Diesel Emissions and Public Health

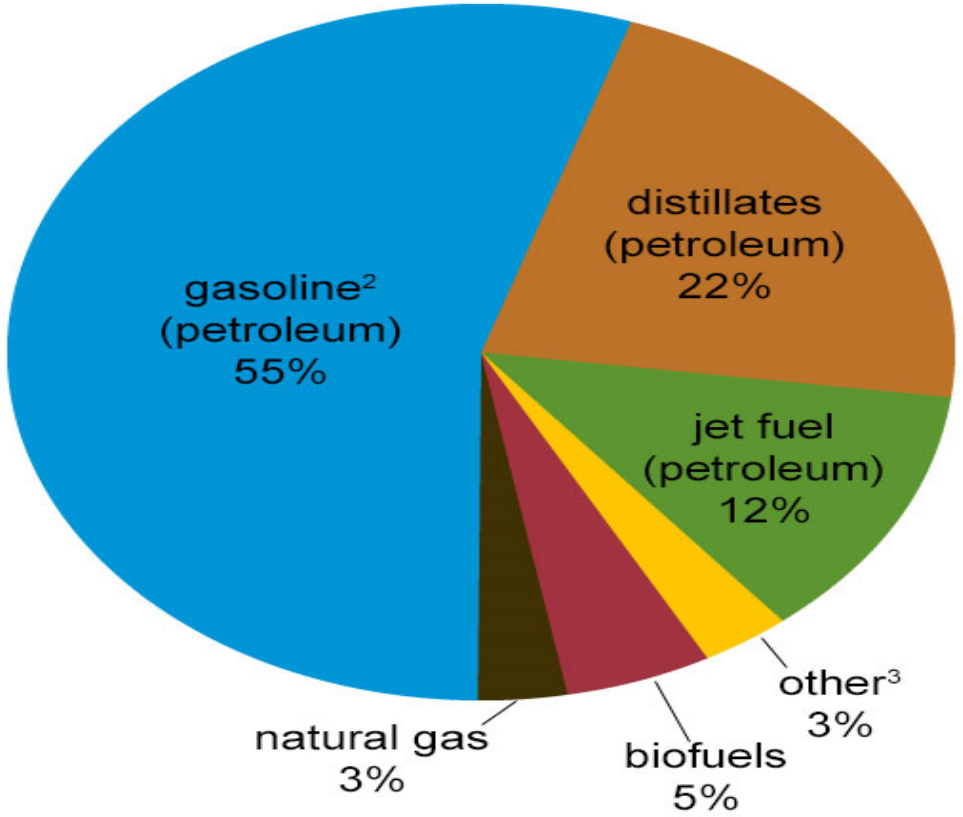
Prepared for Indiana VW Settlement Advisory Committee
Janet McCabe
IU McKinney School of Law and Environmental Resilience Institute
Environmental Law and Policy Center
June 4, 2018
jgmccabe@iu.edu

VW Mitigation Funds: the Opportunity

- More money by orders of magnitude than ever before to reduce air pollution
- 10 years over which to spend it
- Allows for investments in a variety of projects, including emerging technologies
- Allows for learning over time
- Allows for projects or applicants who need longer to develop good proposals and identify partners
- Allows for broad geographic coverage and diversity
- Allows for public health protection from the range of air pollutants emitted by diesel engines
- Flexibility in the amount of match required to encourage projects that do the most public good and/or would not happen but for funding

Diesel fuel makes up about 22% of US transportation fuel.

U.S. transportation energy sources/fuels, 2017[1]



[1] Based on energy content

[2] Motor gasoline and aviation gas; excludes ethanol

[3] Includes residual fuel oil, lubricants, hydrocarbon gas liquids (mostly propane), and electricity (includes electrical system energy losses).

Note: Sum of individual components may not equal 100% because of independent rounding.

Source: U.S. Energy Information Administration, *Monthly Energy Review,* Tables 2.5, 3.8c, and 10.2b, April 2018, preliminary data

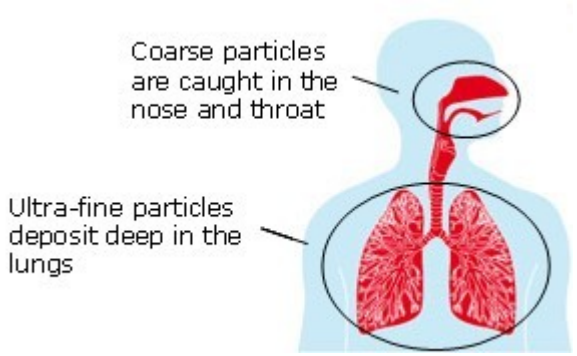
Diesel's contribution to air pollution

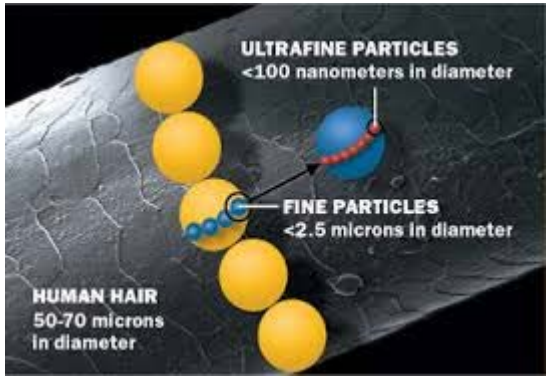
- Diesel sources (onroad and nonroad) contribute more than half of NOx emissions.
- Diesel sources contribute more than two-thirds of all particulate matter (PM) emissions from US transportation sources.

https://www.epa.gov/sites/production/files/2017-04/documents/2014neiv1_profile_final_april182017.pdf

What is Diesel Exhaust?

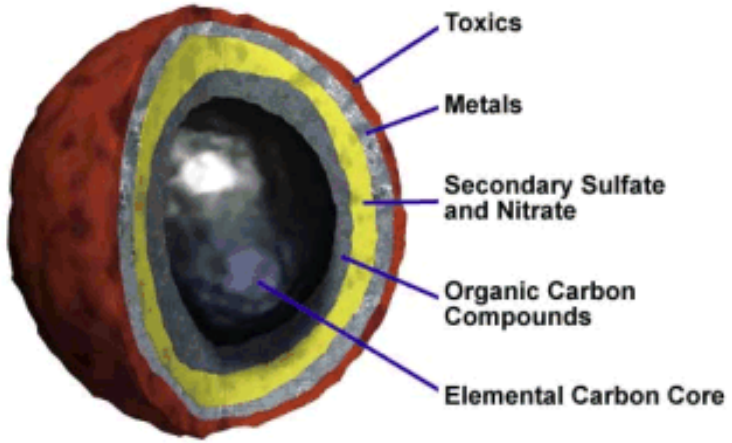
- Diesel particulate matter consists of fine particles (with a diameter <2.5 µm), including a subgroup with a large number of ultrafine particles (with a diameter <0.1 µm).
- Their small size makes them highly respirable and able to reach the deep lung and enter the bloodstream.





Directly emitted particles typically have a carbon core coated with a variety of hazardous substances such as metals, toxics and organic compounds.

Secondary particles form from exhaust gases such as hydrocarbons, sulfur dioxide and nitrogen oxides.



Source: EPA's Health Assessment Document for Diesel Engine Exhaust (2002), https://nepis.epa.gov/Exe/ZyPDF.cgi/300055PV.PDF?Dockey=300055PV.PDF

How are people exposed to diesel emissions?

- Tailpipes are at ground level
- Trucks and other vehicles in our neighborhoods

- Concentrations of diesel vehicles at truck stops, ports and rail yards
- Diesels often idle

Diesel emissions and human health

- Diesel exhaust poses three kinds of health risk
  - Short-term impacts:
    - Irritation to the eyes, nose, throat and lungs, and neurological effects such as lightheadedness. Acute exposure can cause a cough or nausea and exacerbate asthma.
  - Long-term noncancer impacts:
    - Inflammation and changes in the lung (such as inhibiting lung development in children).
  - Long-term cancer impacts:
    - In 2012, the World Health Organization's International Agency for Research on Cancer designated diesel engine exhaust as a human carcinogen.
    - EPA classifies diesel exhaust as "likely to be carcinogenic to humans."
    - The US National Toxicology Program (including NIH, CDC and FDA) has classified diesel exhaust particulates as "reasonably anticipated to be a human carcinogen," based on limited evidence from studies in humans (mainly linking it to lung cancer) and supporting evidence from lab studies.

Health affects associated with the components of diesel exhaust

- Nitrogen oxides
  - Lung irritant, contribute to ozone formation, asthma, chronic obstructive pulmonary disease
- Fine particles
  - Premature death in people with heart or lung disease, nonfatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, and increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing
  - Nationwide, particulate matter— especially the fine particles such as those in diesel exhaust—cause 15,000-21,000 premature deaths every year. (EPA)

Ozone and Particulate Matter

- National Ambient Air Quality Standards exist for ozone and particulate matter.
  - Compliance (known as “Attainment”) of areas is determined by a network of air quality monitors.
  - Most areas of Indiana are now classified as “attainment” for these pollutants.
  - Some areas were once “nonattainment” but air quality has improved. These are called “maintenance” areas and need to keep clean air measures in place.
- PM, NOx and other air pollutants can create “hotspots.”
  - Indiana’s monitoring network is not designed to find these areas.
  - They can, however, create localized areas that can be unhealthy.
  - There can also be temporal hotspots (think rush hour)
  - Adverse health impacts can occur even at levels below the national standards.

Health affects associated with the components of diesel exhaust, cont.

- Air Toxics
  - Diesel exhaust contains acetaldehyde, acrolein, benzene, 1,3-butadiene, formaldehyde and polycyclic aromatic hydrocarbons, which are among the air toxics driving significant health risks from air toxics nationally.
    - National cancer risk driver: Formaldehyde
    - National cancer risk contributors: 1,3-Butadiene, Acetaldehyde, Carbon tetrachloride, Chromium (VI), Ethylbenzene, Naphthalene
    - National noncancer hazard drivers: Acrolein, Chlorine, Diesel PM

Source: EPA's National Air Toxics Assessment (2011)

Who is most at risk?

- Where you are: people who live, work, go to school near busy roadways
  - Concentrations of particulate matter, benzene, aldehydes, and many other compounds are elevated in ambient air within approximately 1,000-2,000 feet of major roadways.

Skiles Test Elementary School, Indianapolis, next to I465

More than 45 million Americans live within 900 feet of a major road, railroad, or airport (EPA).

Numerous studies have shown greater health impacts for people living close to roadways with heavy traffic.

- Who you are: children, older adults, people with preexisting cardiopulmonary disease, and people of low socioeconomic status.
- Children are more at risk:
  - Their lungs are still growing
  - Their immune systems are not fully developed
  - They breathe more per pound of body weight than adults
  - They spend more time outside, often doing things that increases their respiration rate.

http://pediatrics.aappublications.org/content/113/Supplement_3/1037

What about the schoolbus?

- Several recent studies looking at diesel exhaust levels on schoolbuses and other areas of potential exposure to schoolbus emissions.

Children's exposure on the bus is significant

- Relative Importance of School Bus-Related Microenvironments to Children's Pollutant Exposure (AWMA Journal 2012)
  - Measured various air pollutants on busses, at bus stops, and at loading/unloading areas (in LA).
  - Mean exposures on the bus were between 50 and 200 times greater than those for the loading/unloading microenvironment, and 20–40 times higher than those for the bus stops.
  - Although the analyzed school bus commutes represented only 10% of a child's day, on average they contributed one-third of a child's 24-hr overall black carbon exposure during a school day.

Cleaner schoolbusses improve children's health

Adopting Clean Fuels and Technologies on School Buses. Pollution and Health Impacts in Children (American Journal of Respiratory and Critical Care, June 2015)

- Study characterized the exposures and health of 275 school bus riders before, during, and after the adoption of clean technologies and fuels between 2005 and 2009.
- Fine and ultrafine particle concentrations were 10–50% lower on buses using ultra low sulfur diesel fuel or pollution controls.
- Use of ultra low sulfur diesel was associated with improved lung function and lower absenteeism.
- Pollution controls were associated with improvements in children with asthma.

Fuels and greenhouse gases

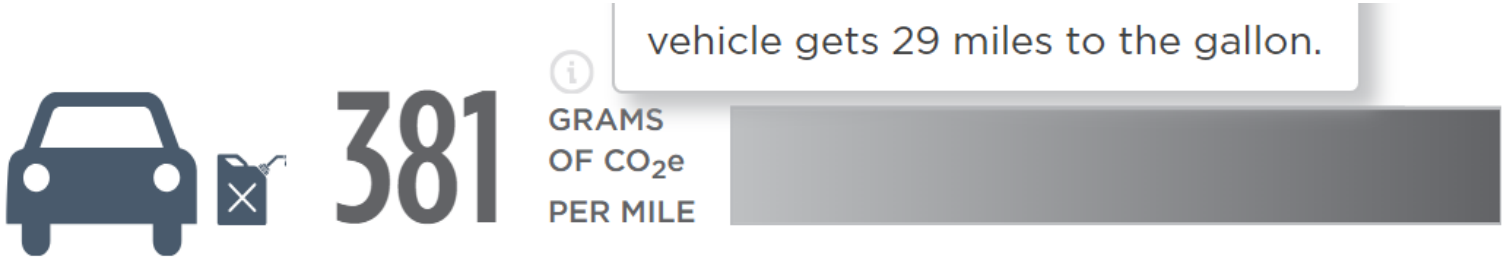
- Diesel engines produce more CO2 per gallon of fuel combusted than gasoline.
  - About 18.9 pounds of CO2 for gasoline (E10)
  - About 22.4 pounds of CO2 for diesel fuel

    Source: US Energy Information Agency, https://www.eia.gov/tools/faqs/faq.php?id=307&t=11
- Diesel and CNG are about equivalent in terms of CO2 tailpipe emissions, but CNG has a larger climate footprint because of methane emissions associated with natural gas development.
- Electric vehicles are generally better for CO2 emissions, even if the local power is significantly produced by fossil-fuels.

Generic comparison

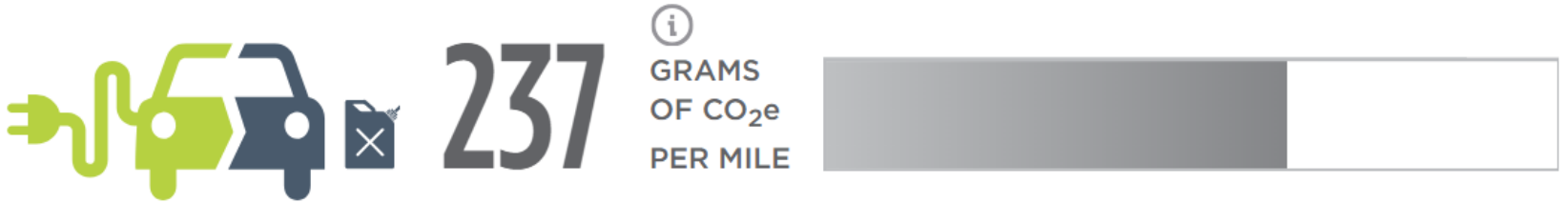
GASOLINE-ONLY

Conventional cars run on gasoline and tend to be dirtier and more expensive to fuel than EVs.



PLUG-IN HYBRID ELECTRIC

Plug-in hybrids use both gasoline and electricity and can be recharged from an outlet.

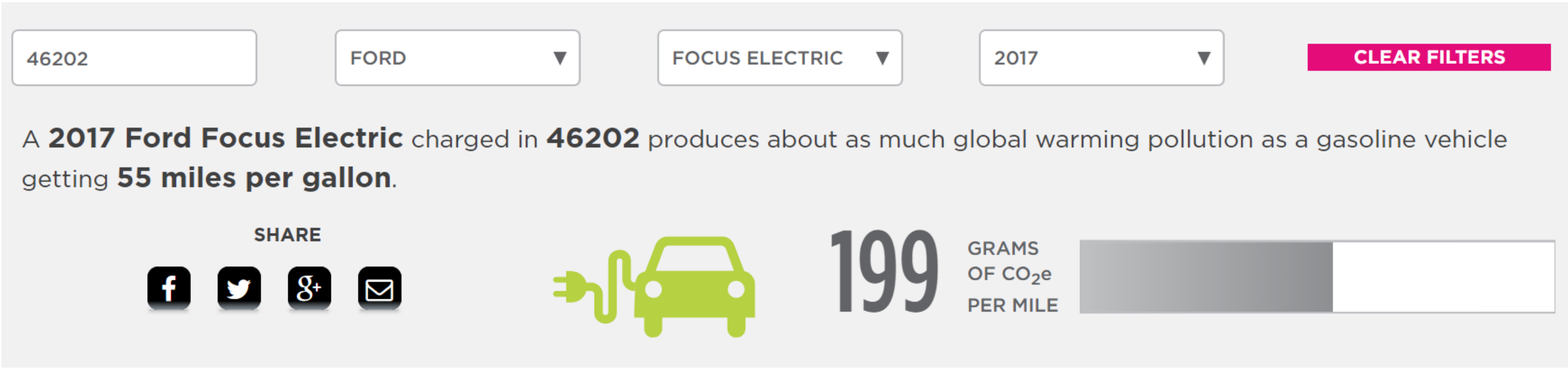


BATTERY ELECTRIC

Battery electric vehicles run on electricity and are some the cleanest and cheapest cars to drive.

Source: https://www.ucsusa.org/clean-vehicles/electric-vehicles/ev-emissions-tool#.WxQ0iEgvw2w

Indianapolis example



Other comparisons

PROPANE
NATURAL GAS
E85
DIESEL
GASOLINE

		GHG Index	Energy Use (mmBTU per unit per year)	Annual Life Cycle GHG Emissions per unit (kg CO_2 equivalent per unit per year) (▒ = upstream; ■ = end-use)
GENERIC LIGHT COMMERCIAL TRUCK: SHUTTLE/ PARATRANSIT VAN (TYPE A BUS)	E85 Type A bus	0.87	160	(62.0) 12,000 — 12,000 total
	Diesel Type A bus	0.97	133	2,950 10,400 — 13,400 total
	Propane Type A bus	1.00	160	2,910 10,900 — 13,800 total
	Compressed natural gas Type A bus	1.02	177	3,620 10,500 — 14,200 total
	Gasoline Type A bus	1.13	160	3,260 12,300 — 15,500 total

Source: US Propane Council 2014, https://www.propanecouncil.org/uploadedFiles/CouncilMain/Site_Content/Our_Work/Our_Work_With_Manufacturers_and_Researchers/GHG%20Report_6-6-14.pdf

GENERIC SCHOOL BUS (TYPE C BUS)	Compressed natural gas Type C bus	0.93	464	
	Propane Type C bus	1.00	464	
	Diesel Type C bus	1.06	422	
	Gasoline Type C bus	1.22	505	

Thank you!

Questions?