VERMONT
DEPARTMENT OF HEALTH

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April 4, 2018

Health impacts from motor vehicle emissions

Motor vehicle emissions are an important source of air pollution.

- Vehicle emissions include carbon dioxide, carbon monoxide, hydrocarbons, nitrogen oxides, particulate matter, and mobile-source air toxics, and contribute to the formation of ozone and aerosols.
- Fine particulate matter ($PM_{2.5}$, less than 2.5 micrometers in diameter) is the key contributor to health impacts.
- In Vermont, 3 percent of $PM_{2.5}$ emissions come from on-road vehicles.[1] About 190 tons are emitted from light-duty gas and diesel vehicles, while about 125 tons are emitted from heavy-duty trucks.
- PM2.5 can stay in the air for weeks, traveling long distances, which means that Vermont emissions can affect health in neighboring states, and vice versa.

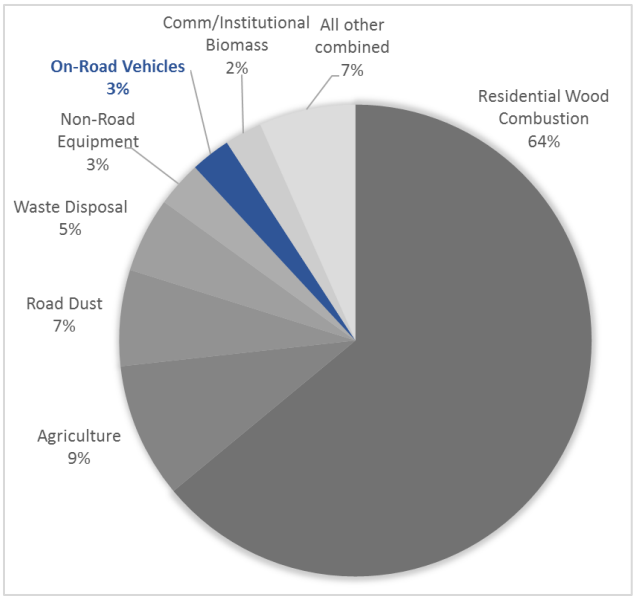

Figure 1. Fine particulate emissions sources in Vermont

Exposure to motor vehicle emissions is associated with a wide range of cardiovascular, cerebrovascular, respiratory, and reproductive health impacts.

- The highest direct exposure to traffic-related air pollution occurs within a few hundred meters of a roadway - urban areas and locations near major travel corridors tend to be most affected.
- Children, older adults, and individuals with pre-existing chronic diseases (particularly, respiratory and cardiovascular conditions and diabetes) tend to be at higher risk for health impacts from exposure to air pollution.
- Exposure to fine particulate matter and ozone from motor vehicle emissions caused about 58,000 early deaths in the United States in 2005, with an estimated 56 in Vermont.[2]

National Ambient Air Quality Standards for fine particulate pollution and ozone are rarely exceeded in Vermont. However, **recent studies have demonstrated that any air pollution is associated with negative health impacts, even at concentrations below National Ambient Air Quality Standards.**

[1] 2014 National Emissions Inventory (NEI): https://www.epa.gov/air-emissions-inventories
[2] Caiazzo, et al. Air Pollution & Early Deaths in the U.S. 2013. https://doi.org/10.1016/j.atmosenv.2013.05.081

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Health benefits of motor vehicle electrification

The following assessment was conducted to estimate the health benefits of meeting Vermont's 2016 Comprehensive Energy Plan goals for electrifying light-duty motor vehicles:

- 10% of light-duty vehicles are electric by 2025 (10% EVs)
- 80% of light-duty vehicles are electric by 2050 (80% EVs)

Based on results from EPA's Co-Benefits Risk Assessment model and the assumptions below, reduced tailpipe emissions from electrifying 10% of the light-duty motor vehicle fleet (about 57,500 vehicles) would provide a monetized health benefit of $2.4 million - $5.5 million per year. Electrifying 80% of the light-duty fleet would provide a monetized health benefit of $19 million - $44 million per year.

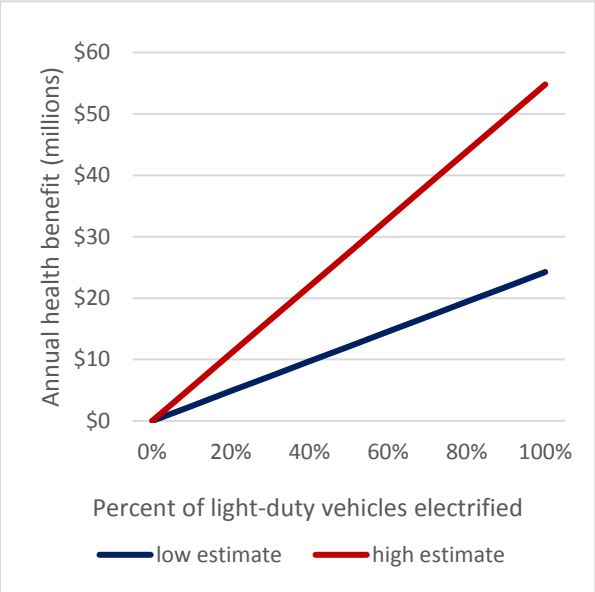

Figure 2. Monetized health benefits of vehicle electrification.

Table 1. Annual health benefits.

	Scenario	
Health outcome	**10% EVs**	**80% EVs**
Total health benefit (millions)	$2.4M - $5.5M	$19M - $44M
Premature deaths avoided	0.3-0.6	2.3-5.1
Nonfatal heart attacks avoided	0.0-0.3	0.3-2.7
Incidences of asthma exacerbation, upper and lower respiratory symptoms avoided	19	150
Minor restricted activity days avoided	217	1734
Days of lost work avoided	36	289

Methods and assumptions:

- Health benefits were estimated using the EPA Co-Benefits Risk Assessment (COBRA) model.
  - COBRA estimates health benefits due to reductions in ambient particulate matter only.
  - All estimates are annualized benefits. Monetized health benefits are estimated for a target year of 2025 only, with values reported in 2010 US dollars. Ranges of benefits were provided where the model generated "low" and "high" estimates.
  - Health benefits to neighboring states from Vermont emissions reductions are included. Health benefits in Vermont from emissions reductions in neighboring states are not included.
- New electric vehicles are assumed to be 50% all-electric and 50% plug-in hybrid. (source: American Lung Association, Clean Air Future)
  - Electric vehicles produce 100% less tailpipe emissions than the equivalent gas/diesel vehicle
  - Plug-in hybrids produce 55% less tailpipe emissions than the equivalent gas/diesel vehicle (source: VTrans, 2017 Vermont Transportation Energy Profile)
- Emissions were reduced from the 2014 NEI baseline of 190 tons $PM_{2.5}$ for light-duty vehicles.
  - For example, the emissions reduction for the 2025 (10%) scenario was estimated as 190 tons $PM_{2.5}$ x 5% all-electric vehicles x 100% emissions reduction + 190 tons x 5% plug-in hybrids x 55% emissions reduction = 14.7 tons $PM_{2.5}$ reduced.
- There are approximately 575,000 registered light duty passenger vehicles, trucks, and pick-up trucks in Vermont. We assumed that every vehicle contributes the same average emissions, and that the vehicles replaced by electric vehicles would have the same average emissions profile as the rest of the fleet. The total number of light duty vehicles is assumed to stay constant at 575,000 over time.
- Non-Vermont vehicles operating in Vermont are assumed to be identical to Vermont vehicles.
- The assessment did not account for the following:
  - Expected incremental efficiency and emissions improvements from gas and diesel vehicles over time.
  - Upstream emissions generated during electric vehicle charging.