 heavy-duty trucks or 235,000 cars off the road each year.

## Program for Energy Efficiency Trucks (PEET) – Top 5 Retrofit Measures Component


Even a limited subset of the above menu, comprising the most cost-effective, technology-based measures, offers significant financial benefits.

 Measure	Estimated Costs	Annual \$ Savings (Fuel)
Improved Aerodynamics (trailer fairings)	\$2,400	\$1,850
Automatic Tire Inflation System	\$900	\$300
Wide-base Tires and Wheels	\$5,600	\$1,260
Low-Friction Lubricants (Full synthetic)	Marginal cost of ~ \$3.30/L (220 L/yr)	\$730
APU (Idle)	\$6,000 – \$9,000	\$4,400
<b>TOTAL (approx.)</b>	<b>\$17,000</b>	<b>\$8,500</b>
* per truck/trailer combination Assumptions: annual savings are based on \$4.86/gallon (avg. NE diesel price as of 07/07/08); 2,400 idle hours/year; 0.6 gal/hr (idling); average consumption of 10,000 gallons/year		

To these avoided energy costs can be added other financially significant benefits, including improved environmental performance, lower healthcare costs, increased competitiveness, and improved regional energy security.

Based on the assumptions outlined in Appendix B, the measures included in this sample package could result in annual savings of more than 278 million litres (73.4 million gallons) of diesel fuel and a reduction of approximately 700,000 tonnes of CO<sub>2</sub>eq within the New England and Eastern Canadian region. This would eliminate approximately 6.5 percent of 2015 projected energy use and greenhouse gas emissions from heavy freight trucks.

## Program for Energy Efficient Trucks (PEET) – Efficient New Trucks Component

 Measure	Incremental Cost	Annual \$ Savings (Fuel)
SmartWay Certified Tractor/Truck	\$16,500	\$12,150
Assumptions: annual savings are based on \$4.86/gallon (avg. NE diesel price as of 07/07/08); average consumption of 10,000 gallons/year; 25% fuel savings		


Assuming that in 2015 the number of trucks in operation in the NE-EC region increased by 20 percent over 2003 levels,<sup>11</sup> and half of all these new trucks (14,400 trucks) are SmartWay certified new tractor-trailers, annual fuel and emissions savings from promoting efficient new truck purchases could reach approximately 136 million litres (36 million gallons) and 323,000 tonnes of CO<sub>2</sub>eq compared to business as usual. This is

<sup>11</sup> This figure is slightly less than the increased in heavy-duty trucks projected for the US in 2015 (23.4%). Business Network – Transportation Industry: “More Freight Means More Trucks Needed in US,” October, 2004, [http://findarticles.com/p/articles/mi\\_qa5375/is\\_200410/ai\\_n21357632](http://findarticles.com/p/articles/mi_qa5375/is_200410/ai_n21357632)

equivalent to approximately 3 percent of the 2015 projected energy use and greenhouse gas emissions from heavy freight trucks.<sup>12</sup>

It is worth noting that reducing speed can also significantly impact fuel use. A reduction from 70 mph to 65 mph could reduce fuel consumption by over 21 million litres (5.5 million gallons) per year in the NE-EC region. Reducing speed from 65 mph to 60 mph could save an additional 106 million litres (28 million gallons) annually in the NE-EC region.

### **Total Incremental Investment Required in NE-EC Region – Retrofit and New Truck/Trailer Programs**

 <b>Environment Northeast</b> <b>Measure</b>	<b>Number of Trucks Participating</b>	<b>Total Direct Investment Required (millions)</b>	<b>Total Annual Savings based on 2008 fuel costs (millions)</b>
Improved Aerodynamics (trailer fairings)	46,800	\$112.3	\$86.6
Automatic Tire Inflation System	68,400	\$61.6	\$20.5
Wide-base Tires and Wheels	68,400	\$383	\$86.2
Low-Friction Lubricants (Full synthetic)	64,800 (engine) + 21,600 (drive train)	\$60.5	\$63.1
APU (Idle)	45,360	\$340.2	\$199.6
SmartWay Certified New Tractor-Trailer	14,400	\$237.6	\$175.0
	<b>TOTAL (approx.)</b>	<b>\$1,195.2</b>	<b>\$631</b>

<sup>12</sup> These fuel and emissions savings are based on a fuel economy improvement of 25 percent in SmartWay certified new tractor-trailer combinations and an annual fuel consumption of 10,000 gallons.