



Clean Trucks, Clean Air, American Jobs:

Eliminating pollution from *all* new truck and buses by 2040 — and urban and community applications by 2035 — will save thousands of lives, cut climate pollution, and result in shared economic benefits

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Introduction

A rapid transition to zero-emitting medium and heavy-duty trucks and buses is critically important to reduce harmful pollution in communities across the country—especially lower income neighborhoods and communities of color that disproportionately bear the burden of this pollution. Eliminating tailpipe pollution from these vehicles is also essential to help meet our nation’s climate goals. Our nation must adopt air pollution standards that ensure that *all* new sales of medium- and heavy-duty trucks and buses are zero emission vehicles (ZEVs) by 2040 at the latest. And we must take swifter action to protect communities more acutely impacted by trucking pollution by eliminating tailpipe pollution from new vehicles that operate in urban and community applications by 2035.¹



Ensuring 100% new medium- and heavy-duty ZEV sales by 2040 will prevent as many as 57,000 premature deaths by 2050.

The Biden-Harris Administration has committed to achieving a 100% clean energy economy and net-zero emissions no later than 2050 and, as part of that goal, ensuring that 100% of new sales for light and medium-duty vehicles will be electrified.² The Biden campaign also set a goal that all new buses be zero emissions by 2030.³ The Administration must also commit to multipollutant standards under the Clean Air Act that ensure all new medium- and heavy-duty vehicles are zero-emitting. Protective standards must be paired with public and private investments in infrastructure and American manufacturing, vehicle purchase incentives and other policies that will ensure good-paying American jobs and a transition to zero emissions that is rapid, durable, and benefits all Americans. This report analyzes the important health and environmental benefits associated with medium- and heavy-duty pollution standards and supporting societal investments that achieve the above goals. Eliminating tailpipe pollution from these vehicles by 2040 would:

- Avoid 224 million metric tons of greenhouse gas (GHG) emissions every year by 2040 and eliminate more than 4.7 billion tons cumulatively by 2050.
- Significantly reduce ozone forming nitrogen oxides (NO_x) pollution by more than 450,000 tons and harmful particulate pollution by nearly 9,000 tons every year by 2040 – pollution that disproportionately impacts people of color and lower income neighborhoods.
- Prevent as many as 2,600 premature deaths and 140,000 lost workdays each year by 2040 and prevent as many as 57,000 premature deaths in total through 2050.
- Provide our nation with up to \$485 billion in health and environmental benefits alone as a result of pollution reductions.

Background



Manufacturers and fleets are **committing to a zero-emission future** and **investing billions of dollars** to bring ZEVs to market.

While passenger cars have been the proving ground for zero emission technologies, momentum is quickly building in the medium- and heavy-duty sector. These vehicles include last-mile delivery trucks, transit buses, short- and long-haul trucks and many other applications that help to deliver goods and services to Americans and power the economy. Manufacturers of these vehicles and the shippers and fleets that purchase them are committing to a zero-emission future and investing billions of dollars to bring ZEVs to market.

For example, Daimler announced a target that all new trucks and buses in North America will be carbon neutral by 2039 and has allocated \$85 billion toward the goal.⁴ And Volvo has said it will aim to go fossil free by 2040.⁵ Cummins will invest more than \$500 million into its Electrified Power technology, and, by 2050, has committed to powering its products using carbon neutral technologies that address air quality.⁶ General Motors, which recently announced plans to eliminate tailpipe pollution from its passenger cars by 2035, is working on clean technology for heavy-duty trucks and will reportedly provide fuel-cell technology for Navistar International Corp.⁷

Large fleets and shippers are also pledging to deploy zero emission trucks and buses as components of their sustainability initiatives. Walmart has committed to zero-carbon operations, including long-haul trucks, by 2040.⁸ Fed Ex announced that its entire global parcel pickup and delivery fleet will be zero-emitting electric vehicles by 2040.⁹ Amazon has ordered 100,000 all-electric delivery vans from EV startup Rivian, some of which have hit the road.¹⁰ And Ikea has committed to 100 percent ZEVs for deliveries and services by 2025.¹¹ An executive order from President Biden that directs all federal agencies to procure only ZEVs, including the United States Postal Service, will help to further spur uptake.¹²

These manufacturers and fleets are planning to develop and deploy a range of ZEV vehicle types including delivery vans, commuter buses, transit buses, garbage trucks and semi trucks. There are currently 40 medium-duty electrified models, 24 heavy-duty models, and over 40 bus models offered across a range of vehicle vocations, and this number will continue to grow in coming years.¹³ For instance, Ford, the world's largest manufacturer of cargo vans, announced a model year 2022 all electric cargo van for last-mile urban deliveries backed with a multi-billion dollar investment.¹⁴ General Motors also just launched BrightDrop, a new business that will produce the EV600, a zero emitting advanced freight vehicle for last mile delivery.¹⁵

These and other market segments are poised for swift electrification. For instance, there are already many zero-emitting transit buses in operation around the country. And most freight trucks used in local delivery applications do not travel more than 100 miles per day, and many zero-emission trucks and buses are commercially available today that exceed 100 miles of available range with forthcoming offerings that exceed 200 miles.¹⁶ Other vocational trucks have similar operating characteristics and are well suited for electrification. There are a number of zero emission regional haul trucks being commercialized over the next few years that industry leaders are

anticipating will comprise a significant percentage of the market over the next decade.¹⁷ Finally, several more battery-electric and hydrogen fuel cell models targeted for the long-haul market are expected to reach the market over the next few years.¹⁸



Compared with diesel, electricity reduces fuel costs an estimated 30-75%.

The rapid development of zero emission technology has brought the costs down considerably and this trend is projected to continue as the production of these technologies are scaled up. Numerous studies show that the total cost of ownership of certain battery electric trucks (transit and some urban delivery) are already competitive with their diesel counterparts today.¹⁹ E-buses in most charging configurations cost less than comparable diesel buses on a total-cost-of-ownership basis.²⁰ A recent study found that in nearly every vehicle case examined, including long-haul trucks, battery-electric trucks and buses will have a lower total cost of ownership than diesel vehicles when purchased within the next 10 years.²¹ The largest savings come from lower fuel costs due to vehicles' currently low fuel economy and often high mileage, specifically for long-haul trucks. Compared with diesel, electricity reduces fuel costs an estimated 30 to 75 percent, depending on vehicle efficiency and fuel prices.²²

The transition to medium- and heavy-duty ZEVs and related increase in manufacturing and charging infrastructure will create jobs. Navistar is investing \$250 million in a San Antonio plant that will produce both diesel and electric trucks, through which it expects to support 600 new jobs. It also announced a new facility outside of Detroit that will employ 50 eMobility specialists.²³ Tesla will invest \$1 billion to produce a range of EVs, including the Tesla Semi Truck at its next Gigafactory in Austin, TX – an effort that will support 5,000 new jobs.²⁴ Daimler Trucks North America expects to start production of the eCascadia and eM2 trucks in Portland, Oregon in 2022.²⁵

Increasing model availability and decreasing costs make zero emitting trucks a compelling path toward cleaner freight. But, as many groups have recognized, well-designed air pollution standards and incentives are critical to save lives from climate and air pollution and hasten ZEV deployment. For instance, the Moving Forward Network – a national coalition of community-based groups, national environmental organizations, and academic institutions, representing over 2 million members, and committed to resolving the public health harms created by our country's freight system and achieving environmental justice and climate justice – has asked that EPA “adopt regulations to reduce and eliminate emissions from the freight sector,” and “identify reducing freight-related air pollution as a top priority for the Agency.”²⁶ It is essential to ensure that environmental justice communities and leaders are thoroughly engaged – and heard – in shaping and designing these pollution standards.

Leading businesses have also recognized the importance of pollution standards and complementary policies in hastening ZEV deployment. For instance, the Zero Emission Transportation Association (ZETA) – a coalition of major businesses including electric vehicle manufacturers, power companies, and many others – has urged adoption of ambitious policies to support medium- and heavy-duty electrification, including multi pollutant

standards under the Clean Air Act.²⁷ The National Zero-Emission Truck (ZET) Coalition is a group of America’s biggest truck equipment manufacturers, suppliers and key stakeholders, such as Cummins, Daimler, PACCAR, Eaton, Tesla and Rivian, advocating for federal charging and refueling infrastructure and increased federal investments and incentive programs to help drive the near-term production of ZEV trucks and buses in the United States.²⁸

The European Automobile Manufacturers Association – which includes Scania, Daimler Truck AG, Ford Trucks and Volvo Group, among others – together with the Potsdam Institute for Climate Impact Research, has pledged that by 2040 all new commercial vehicles sold must be fossil free.²⁹

States are also taking the lead. California adopted the world’s first zero-emission truck rule, which will require manufacturers to start selling new heavy-duty ZEVs by 2024.³⁰ This landmark Advanced Clean Truck (ACT) rule is expected to prevent more than 900 premature deaths, save the state economy up to \$12 billion over the next 20 years and create thousands of new jobs by 2035.³¹ New Jersey recently announced plans to adopt California’s ACT rule.³² By subsequent Executive Order, California Governor Gavin Newsom directed the Air Resources Board to develop standards consistent with the goal that all medium and heavy-duty trucks operating in drayage applications in California are zero-emitting by 2035 and trucks operating across all applications are zero-emitting by 2045.³³

Fifteen other states and the District of Columbia recently launched a multi-state initiative to advance and accelerate the market for electric medium- and heavy-duty vehicles. The voluntary initiative set a target of 30 percent of new truck and bus sales being ZEV by 2030 and 100 percent ZEV sales by 2050 with an emphasis on the need to accelerate deployment in disadvantaged communities.³⁴ The agreement could result in an estimated reduction of up to 740 million barrels of oil by 2045, which is equivalent to more than 300 million metric tons of CO₂ pollution.³⁵



More than **20,000** Americans die prematurely every year as a result of the motor vehicle pollution on our roads and highways.

This progress, together with durable federal multipollutant emissions standards that accelerate zero emitting solutions for urban and community applications and ensure all new vehicles sold are zero emitting by 2040, will help cement a full transition to a zero-emitting medium- and heavy-duty fleet and extend the substantial health and economic benefits across the country.

Protecting the health of communities across the Nation

The health burden from truck and bus pollution is substantial, causing adverse health impacts in utero, in infants and children, and in adults and the elderly – with those who live closest to our nation’s roads and highways, ports, distribution centers, freight depots and other well-known sources of truck pollution facing the greatest harms.³⁶

Despite making up only about 4 percent of vehicles on the road,³⁷ the buses, trucks and tractor trailers that distribute our people and goods are the largest contributor to ozone-forming oxides of nitrogen (NO_x) emissions and health-

harming fine particulates from all highway vehicles and will be one of the largest mobile source contributors to ozone in 2025.³⁸ They are also responsible for more than 420 million tons of climate pollution – more than the entire country of Australia.³⁹

More than 20,000 Americans die prematurely every year as a result of the pollution from our highway vehicles.⁴⁰ But air pollution varies dramatically within cities and neighborhoods, with the health burden having a greater impact on people of color and lower income households. A recent report by Moving Forward Network found that, on average, Asian and Black Americans are exposed to PM2.5 pollution that is 56 and 44 percent higher, respectively, than white Americans.⁴¹



Air pollution varies dramatically within cities and neighborhoods, with the health burden disproportionately impacting people of color and lower income families.

People who drive or ride on buses also face an elevated risk due to their close proximity to tailpipe emissions. Prior to the COVID-19 pandemic, there were nearly half a million school buses in the United States, traveling a total of 3.4 billion miles per year to transport 25 million children every school day.⁴² And there are typically thousands of public transit buses that collectively travel more than 2 billion miles annually.⁴³ Lower income households and communities of color disproportionate rely on these school and public transit buses.

Commercial diesel trucks take an especially heavy toll on neighborhoods along their routes. A study in Oakland, California found that transportation-related air pollution (black carbon and NOx) was much higher (in some cases double) on a freeway that is a designated truck route (I-880) compared to another freeway in the same city where trucks are prohibited (I-580).⁴⁴ Another study near the Port of Oakland also found that black carbon levels measured along truck routes were higher compared to measurements at most other sites, including those near industrial facilities, other highways and on residential streets.⁴⁵

Warehouses and distribution centers where trucks pull in and out, and often idle, are also concentrated sources of risk. And many discriminatory policies have led to the siting of these facilities near communities of color who face higher rates of underlying health conditions as a result of the cumulative burden from air pollution and other factors.⁴⁶ In Houston's Fifth Ward, diesel trucks that come and go from the cluster of metal recyclers and concrete processing plants, drive up ambient nitrogen dioxide (NO₂) levels by 48 percent relative to the rest of the city. Residents are largely people of color (more than 90 percent), 40 percent live below the federal poverty line and life expectancy is almost a decade lower than the rest of the region (69 compared to 78 years).⁴⁷

The actual health burden from truck pollution may be larger still, as analyses often do not account for the potential impact from after-market defeat devices on medium- and heavy-duty trucks. The EPA believes the use of aftermarket defeat devices “occurs within most or all categories of vehicles and engines, including commercial trucks...”⁴⁸ A zero-emitting truck and bus fleet would avoid this problem of emission control tampering.



A shift to electrification and zero emitting vehicles is one of the most important steps our nation can take to alleviate the enormous health burden on communities across the country.

A shift to zero emitting medium- and heavy-duty vehicles – including rapid deployment in communities long overburdened by this pollution – is one of the most important steps our nation can take to save lives and bring cleaner air to neighborhoods across the nation.

National pollution standards must achieve 100% new ZEV sales for all trucks and buses no later than 2040 with accelerated deployment in urban and community applications by 2035

This report examines the climate, air pollution, health benefits and monetized impacts that would result from eliminating pollution from new medium- and heavy-duty vehicles, from urban applications to long-haul trucks, by 2040. To achieve these goals, the analysis assumes that 100 percent of new transit and school buses will be ZEVs by 2030. We assume 30 percent of other new buses and trucks will be ZEVs by 2030, growing to 100 percent by 2040. The analysis assumes the vast majority of ZEVs are battery electric vehicles (BEVs) with the sale of hydrogen fuel cell vehicles (FCVs) growing slowly over time as a percentage of ZEV sales, reaching 2.5 percent of school and transit buses, 10 percent of single unit trucks and 20 percent of combination trucks in 2030 and increasing to 30 percent of new combination truck sales in 2050. These assumed percentages are meant to illustrate the magnitude of benefits associated with eliminating pollution from medium- and heavy-duty vehicles by 2040 but not to suggest particular regulatory pathways for doing so.

The analysis estimates these impacts against a baseline that uses Annual Energy Outlook (AEO) 2020 vehicle fleet and vehicles miles traveled (VMT) assumptions, adjusted based on the assumption that the California Advanced Clean Truck Rule and existing fleet commitments will result in 250,000 in-use heavy-duty ZEVs in 2030 and 1.7 million ZEVs on the road by 2050. Our analysis also assumes that the electricity grid will be 100 percent renewable by 2035, consistent with commitments by the Biden administration under both baseline and ZEV scenarios.⁴⁹

The methodologies underpinning this analysis are generally consistent with previous analyses conducted by the U.S. Environmental Protection Agency (EPA) in these areas, such as those used in its original Proposed and Final Determinations regarding the 2022-2025 GHG standards for cars and light trucks.⁵⁰ New vehicle sales, scrappage, use and associated emissions (GHG, NOx, and PM) were projected using the State Emissions Pathway (STEP) model developed by M.J. Bradley and Associates and ERM Group Company.⁵¹



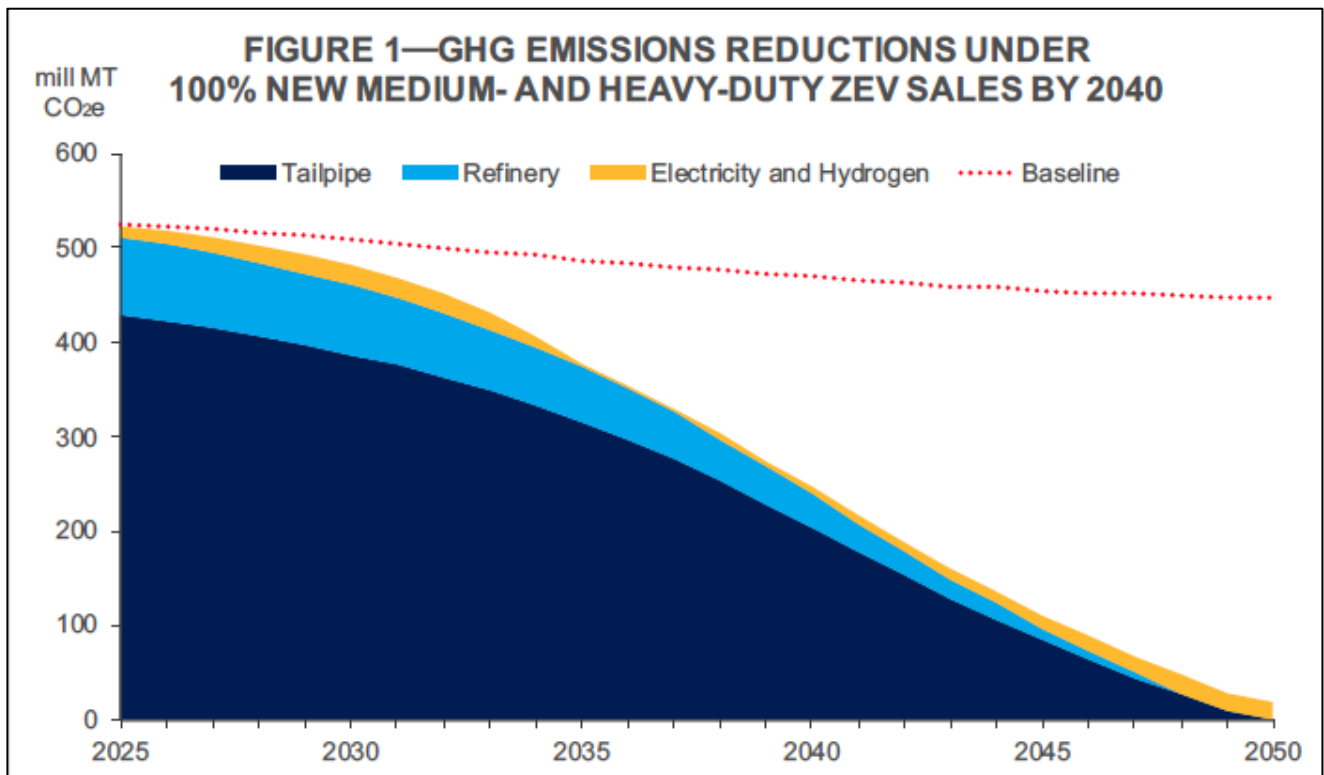
The standards would essentially **eliminate** all harmful tailpipe emissions from the heavy-duty fleet by **2050**.

National pollution standards that achieve 100% new medium- and heavy-duty ZEV sales by 2040 will reduce greenhouse gases by billions of tons

National pollution standards for new medium- and heavy-duty vehicles will deliver significant climate and health benefits by reducing greenhouse gas and other harmful air pollutants, including CO₂, NO_x, particulates, air toxics and other health-harming pollutants. And these reductions will begin long before the standards are fully phased in.

Multipollutant standards have the potential to reduce 110 million metric tons of GHG emissions annually in 2035, doubling to 224 million tons in 2040 and doubling again to more than 428 million tons every year by 2050, relative to no federal action. Between now and 2050, the standards will eliminate more than 4.7 billion tons of GHG emissions in total.

As shown in Figure 1, standards that achieve 100 percent new ZEV sales by 2040 would eliminate tailpipe CO₂ emissions from the heavy-duty fleet by 2050 – one of the biggest contributors to the nation’s GHG inventory.



National pollution standards that achieve 100% new medium- and heavy-duty ZEV sales by 2040 will significantly reduce health-harming pollution – especially in communities that disproportionately bear the burden of this pollution



The standards will secure cumulative NO_x emissions reductions of more than **10 million tons** by 2050.

The nation will also see a significant reduction in health-harming particulates and ground level ozone-forming pollution, especially in communities near busy truck routes.

As Figure 2 shows, well-designed climate and air pollution standards that save lives by relying on the availability of 100% new ZEV sales by 2040 would eliminate tailpipe NO_x emissions by 2050. They would reduce NO_x emissions by 222,000 tons per year in 2035, 453,000 tons by 2040 and 887,000 tons annually by 2050 – roughly equivalent to the annual NO_x emissions from all of today's power plants.⁵² In total, the standards would reduce more than 10 million tons of NO_x by 2050. NO_x contributes to the formation of fine particles (PM_{2.5}) and ground level ozone, both of which are associated with adverse health effects, including premature death.⁵³

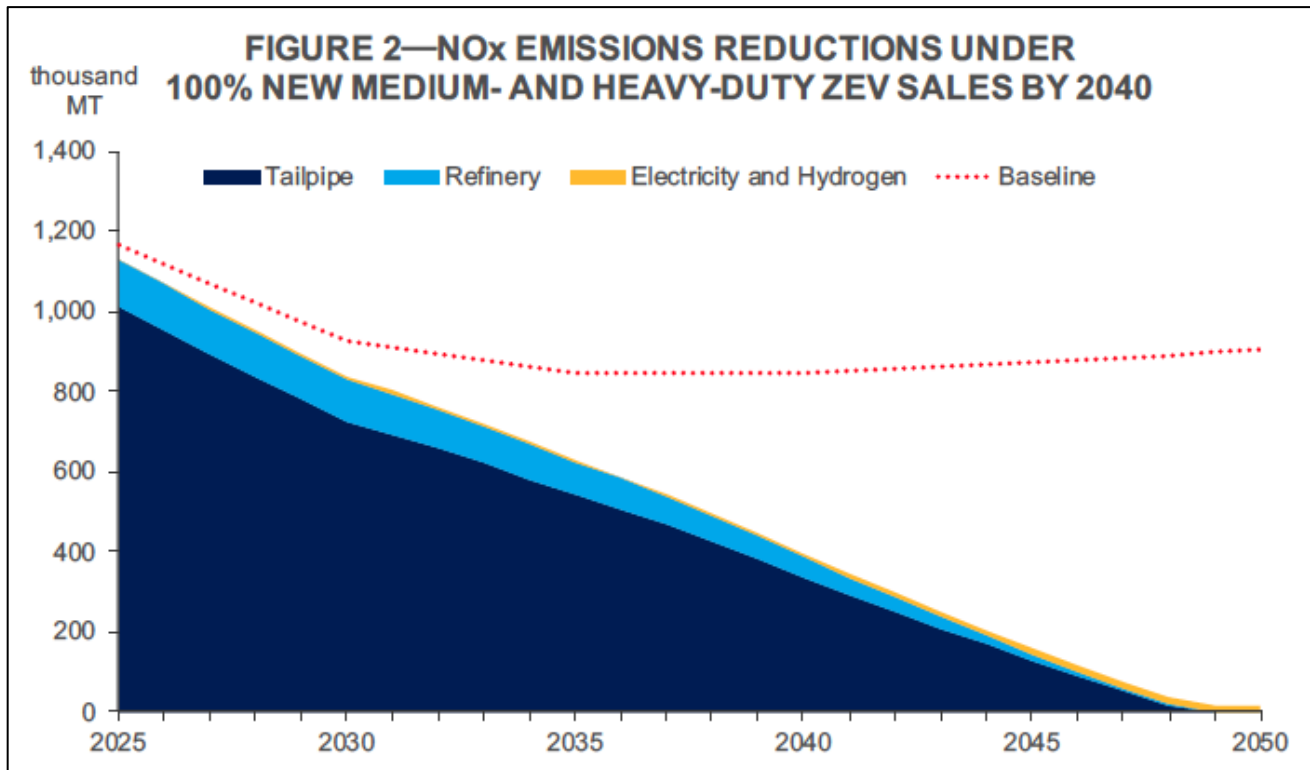
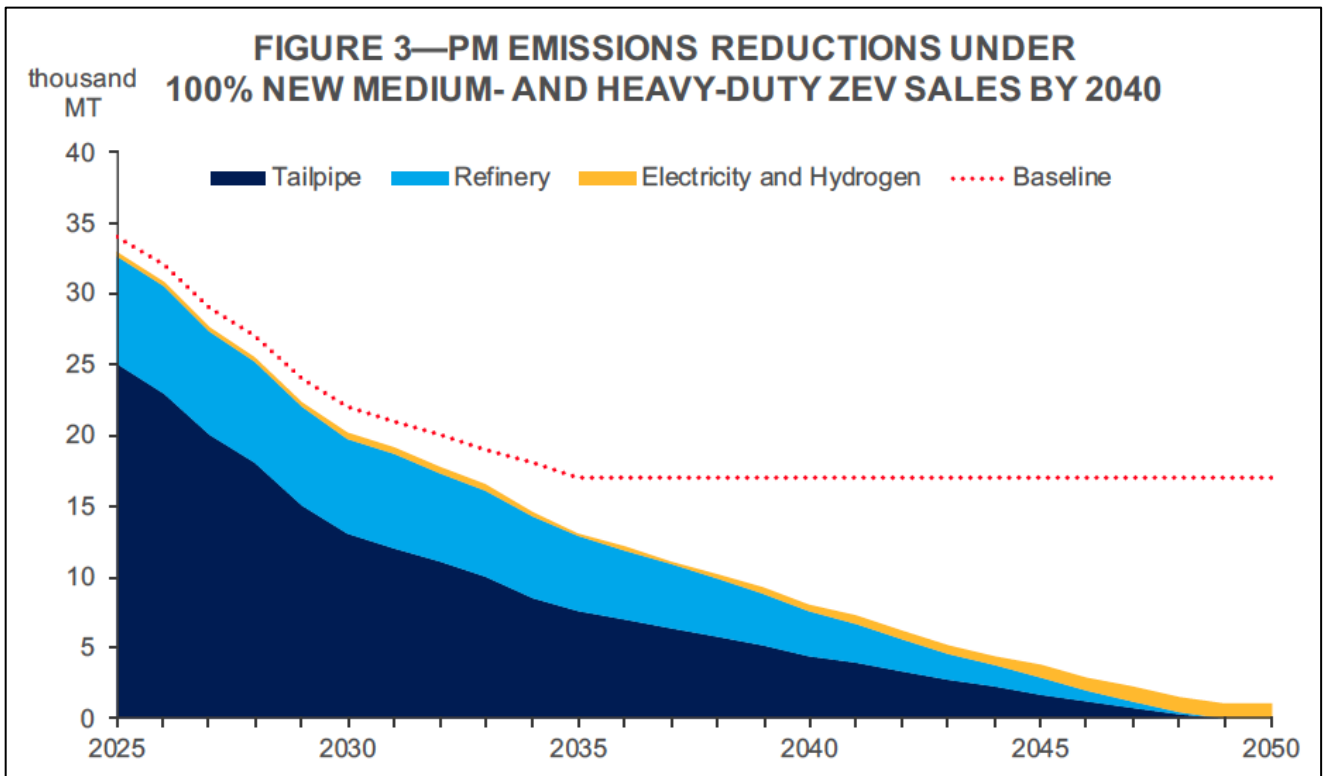


Figure 3 shows that health-harming particulate pollution will also be eliminated from the medium- and-heavy-duty fleet before 2050. The transition to ZEVs will reduce PM pollution by more than 4,000 tons every year by 2035, nearly 9,000 tons yearly by 2040 and 16,000 tons each year by 2050. The cumulative reduction by 2050 will reach nearly 200,000 tons.

Multipollutant medium- and heavy-duty standards would also reduce sulfur oxides (SO_x), which contribute to particulate formation, by a total of more than 200,000 tons between now and 2050. Volatile organic compounds (VOCs) and toxic benzene would also be significantly reduced.



We translated these pollution reductions into health benefits using EPA’s Benefit per Ton screening and mapping tool.⁵⁴ Table 1 shows that the medium- and heavy-duty pollution standards would result in an estimated 1,157 – 2,613 fewer premature deaths and nearly 140,000 fewer lost workdays each year by 2040. By 2050, a total of 57,214 fewer Americans will have died prematurely.

TABLE 1: 100% NEW MEDIUM- AND HEAVY-DUTY ZEV SALES BY 2040 YIELD SIGNIFICANT REDUCTIONS IN HEALTH IMPACTS

INCIDENCES	2030	2040	2050	TOTAL THRU 2050
PREMATURE MORTALITY	180 – 417	1,157 – 2,613	2,168 – 4,892	25,295 – 57,214
WORK LOSS DAYS	22,670	137,186	255,870	3,005,846
RESPIRATORY SYMPTOMS	8,204	49,574	92,475	1,086,289
ASTHMA EXACERBATION	5,625	34,087	63,639	746,985
ACUTE BRONCHITIS	412	2,328	4,177	50,356
HEART ATTACKS	204	1,312	2,456	28,676
EMERGENCY ROOM VISITS OR HOSPITAL ADMISSIONS	187	1,181	2,210	25,854

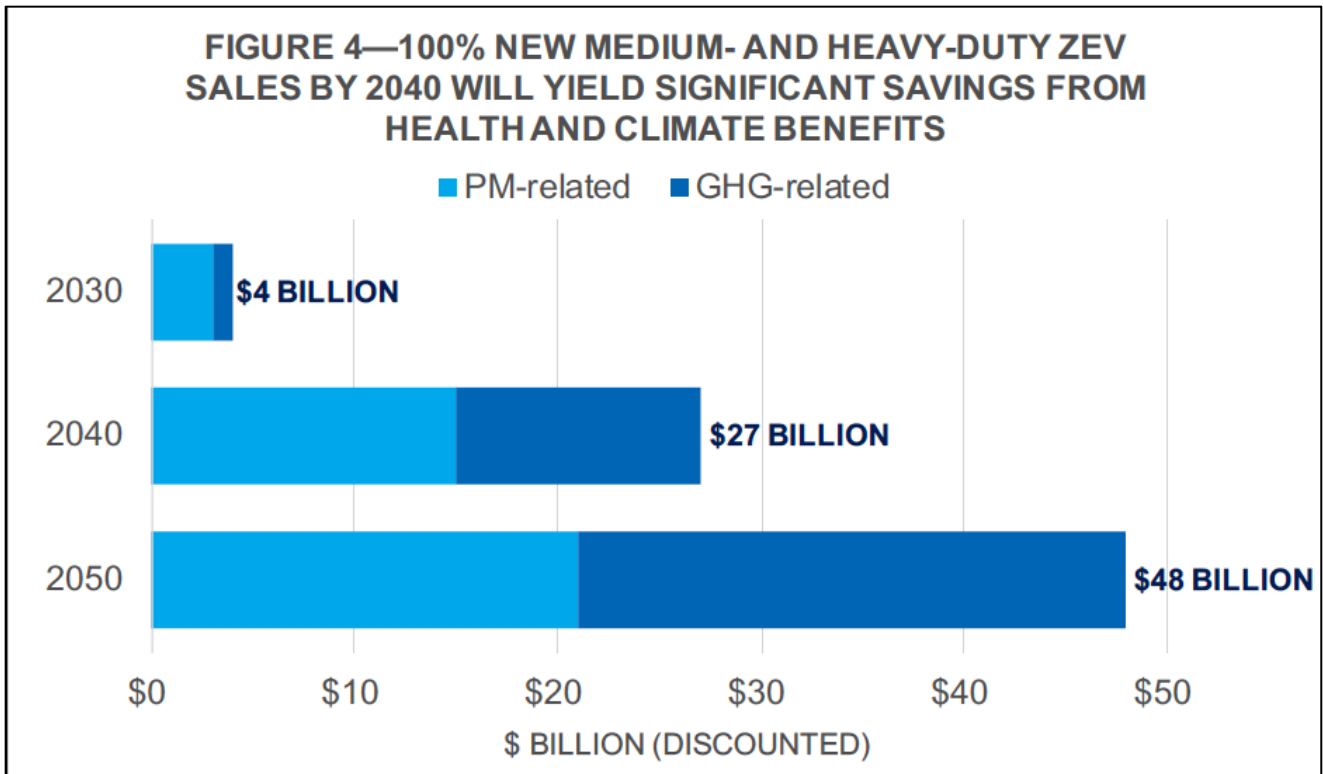
All of these health impacts are due to changes in ambient fine particulate matter levels and do not include the substantial additional benefits that would result from reduced ozone or GHGs, which would further enhance the program’s health benefits.

National pollution standards that achieve 100% new medium- and heavy-duty ZEVs sales by 2040 will deliver massive pollution-related economic benefits

To evaluate the economic impacts of eliminating pollution from new vehicles sold by 2040, we monetized the benefits of the GHG emissions reductions and ambient PM-related health benefits to society.⁵⁵ Figure 4 summarizes the substantial aggregate benefits to the nation, relative to no federal action. The annual benefits are an estimated \$4 billion in 2030 – long before the standards are fully in effect – and jump to as high as \$27 billion in 2040 and \$48 billion in 2050. The cumulative pollution-related savings to the United States as a result of federal standards that ensure new ZEV sales would reach \$485 billion by 2050.



Cumulative pollution-related savings to the United States would reach **\$485 billion by 2050.**



Conclusion

Air pollution standards that ensure new zero-emitting medium- and heavy-duty vehicles are deployed swiftly in urban and community applications by 2035 and that *all* new medium- and heavy-duty trucks and buses sold by 2040 are zero-emitting would have substantial benefits for all Americans. These standards would avoid 224 million metric tons of greenhouse gas emissions every year by 2040 and a total of more than 4.7 billion tons by 2050. They would likewise significantly reduce ozone forming pollution and harmful particulate pollution that disproportionately burdens people of color and lower income communities. The standards would avoid as many as 2,600 premature deaths and 140,000 lost workdays each year in 2040 and prevent more than 57,000 premature deaths in total by 2050. Adopting national multipollutant standards would save Americans up to \$27 billion annually by 2040 in pollution benefits and \$485 billion cumulatively by 2050.

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- ⁴⁹ Grid emissions through 2025 are based on GREET2020 projections. Emissions after 2025 decline linearly until reaching zero in 2035. The benefits of medium- and heavy-duty standards would be substantial even if the transition to 100 percent renewable electrical grid takes until 2050. For example, emission reductions through 2050 would only be reduced by 1% for GHGs, 0.1% for NOx and 0.4% for PM. Likewise, the impacts on pre-mature mortality and monetized health and welfare benefits would only decrease by 1%.

⁵⁰ U.S. EPA. 2019. Final Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation, EPA-420-R-17-001. U.S. EPA. 2016. Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation, EPA-420-R-16-020.

⁵¹ Inputs to this model are based on data and projections contained in the ORNL Transportation Energy Book, EPA's MOVES model and EIA's AEO2020 analysis. We added projections of SO_x emissions to the GHG, NO_x and PM emission projections made by M.J. Bradley & Associates. Vehicular SO_x emissions were based on the sulfur standards for gasoline and diesel fuel of 10 ppm. Upstream SO_x emissions for gasoline, diesel fuel, electricity and hydrogen were taken from GREET2020, with SO_x emissions from electricity generation adjusted as previously described.

⁵² <https://www.epa.gov/airmarkets/power-plant-emission-trends>

⁵³ Health Effects Institute. 2019. State of Global Air 2019.

https://www.stateofglobalair.org/sites/default/files/soga_2019_usa.pdf

⁵⁴ <https://www.epa.gov/benmap/estimating-benefit-ton-reducing-pm25-precursors-17-sectors>

⁵⁵ CO₂ was valued at \$48 per metric ton in 2021, increasing in real terms by roughly 2% per year. See EPA, Technical Support Document, Estimating the Benefit per Ton of Reducing PM_{2.5} Precursors from 17 Sectors, February 2018. <https://www.epa.gov/benmap/estimating-benefit-ton-reducing-pm25-precursors-17-sectors>