VOLKSWAGEN SETTLEMENT

BENEFICIARY MITIGATION PLAN TOOLKIT

NASEO
National Association of State Energy Officials

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Introduction

This toolkit is a resource for State Energy Offices, State Environmental Agencies, and others to use as they develop their beneficiary mitigation plans under the environmental mitigation trust. The report provides an overview of the portions of the settlement that are relevant to states; highlights plan considerations for beneficiaries, various repower and replacement options, and tools that states can use to calculate NOx and other emissions reductions; and summarizes each eligible mitigation action, provides estimates of expected NO_X reductions, and showcases successful implementation of technologies.

Settlement Summary

States, Puerto Rico, the District of Columbia and tribes will receive $2.7 billion from Volkswagen AG's (VW) historic settlement with United States Environmental Protection Agency (U.S. EPA) to support projects that reduce nitrogen oxide (NO_X) emissions from the transportation sector. To administer these funds, an "environmental mitigation trust" will be established, and states that wish to access their allocated portion of the funds will apply to become beneficiaries of the trust. Beneficiaries will develop a "beneficiary mitigation plan" that provides a high-level summary of how they intend to spend their allocated funds. The settlement provides detailed information on the types of projects states can undertake (known as "eligible mitigation actions"), which will allow states to repower or replace vehicles, develop shore power for ports, build out electric vehicle charging station infrastructure, and expand other emissions-reducing programs. How each state will choose to invest its funds will be determined by state air, energy and climate goals, existing infrastructure, expected emissions reductions benefits, and many other variables. While the environmental mitigation trust's chief aim is to reduce NOx emissions in the transportation sector, states have a unique opportunity to invest in forward-thinking projects that have the potential to transform markets and achieve significant gains.

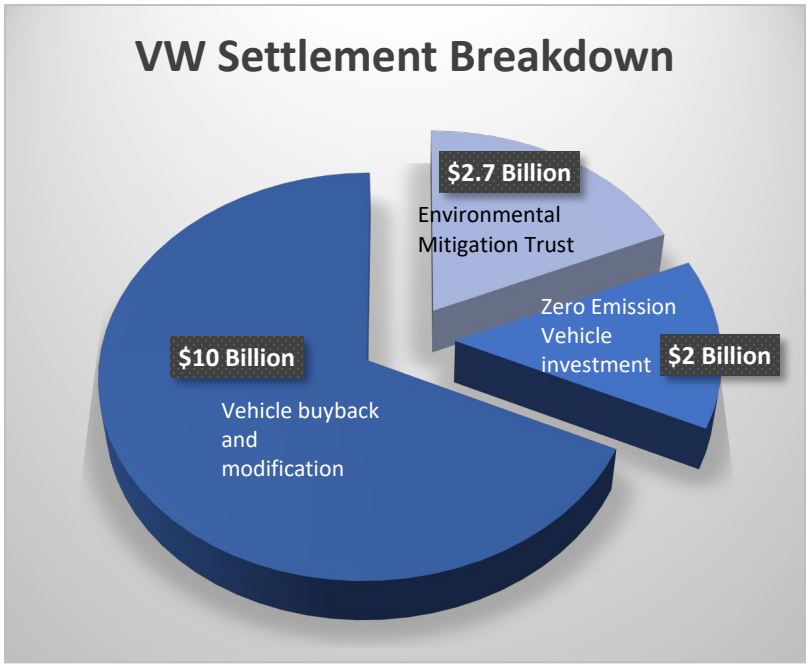
Background

In June, 2016, the U.S. Department of Justice issued a partial consent decree settling claims by the U.S. EPA and the Federal Trade Commission against German automaker, Volkswagen AG (VW). The civil complaint filed against Volkswagen claimed that the automaker installed software in its 2.0 liter diesel engine vehicles to disable emission controls under normal use and to turn on emission controls only when the vehicle was being tested.[1] This "defeat device" resulted in better real world fuel mileage and driving performance, but also resulted in the release of thousands of tons of NO_X emissions in excess of regulated limits.[2] The VW emissions control problem was identified and flagged by researchers at West Virginia University who were funded by the International Council on Clean Transportation. The researchers conducted on-road testing of VW models equipped with 2.0 liter turbocharged 4-cylinder diesel engine in May 2014. The testing revealed that average emissions in on-road testing exceeded federal NO_x limits by between 9 and 38 times the U.S. limit depending on driving conditions[3] which is roughly equivalent to real-world emissions from a modern tractor-trailer truck.[4]

Volkswagen agreed to spend $14.7 billion to settle allegations of cheating emissions. The settlement is divided into three distinct parts as illustrated in Figure 1. Ten billion dollars of the settlement money will be used to buy back or modify diesel vehicles from consumers. Modifications are expected to be proposed as they are developed, and will be approved by the U.S. EPA and California Air Resources

Board. The second requirement of the settlement is that VW must create a National Zero Emission Vehicle (ZEV) Investment Plan and spend $2 billion on ZEV infrastructure and programs and brand-neutral media activities aimed at increasing public awareness of zero emission vehicles. The amount will be divided between California ($800 million) and the rest of the U.S. ($1.2 billion).

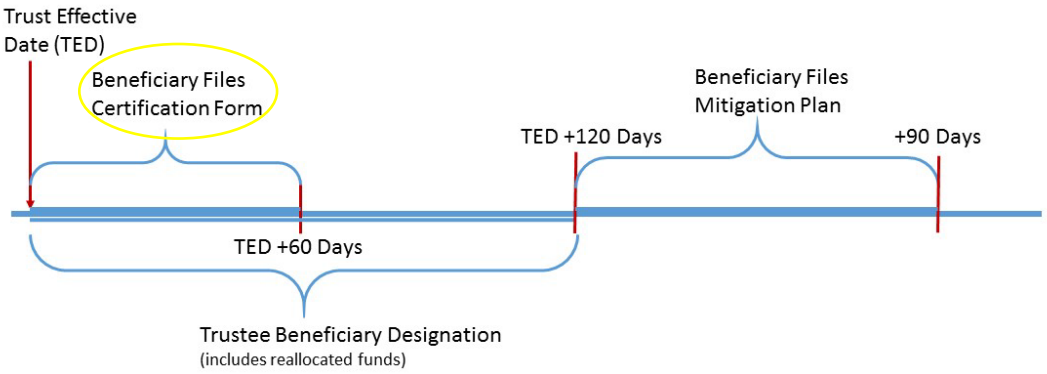
Figure 1: VW Settlement Breakdown



The third component of the settlement and the focus of this guide is the environmental mitigation trust. To mitigate environmental damages from violating the Clean Air Act, the settlement requires VW to invest $2.7 billion in an independently-administered environmental mitigation trust, which will fund projects to reduce diesel emissions. States, tribes, Puerto Rico, and the District of Columbia have been allocated a portion of the trust (based on the number of affected vehicles in their jurisdiction), and must file as "beneficiaries" to receive their allocations. The list of initial allocations for the 2.0 liter settlement can be found in Appendix D-1 of the amended 2.0 Liter Partial Consent Decree, and is also listed in Appendix 2 of this document. Appendix 2 of this document also lists additional funds that will be added to the trust from the VW 3.0 liter engine settlement as outlined in the Second Partial Consent Decree.[5]

Beneficiary Requirements

Once the environmental mitigation trust is established (known as the "trust effective date"), each state and territory may elect to become a beneficiary by filing a "Certification for Beneficiary Status Under Environmental Mitigation Trust Agreement" (known as the "Certification Form") with the Trustee. Prior to submitting the Certification Form, the Governor's office must appoint a lead agency and ensure compliance with all requirements outlined in the form. The Certification Form can be found as Appendix D-3 of the final consent decree, and is also included in Appendix 3 of this document. ***This form must be filed within 60 days of the trust effective date.***



After a state has filed its certification form, the trustee will approve or deny beneficiary status. Once a state has been designated a beneficiary, they have 90 days to submit a "beneficiary mitigation plan." This plan is non-binding, but its purpose is to provide the public with a general sense of how the beneficiary intends to spend their allocated funds. It must be made publicly available and should summarize the following[6]:

1. The beneficiary's overall goal for the use of the funds.
2. The categories of eligible mitigation actions the beneficiary anticipates will be appropriate to achieve the stated goals and the preliminary assessment of the percentages of funds anticipated to be used for each type of eligible mitigation action.
3. A description of how the beneficiary will consider the potential beneficial impact of the selected eligible mitigation actions on air quality in areas that bear a disproportionate share of the air pollution burden within its jurisdiction.
4. A general description of the expected ranges of emission benefits the beneficiary estimates would be realized by implementation of the eligible mitigation actions identified in the beneficiary mitigation plan.
5. An explanation of the process by which the beneficiary shall seek and consider public input on its beneficiary mitigation plan.

If a beneficiary chooses to use the Diesel Emission Reduction Act (DERA) option for mitigation, it may use its final Approved DERA Workplan as its beneficiary mitigation plan. Beneficiaries may adjust their goals and specific spending plans at their discretion and, if they do so, shall provide the trustee with updates to their beneficiary mitigation plan. A timeline for the environmental mitigation trust is included in Figure 2.

Beneficiaries may use up to 15 percent of their allocated trust funds for administrative expenditures associated with implementing the eligible mitigation actions. This amount includes the total aggregated amount of administrative expenditures incurred by the beneficiary and any third-party contractors. Administrative expenditures are described in detail in the Consent Decree.[7]

The DERA Option

The Diesel Emission Reduction Act (DERA) provides funding for projects that reduce emissions from existing diesel engines. Under the VW Settlement, beneficiaries may use the "DERA Option" to leverage additional funding and support projects that are not specifically enumerated in the Consent Decree.

Figure 2: Environmental Mitigation Trust Timeline

VW Environmental Mitigation Trust Timing		
Timing	**Estimated Date**	**Consent Decree Milestone**
Settlement Effective Date (SED)	October 25, 2016	Consent Decree entered into court
SED + 30 Days	November 24, 2016	Trustee candidates submitted
Trust Effective Date (TED)	Spring-Summer, 2017	Establishment of Environmental Trust
TED + 15 days		Trustee established trust account
TED + 60 days		Governmental entities file Certification Forms
TED + 120 days (note: proposed consent decree includes the phrase "no later than," so the Trustee may grant Beneficiary status sooner than 120 days)		Trustee approves /denies Beneficiary status
TED + 210 days (not later than 90 days after being deemed a Beneficiary)		Beneficiary Mitigation Plan submitted

Plan Considerations for Beneficiaries: Goals and Policy Objectives

While the primary goal of the environmental mitigation trust is to reduce NO_X emissions, beneficiaries may choose to consider how environmental mitigation trust funds could help achieve additional goals and policies related to economic development, health, fuel security, greenhouse gas emissions, energy, renewable portfolio standards, and benefits to vulnerable populations. The following section provides an overview of NO_X emissions and impacts, as well as a summary of other policy goals that may be addressed through the environmental mitigation trust.

NO_X Emissions

NO_X represents a family of seven compounds, one of which (NO_2) is regulated by the EPA as a proxy for all of the NO_X compounds. Nitric oxide (NO) and nitrogen dioxide (NO_2) are the most significant forms of NOx released by combustion processes, including diesel engines. NO_X reacts with carbon monoxide (CO) and Volatile Organic Compounds (VOCs) in sunlight to form tropospheric or ground-level ozone, the major component of smog, which is a significant air pollution problem in the United States.[8]

Ozone is linked to health effects including asthma, respiratory system irritation, allergen sensitivity, respiratory infections and premature death. Particulate matter emissions, especially fine particulates

that can more deeply penetrate lungs, from diesel emissions and other sources is also linked to serious health risks and has a causal relationship with cardiovascular effects, respiratory effects, and mortality.[9] Peer-reviewed research estimates that over the sales period of the 2.0 liter vehicles installed with defeat devices, 59 deaths will be caused in the United States by the excess emissions from the vehicles.[10]

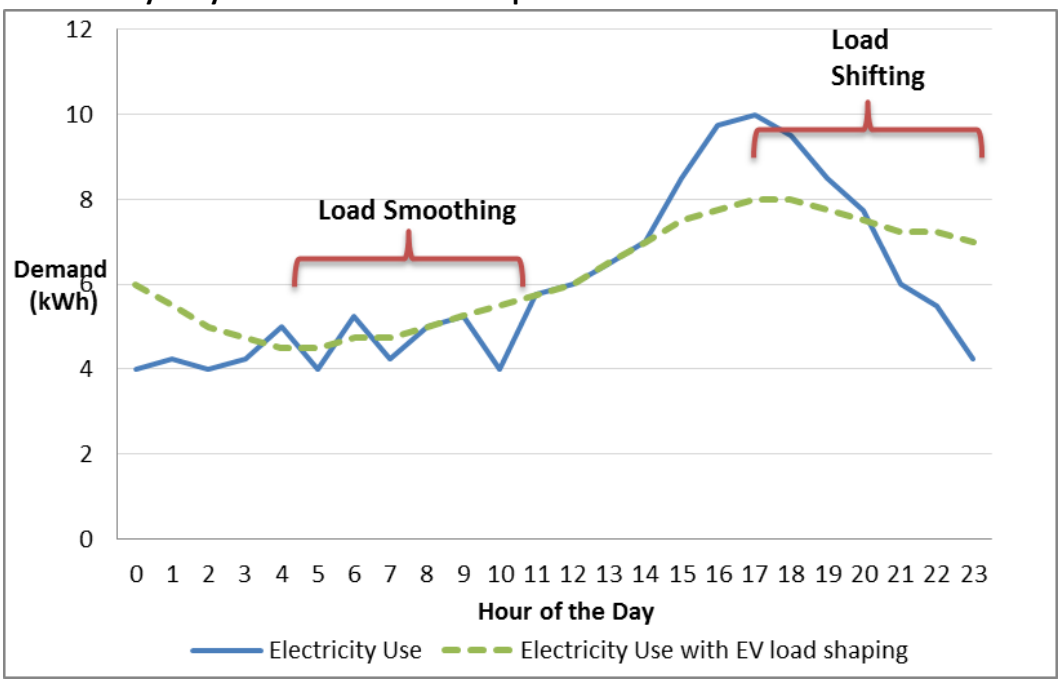
In addition to health risks, NO_X poses other significant environmental risks contributing to acid precipitation that can damage forests, crops, and waterways,[11] and the deposition of excess nutrients to lakes, ponds, and coastal waters that contributes to algal blooms, damage to fish and shellfish, and other impacts of eutrophication of lakes, ponds, and coastal waterways.[12] Mobile sources (including diesel and gasoline vehicles) are currently the largest source of NO_X emissions. Reducing the use of petroleum-based fuels in transportation (particularly in heavy duty vehicles which disproportionately contribute to emissions)[13] is an important mechanism to reduce NO_X emissions.

Greenhouse Gas Emission Goals and Renewable Portfolio Standards

States have an opportunity to use environmental mitigation trust funds to support projects that help achieve other air quality and environmental goals. Twenty states currently have greenhouse gas (GHG) emissions targets,[14] and twenty-nine states, the District of Columbia and three territories currently have Renewable Portfolio Standards (RPS).[15] Factoring in these targets when developing a plan based on eligible mitigation actions will leverage mitigation trust funds into increased opportunity to reach these GHG emission and renewables goals.

Of the alternative fuel options eligible under the settlement, electric vehicles (EVs) offer the unique ability to support renewable integration with the electric grid, which could help support RPS and similar goals or targets (Figure 3). The flexibility of EV charging creates the opportunity to absorb excess intermittent generation, such as that from renewably generated wind and solar power. Certain technologies, like electric school buses, offer a good fit with solar generation. Buses can charge using solar power during the day when the resource is abundant between delivering students on the morning and afternoon runs. If necessary, they can charge again at night, when electricity use among other customers is at its lowest and available electricity is abundant. EVs can also offer the opportunity for supporting the evolution of a more dynamic, smarter grid not only by being able to charge when lower cost electricity is available, but also by feeding power back to the grid to provide valuable ancillary services of voltage and frequency regulation.[16]

Figure 3: How Heavy Duty Electric Vehicles can Impact the Electric Grid



In addition, by incentivizing EV charging during off-peak hours, utilities can save money by securing energy at lower costs. Many of the vehicles included in the eligible mitigation actions such as delivery trucks, transit buses, and school buses have very predictable, fixed use cases. These vehicles mainly operate during the day and charge at night, when electricity is least expensive and most abundant.

While electricity is one option to support air and environmental goals, other fuels, such as renewable natural gas and renewable diesel, also offer renewable options. Renewable diesel differs from biodiesel in that it is produced through a different process (hydrogenation instead of esterification).[17] Even though renewable diesel comes from bio-feedstock sources, such as vegetable and animal fats, chemically it is identical to petroluem diesel and can be used in existing diesel engines. In 2015, San Francisco transitioned its entire fleet of diesel vehicles (1966 vehicles) including public transportation and service vehicles such as ambulances and fire trucks to renewable diesel fuel. [18]

RNG, or biomethane, is a gas resulting from the decomposition of organic matter. It can be produced through a number of mechanisms including landfills, livestock operations, and wastewater treatment. With minor refining, it can be used for heating and electricity generation and must be processed to a higher level of purity for transportation use. Once it reaches this level of purity, it is fully interchangeable with pipeline natural gas. RNG qualifies as an advanced biofuel under the Renewable Fuel Standard which requires that it must demonstrate a life-cycle GHG emissions reduction of at least 60 percent over petroleum-based fuels they replace.[19] According to NGV America, RNG provides well-to-wheels reductions relative to diesel fuel of 80 percent or more.[20] Today, biomethane is the number one selling cellulosic fuel sold under the Renewable Fuel Standard Program and accounts between 20 and 30 percent of natural gas used in natural gas vehicles.

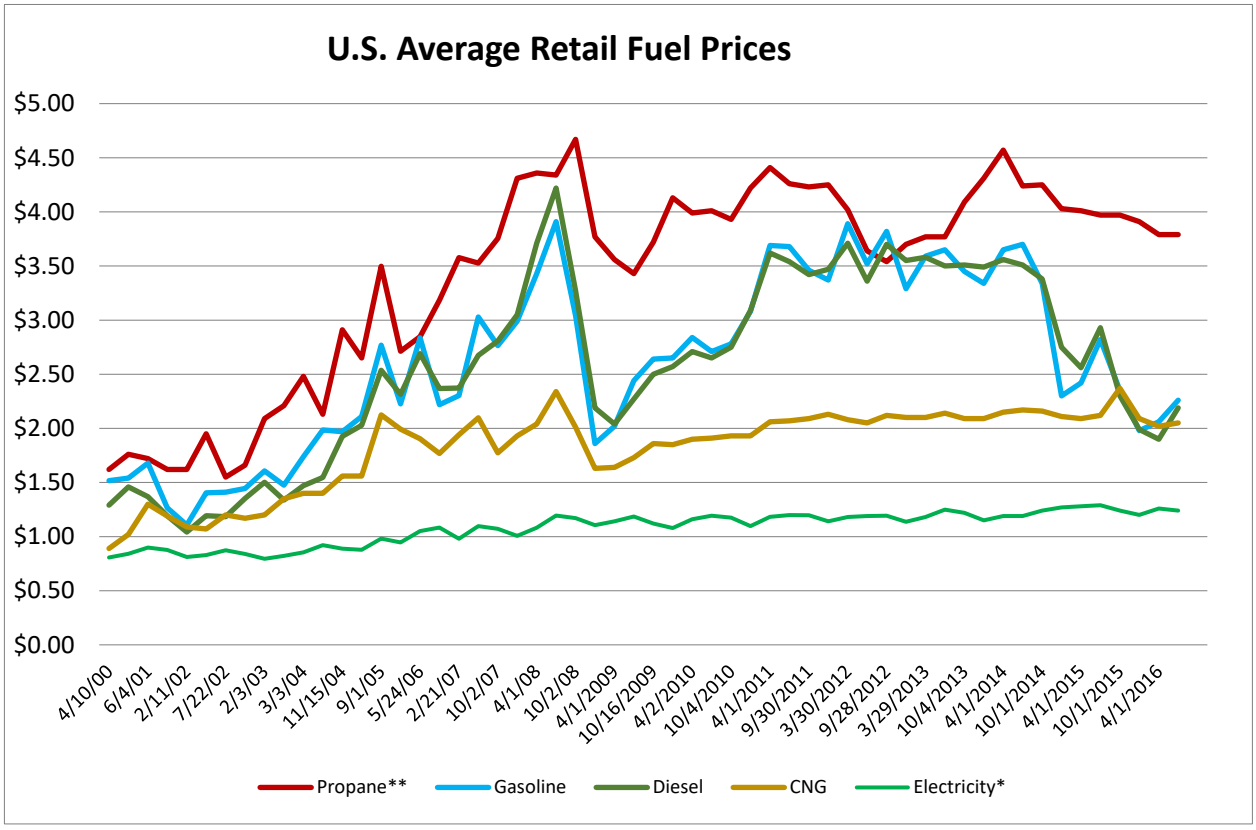
Fuel Security, Energy Assurance, and Economic Benefits

In addition to reducing NO_X emissions, projects funded through the environmental mitigation trust can help states tap into greater fuel security, energy assurance, and economic benefits. Choosing to

repower or replace vehicles with those that rely on domestically sourced energy has the potential to increase U.S. fuel security by reducing the nation's dependence on foreign fuels and becoming independent of the global oil market. In addition to the costs of military operations necessary to secure oil, U.S. demand for oil increases world oil prices and puts the U.S. economy at risk from oil price and supply volatility (macroeconomic disruption and adjustment costs). In 2014, about 27 percent of the petroleum used in the United States was imported. Diversifying transportation fuels in the United States to include more non-petroleum domestic fuels helps the United States reduce reliance on petroleum reserves located in politically volatile countries and separate from the global oil market.[21]

Environmental mitigation trust projects can result in economic benefits as well. By repowering or replacing older diesel vehicles with clean diesel vehicles or vehicles that use a domestically sourced fuel such as electricity, propane (which can be a by-product of natural gas processing), or natural gas, states can ensure that more money will remain in their local economy creating more local jobs. Fuel price stability should also be taken into account (Figure 4). Heavy Duty vehicle repairs and replacements are long term investments and choosing a fuel type commits the fleet owner to purchase the selected fuel for a decade or more. Volatile fuel prices are difficult to budget for and may cost more in the long run. Finally, when making purchase decisions, states and fleets may take into account total cost of ownership. Purchasing vehicles with a lower initial purchase price may seem like a good way to make these most of these mitigation funds, but may end up costing more over the life of the vehicle. For government-owned vehicles, fuel and maintenance costs are passed onto taxpayers for the life of the vehicle.

Figure 4: U.S. Average Retail Fuel Prices[22,23]



Health Impacts

Each of the ten eligible mitigation actions has the potential to result in significant positive health impacts. Diesel exhaust is classified as a Group 1 Carcinogen by the International Agency for Research on Cancer (IARC),[24] which is part of the World Health Organization. This means that there is sufficient evidence to conclude that exposure to diesel engine exhaust is associated with an increased risk of lung cancer in humans.[25] A study by the California Environmental Protection Agency's Office of Health Hazard Assessment found that long-term exposure to diesel exhaust poses the highest cancer risk of any toxic air contaminant it evaluated.[26] In addition to cancer, fine particle pollution from diesel exhaust has a causal relationship to cardiovascular harm, respiratory harm, and early mortality.[27]

Researchers from Massachusetts Institute of Technology estimate that $PM_{2.5}$ from on-road pollution causes 52,800 premature deaths in the United States each year.[28] The people most susceptible to pollution-related health problems include children, the elderly, those with preexisting respiratory conditions, and low income populations. While the mitigation trust is focused on reducing NOx emissions, states may choose to take into account health impacts from other air pollutants. Particulate matter (PM_{10} and $PM_{2.5}$) is found in diesel exhaust as well as at least 40 toxic air pollutants including benzene and 1,3-butadiene, which are known human carcinogens.[29]

Disproportionately Impacted Communities

The Partial Consent Decree specifically requires that beneficiaries describe how their action mitigates the impacts of NOx emissions on communities that have historically borne a disproportionate share of the adverse impacts of such emissions.[30] There are several ways states can identify communities that bear a disproportionate share of these negative impacts. This can be done by identifying U.S. EPA non-attainment or maintenance areas and targeting mitigation actions to these areas.[31] States, territories and tribes that do not have specified non-attainment areas can identify vulnerable communities through examination of air quality in microenvironments. Additionally, identifying populations most vulnerable to negative health impacts from emissions and targeting mitigation actions in those populations may help address this requirement.

The U.S. EPA publishes current lists of nonattainment areas for all criteria pollutants including NO_X and ozone on its website.[32] This information designates geographically broad non-attainment areas, generally at the county level. Some states may not have entire counties designated as non-attainment areas. In both urban and rural settings, it is important to assess microenvironments and the impact of ambient air quality in more granular geographic areas. For example, a state may not have any U.S. EPA-designated non-attainment or maintenance areas, however, there may be neighborhoods located near busy highway corridors or near ports, railyards or other areas of high heavy-duty vehicle activity, resulting in higher local exposure to high air pollutant concentrations.

Communities that bear a disproportionate share of the impact of pollution can also be identified through incidence of health problems associated with these emissions. Children are more susceptible to health impacts of pollution because of their breathing rates, because their lungs are growing, and because they are more active than adults. The Center for Public Integrity and the Center for Investigative Reporting teamed up to identify schools within 500 feet of busy roads: nearly 8,000 U.S. public schools are located within 500 feet of highways, truck routes and congested roads.[33] Schools with a high proportion of minority students were three times more likely to be located close to busy roads

than schools with predominantly white students.[34] States can target mitigation funding based on a combination of vulnerable populations and microenvironments, and can use the online interactive tool developed by these organizations to identify schools located near busy roads in their territory.[35]

LANGUAGE FROM THE SETTLEMENT…

"REPOWER" SHALL MEAN TO REPLACE AN EXISTING ENGINE WITH A NEWER, CLEANER ENGINE OR POWER SOURCE THAT IS CERTIFIED BY EPA AND, IF APPLICABLE, CARB, TO MEET A MORE STRINGENT SET OF ENGINE EMISSION STANDARDS. REPOWER INCLUDES, BUT IS NOT LIMITED TO, DIESEL ENGINE REPLACEMENT WITH AN ENGINE CERTIFIED FOR USE WITH DIESEL OR A CLEAN ALTERNATE FUEL, DIESEL ENGINE REPLACEMENT WITH AN ELECTRIC POWER SOURCE (GRID, BATTERY), DIESEL ENGINE REPLACEMENT WITH A FUEL CELL, DIESEL ENGINE REPLACEMENT WITH AN ELECTRIC GENERATOR(S) (GENSET), DIESEL ENGINE UPGRADES IN FERRIES/TUGS WITH AN EPA CERTIFIED REMANUFACTURE SYSTEM, AND/OR DIESEL ENGINE UPGRADES IN FERRIES/TUGS WITH AN EPA VERIFIED ENGINE UPGRADE. ALL-ELECTRIC AND FUEL CELL REPOWERS DO NOT REQUIRE EPA OR CARB CERTIFICATION.

REPLACED VEHICLES MUST BE SCRAPPED

"SCRAPPED" SHALL MEAN TO RENDER INOPERABLE AND AVAILABLE FOR RECYCLE, AND, AT A MINIMUM, TO SPECIFICALLY CUT A 3-INCH HOLE IN THE ENGINE BLOCK FOR ALL ENGINES. IF ANY ELIGIBLE VEHICLE WILL BE REPLACED AS PART OF AN ELIGIBLE PROJECT, SCRAPPED SHALL ALSO INCLUDE THE DISABLING OF THE CHASSIS BY CUTTING THE VEHICLE'S FRAME RAILS COMPLETELY IN HALF.

Plan Considerations for Beneficiaries: Overview of Repower or Replacement Options

Through the environmental mitigation trust, states will support projects that fall within ten eligible mitigation action categories. Most of the mitigation actions revolve around repowering and replacing vehicles with new vehicles or engines that use a variety of fuels. In this instance, "repower" means "to replace an existing engine with a newer, cleaner engine or power source that is certified by U.S. EPA and, if applicable, CARB, to meet a more stringent set of engine emission standards."[36] The replaced vehicles must also be scrapped. At a minimum, fleets that scrap a vehicle must cut a 3-inch hole in the engine block. In addition, "if any Eligible Vehicle will be replaced as part of an Eligible project, scrapped shall also include the disabling of the chassis by cutting the vehicle's frame rails completely in half."[37]

In most eligible mitigation action categories, diesel engines can be replaced with an engine certified for use with the following fuels:

- Diesel, including biodiesel and renewable diesel
- Natural Gas, including CNG (Compressed Natural Gas), LNG (Liquefied Natural Gas) and RNG (Renewable Natural Gas).
- Propane (Liquid Propane Gas)
- Hybrid (a vehicle that combines an internal combustion engine with a battery and electric motor)
- All-Electric (powered exclusively by electricity provided by a battery, fuel cell or the grid).

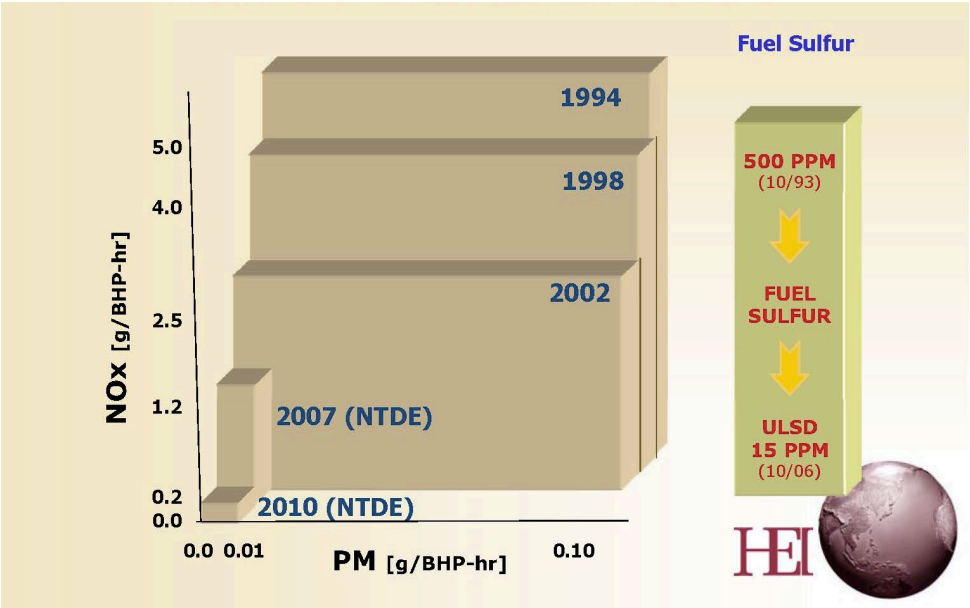
As states make decisions about which vehicles to support through the eligible mitigation actions, they may consider the pros and cons of various fuel options, and how selected vehicles and fuels may achieve NOx reduction and align with their state policy goals for energy, GHG emissions, and transportation. This section will describe the vehicles and fuels eligible for funding under various eligible mitigation categories.

Diesel Repower or Replacement

Diesel is a petroleum-based fossil fuel which has the highest energy density among fossil fuels, storing more energy per gallon than any other transportation fuel. This is one reason why diesel engines are frequently used for long-distance hauling. A typical Class 8 long-haul tractor trailer has two diesel tanks and can drive between 1,500-2,000 miles between refueling. In recent years, diesel engines have become cleaner because of the use of ultra-low sulfur diesel fuel, advances in engine technology and design, and the employment of emission control devices. Ultra-low sulfur diesel use results in a 10 percent reduction in soot from diesel emissions. It also enables the use of emission control devices that cannot be used with higher sulfur content diesel fuel.[38]

Diesel engines can run for decades, and due to this longevity there are many older, higher-emitting diesel engines in operation. To introduce new clean technologies to reduce emissions from older diesel engines still in use, the Diesel Emissions Reduction Act (DERA) was passed as part of the Energy Policy Act of 2005, and subsequent standards have further reduced emissions. U.S. EPA emission standards have required significant reductions in NOx and particulate matter emissions in heavy-duty diesel vehicles through the use of lower sulfur diesel fuel, inclusion of filters and catalysts to reduce particulate matter and through exhaust recirculation and catalytic reduction of NO_X.[39] These standards and the technologies associated with meeting them have led to dramatic reductions in harmful emissions from diesel engines (figure 5). Lifetime mileage-weighted average NO_X emission factors, in grams per mile, for diesel school buses were reduced by 91.8 percent between 1995 and 2015.[40]

Figure 5: Evolution of US Heavy Duty Diesel On-Road Emission Standards[41]



Pros of Diesel Repower or Replacement:

- Low up-front vehicle purchase price
- Proven technology
- High amount of low-end torque
- Long-lasting, durable engine
- Biofuel blends are cleaner burning.
- Diesel relies on a well-established fuel infrastructure
- New diesel vehicles demonstrate significant NOx reduction from older vehicles
- Compatible with biodiesel blends and renewable diesel

Cons of Diesel Repower or Replacement:

- Does not reduce reliance on petroleum-based fossil fuel
- Biofuels can result in reduced engine performance
- New diesel engines may require more maintenance than older diesel engines including
- Diesel engines can be difficult to start in cold temperatures and may require an engine block heater in cold climates

Alternative Fuel: Propane Autogas

Propane, also known as Liquefied Petroleum Gas (LPG) or Propane Autogas is the byproduct of natural gas production and oil refining. Because it is not produced independently of these processes, its price and availability are tied to those of oil and natural gas. More than 90 percent of propane in the United States is produced domestically, and the United States has become a net exporter of propane. Propane is nontoxic, colorless, and virtually odorless; an identifying odor is added so it can be detected. When used as a vehicle fuel, propane is known as a propane autogas.

Propane autogas is best suited for fleets with fixed routes with a central fueling location but the increase of public fueling stations and local fueling networks is making propane autogas more available to long-distance fleets. Propane tends to follow the price signals of crude oil, and its main use is not transportation, but rather as a raw material used in the petrochemical industry (to make plastics, fibers, and cosmetics) and as a source of home heating and cooking.[42] Because of the demand for propane for heating, and its fixed production volume (as a by-product), its price can vary a great deal seasonally.

Refueling stations can range from $45,000 to $220,000.[43] Because of this, propane autogas works best for fleets that return to the same station for refueling.

Pros of Propane Repower or Replacement:

- Proven technology; 11,000 propane-fueled school buses now in service
- More than 90 percent is produced domestically (in the United States)
- Generally less expensive than diesel or gasoline
- Works well in cold climates
- More than 2,000 public and private fueling stations exist in the United States[44]
- Cleaner burning than diesel
- High octane rating prevents engine knocks and provides smoother engine performance
- Quiet operation reduces ambient noise
- Multiple refueling options allow fleets to tailor infrastructure to their needs
- Switching to a propane autogas vehicle can reduce NOX emissions by up to 20 percent, it can also reduce carbon monoxide emissions by up to 60 percent[45]

Cons of Propane Repower or Replacement:

- Does not reduce reliance on petroleum-based fossil fuel
- May be produced from imported crude oil
- Prices can fluctuate seasonally, especially if the fleet does not lock in the price with a fuel contract
- Not compatible with existing diesel engines
- Initial cost is greater than replacing with a new diesel vehicle
- Refueling infrastructure requires a strategy because propane has fewer public fueling stations than traditional fuels

Alternative Fuel: Natural Gas

Natural gas is used for about one-quarter of the energy use in the United States. Most natural gas is from fossil fuels, but (RNG), also known as biomethane, comes from organic materials. RNG is chemically identical to conventional natural gas, and can be used interchangeably with natural gas vehicles and infrastructure. Because natural gas is a gas at ambient temperature, it must be compressed or liquefied to be used to power vehicles.

As its name implies, CNG is created by putting natural gas under a great deal of pressure (CNG in vehicles is stored at between 3,000-3,600 pounds per square inch). LNG is liquefied from its gaseous state by cooling natural gas to -260 degrees F (-162 C) at atmospheric pressure. LNG has a higher energy density than CNG, so transportation applications that require infrequent refueling such as long-haul trucking and marine applications (primarily car and passenger ferries) are often fueled by LNG.

LNG can be used in virtually all the same applications as CNG with respect to medium and heavy duty vehicles but has not been used in school buses. Also, CNG vehicles today are capable of carrying in excess of 160–180 diesel gallon equivalents so concerns about range are less of an issue than they once were. Increasingly, CNG is being used in truck fleets by companies such as UPS, Anheuser-Busch and others.

Not all areas of the United States are served by a natural gas pipeline (Figure 6) and may have limited access to the fuel. However, natural gas is available in all major urban areas and all major non-attainment areas. In areas without pipeline access, LNG can be delivered by trucks.

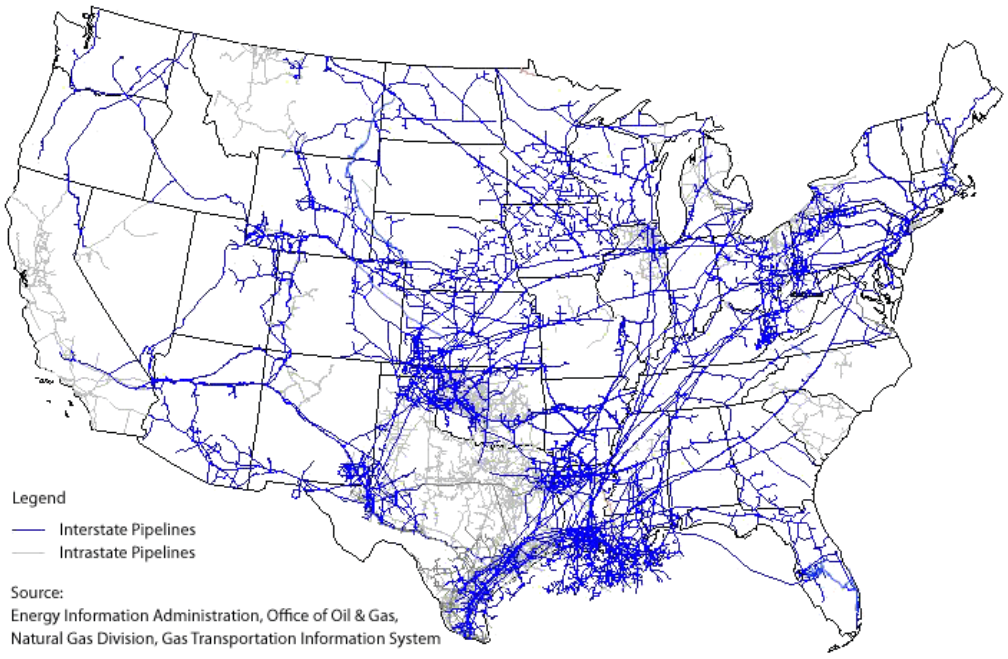
Pros of Natural Gas Repower or Replacement:

- North American fuel source, reduces reliance on imported oil and improves energy security
- When burned, natural gas produces lower CO_2 and NO_X emissions than petroleum-based fuel
- Lower maintenance due to cleaner-burning fuel and natural gas does not react with metals used in pipes and mufflers
- Generally less expensive than diesel or propane
- Less price volatility than petroleum-based fuels
- Available from the same major manufacturers of heavy-duty diesel vehicles
- Compatible with renewable natural gas

Cons of Natural Gas Repower or Replacement:

- Vehicle refueling infrastructure can be costly
- Natural gas pipelines and infrastructure may not be available in some areas of the country
- Not compatible with existing diesel engines
- Methane Slip (the loss of unburned methane into the atmosphere) can exacerbate GHG emissions, although newer natural gas engines include upgrades to limit slip

Figure 6: Map of U.S. Natural Gas Pipeline

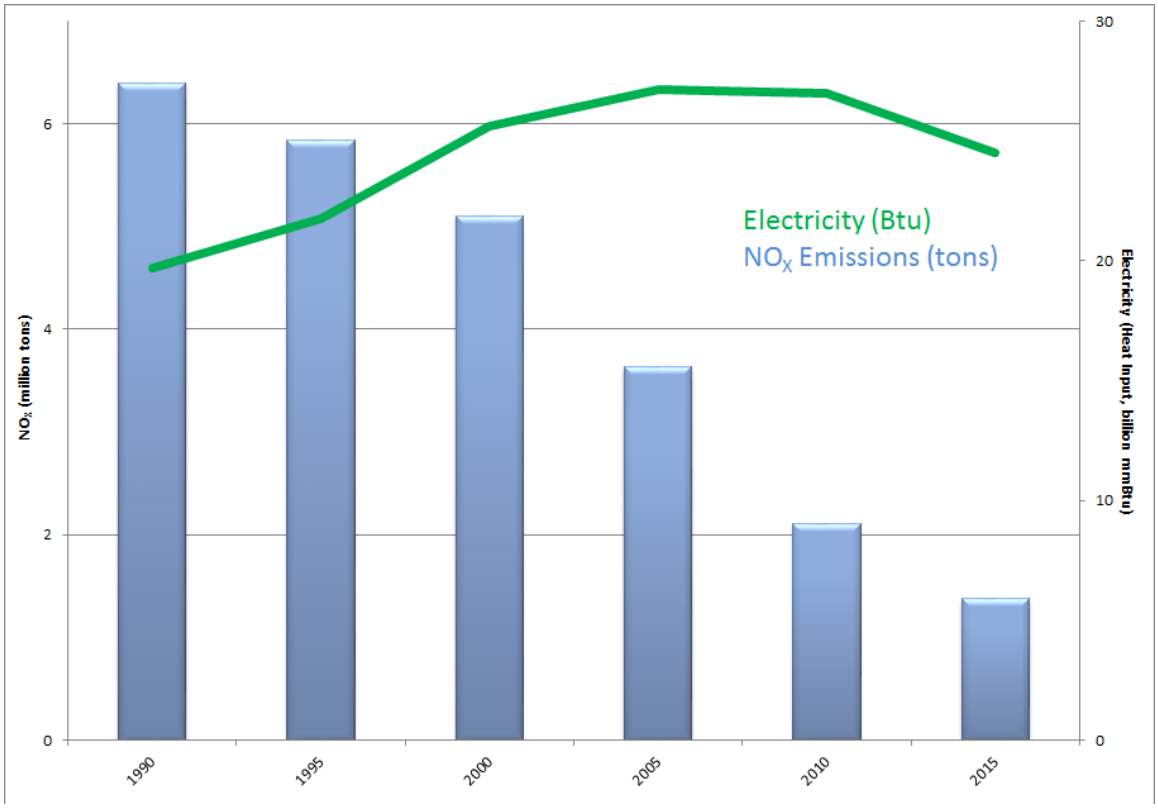


All-Electric and Hybrid-Electric Vehicles

All-electric vehicles store electricity from an external source (usually the electric grid) in batteries to be used as transportation fuel. Hybrid vehicles combine two different power sources, usually a fossil fuel such as gasoline or diesel combined with electricity to supplement fuel efficiency. There are two types of hybrid-electric vehicles: those that plug in to the grid to charge a battery and those that do not have a plug, but have a battery that is charged by regenerative braking which provides supplemental power to the vehicle. Both all-electric and hybrid-electric vehicles use regenerative braking systems, which utilize energy from the braking process to repower the vehicle's battery.

Since all-electric vehicles have zero tailpipe emissions, assessing the value of NO_X emissions reductions from electric vehicles requires the incorporation of NO_X emissions from electricity generation in the region. The reduction in NO_X emissions achieved from switching from diesel to electric vehicles will vary based on what fuel is used to produce the electric power received from the grid. Almost all regions of the United States have some emissions associated with electricity production. Benefits of transportation electrification are greatest in regions with limited or no use of coal and oil for electricity generation. However, studies have shown that even in states with a high proportion of coal power generation, all-electric vehicles have lower emissions than traditional gasoline- or diesel-powered vehicles.[46] Nationally, CO_2 emissions from an all-electric vehicle are less than half those of a comparable gasoline vehicle.[47] NO_X emissions from electricity generation have decreased significantly over the last 25 years (see Figure 7). As emissions from electricity generation decrease, the air-quality benefits of electric vehicles increase.

Figure 7: NO_X Emissions and Electricity Generation from U.S. Power Plants Since 1990[48]



While electric vehicles have been shown to reduce GHG emissions in all states, those in states with the cleanest electricity generation mix will result in the greatest reduction in NO_X emissions. Appendix 4 illustrates NO_X emissions associated with electricity production by state from 2012. Because grid emissions continue to decrease, NO_X emissions may be slightly lower than those in Appendix 4. When calculating NO_X emissions reductions by switching from diesel fuel to electricity, NO_X emissions from electricity generation should be subtracted from the savings to achieve net reduction.

Pros of Electric or Hybrid Repower or Replacement:

- For trucks that make frequent stops (like garbage trucks), regenerative braking on electric and hybrid electric trucks improves vehicle efficiency
- Quiet operation reduces ambient noise
- Proven technology in some markets: there are a number of hybrid-electric heavy duty trucks available in the U.S. market and currently operating in fleets around the country
- Improved energy security and reduction of dependence on foreign oil
- Battery technology has improved and come down in price and is expected to continue to do so
- Auxiliary functions can run off of batteries, eliminating idling and further reducing noise and pollution.
- Zero tailpipe emissions from all-electric vehicles
- Potential future use as energy storage device to offset peak energy needs

Cons of Electric or Hybrid Repower or Replacement:

- Currently more expensive up-front purchase price than diesel vehicles and other alternative fuel vehicles
- Requires EVSE infrastructure (which can be included in mitigation trust request)
- Nascent technology with limited availability in some heavy duty vehicle markets such as marine applications and freight-switchers
- Current battery capacity not adequate for long-distance travel applications

Plan Considerations for Beneficiaries: Emissions Calculation Tools

There are several modeling tools available online at no charge that can serve as resources for states to use in calculating NO_X and other greenhouse gas emissions reductions. Depending on the tool selected, users can also estimate total cost of ownership, return on investment, and monetized value of health benefits. Deciding which tool to use will be a factor of user interface preference, replacement fuel determinations, and previous user experience. Many of the tools rely on information from the same databases. The following section outlines several tools that states may wish to use when calculating avoided emissions under the environmental mitigation trust. Additional supporting tools (such as eGRID and AVERT, for modeling emissions from electricity generation) are listed in Appendix 1.

GREET

Greenhouse gases, **R**egulated **E**missions, and **E**nergy use in **T**ransportation Model (GREET) is a life-cycle assessment model developed to evaluate emission and energy impacts of advanced vehicle technologies and new transportation fuels. The GREET model was developed by Argonne National Laboratory for the

U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE). The model began as an Excel spreadsheet and was later developed into a graphic user interface available at GREET.net. Both interfaces of the models are currently available depending on user preference. The model focuses on assessing energy and emissions for the full life-cycle of transportation fuels (from well-to-wheels) and all phases of the vehicle cycle, from vehicle development to material recovery and vehicle disposal. [49]

AFLEET

The **A**lternative **F**uel **L**ife-Cycle **E**nvironment and **E**conomic **T**ransportation (AFLEET) Tool has been developed and maintained by Argonne National Laboratory for Clean Cities stakeholders. The tool is based on an Excel spreadsheet and, after entering inputs into different tabs or relying on default values, can provide users with estimates of fuel use, GHG emissions, emissions of other pollutants, and cost of ownership information. AFLEET pulls data from Argonne's GREET model as well as the U.S . EPA's Motor Vehicle Emission Simulator (MOVES) model. The AFLEET model can be used to estimate NO_X reductions achieved by switching to alternate fuel use in fleets. It also can estimate NO_X reductions achieved by replacing older diesel vehicles with new diesel vehicles.[50]

MOVES

MOtor **V**ehicle **E**missions **S**imulator (MOVES) is U.S. EPA's emission modeling system that estimates emissions for both on-road motor vehicles and non-road equipment. It creates emission factors and emission inventories of mobile sources at the national, county or project level. The tool estimates criteria air pollutants, (carbon monoxide, lead, ground-level ozone, particulate matter, nitrogen dioxide, and sulfur dioxide) as well as greenhouse gases and other air toxics. The current version of MOVES is MOVES2014A. While the team who develops and maintains MOVES works continuously to improve and provide updates to the database, users have the ability to customize inputs to the model which may provide more accurate results at the local level. To use MOVES, the user downloads the most recent version from the EPA website. Once installed, the user specifies a number of variables including vehicle types, geographic areas, time periods, pollutants, and vehicle operating characteristics.[51]

Diesel Emissions Quantifier

The **D**iesel **E**missions **Q**uantifier (DEQ) is a U.S. EPA tool that specializes in estimating emissions from medium-duty and heavy-duty diesel engines. The interactive tool is designed to estimate baseline emissions, emissions reduction, cost-effectiveness, and health benefits from the reduction of particulate matter (it also monetizes these health benefits). The DEQ is frequently used to estimate diesel emissions reduction for DERA projects. Its focus includes estimating emissions reductions from the repower or replacement of diesel engines with newer diesel engines and the use of emissions control devices. While the tool is relatively simple to use, the DEQ has somewhat limited input options for alternative fuel replacement, though some workarounds can be used.[52]-[53]

10 Eligible Mitigation Actions from Final Consent Decree

Beneficiaries may spend funds from the environmental mitigation trust on projects that fall within ten eligible mitigation action categories. According to the final consent decree, "the goal of each Eligible Mitigation Action shall be to achieve reductions of NO_X emissions in the United States."[54] The following section provides a summary of each eligible mitigation action, expected emissions reductions associated with each action, and examples of best practices.

1) Class 8 Local Freight Trucks and Port Drayage Trucks (Eligible Large Trucks)

The first eligible mitigation action is the repower or replacement of Class 8 (over 33,000 pounds) local freight and port drayage trucks. This includes trucks used for hauling cargo to and from ports and intermodal rail yards as well as trucks used for freight or cargo delivery including waste haulers, dump trucks, and concrete mixers. Intermodal rail yards are facilities where cargo is transferred between trucks and trains. Fleets of port drayage trucks are often heavy polluters because port drayage trucks are often older, repurposed vehicles. They generally travel short, fixed routes, and are typically purchased used from long-haul trucking companies which tend to have newer fleets and higher turnover rates.[55]

Vehicles eligible for repower or replacement must be scrapped, and include those with engine model years 1992-2009. An updated version of the DEQ will be released in 2017, and will include a more robust set of alternative fuel input options. For states which already require replacement of these vehicles, trucks using engines from model years 2010-2012 will also be eligible. Long haul trucks are not eligible for repower or replacement under this mitigation action; however, they are eligible for repower or replacement under the DERA option (see mitigation action # 10). Figure 8 illustrates types of Class 8 vehicles, and Table 1 provides an illustrative example of estimated NO_X emission reduction impacts from repowering or replacing a port drayage truck with a new diesel or alternative fuel option. Table 2 provides information on the percentage of an eligible mitigation action #1 project that can be funded through the environmental mitigation trust.

Figure 8: Class 8 Vehicles[56]

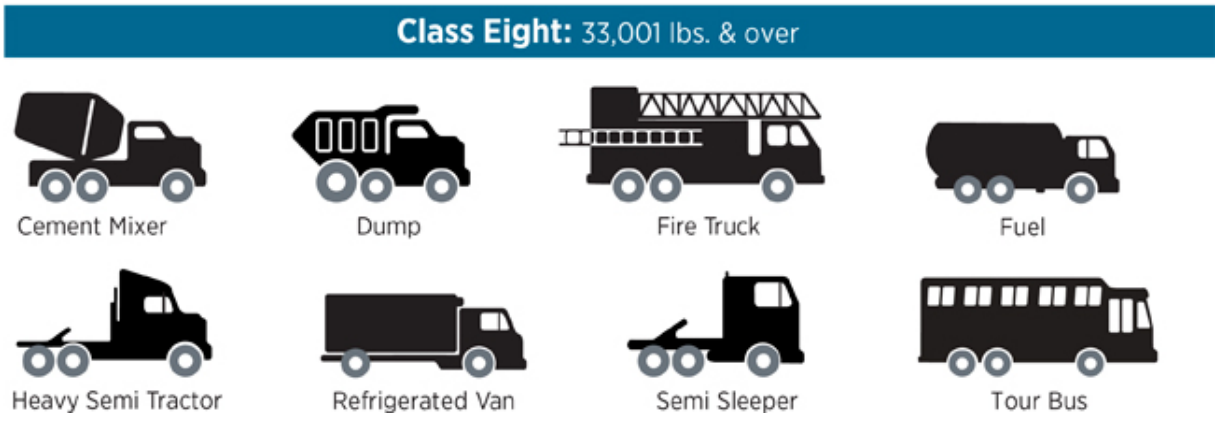


Table 1: Typical Emissions Impact of a Port Drayage Truck per Year - NO_X pounds[57]

Old Vehicle Year	Port Drayage Truck	Repower or Replacement Equipment – Port Drayage Truck				
		New Diesel	CNG/LNG	Hybrid	Plug-In Hybrid	All-Electric
	Pre-1991	-1,282	-1,298	-1,298	-1,301	-1,326
	1991-1993	-1,061	-1,077	-1,077	-1,080	-1,105
	1994-1997	-1,061	-1,077	-1,077	-1,080	-1,105
	1998-2003	-840	-856	-856	-859	-884
	2004-2006	-398	-413	-414	-417	-442
	2007-2009	-221	-237	-237	-240	-265
	2010+		-15	-16	-19	-44

Table 2: Percentage of Project that can be funded through Trust – Class 8 Local Freight Trucks and Port Drayage Trucks

	Government Owned	Non-Government Owned
Repower with new diesel or alternate fueled engine	Up to 100%	Up to 40%
Replace with new diesel or alternate fueled vehicle	Up to 100%	Up to 25% (local freight) Up to 50% (drayage)
Repower with all-electric engine (includes infrastructure)	Up to 100%	Up to 75%
Purchase new all-electric vehicle (can include infrastructure)	Up to 100%	Up to 75%

Success Story: City of Milwaukee's Department of Public Works[58]

Thanks to a $4.4 million grant from the Department of Energy, the city of Milwaukee was able to begin transitioning their refuse fleet to CNG. The city utilized $750,000 of this funding to cover the incremental costs of purchasing 21 CNG trucks. The rest of the funding went towards the installation of two CNG fueling stations. These stations provide fueling for the city's refuse truck, and have also allowed the city to adopt other CNG vehicles. Milwaukee has been dedicated to increasing the number of CNG vehicles due to their positive impact on air quality and a lower, less volatile cost of fuel.

Table 3 estimates the typical emissions impact of replacing an older diesel refuse truck with a new diesel or alternative fueled truck, based on a fleet in Milwaukee, Wisconsin.

Table 3: Typical Emissions Impact per Refuse Truck per Year - NO_X pounds[59] (Milwaukee, Wisconsin)

Replacement Vehicle Year	Refuse Truck				
		New Diesel	CNG/LNG	All-Electric (National Average grid mix)	All Electric (clean electricity)
	1992	-1363	-1390	-1362	-1417
	1995	-1368	-1395	-1367	-1422
	2000	-873	-900	-872	-927
	2005	-428	-455	-427	-482
	2008	-285	-313	-284	-340
	2010+	-31	-58	-30	-85

2) Class 4-8 School Bus, Shuttle Bus, or Transit Bus

The second eligible mitigation action is the repower or replacement of a Class 4-8 School Bus, Shuttle Bus, or Transit Bus. Vehicles eligible for scrappage and repower or replacement include those with engine model years prior to 2009. For states which already require replacement of these vehicles, buses using engines from model years 2010-2012 will also be eligible. School buses owned by public school districts fall under the "government owned" category. Since many school districts contract out student transportation, school buses which are privately owned, but are contracted with a public school district are eligible for funding at the "government owned" rate.[60]

Class 4-8 School Bus, Shuttle Bus, or Transit Bus (Buses) are defined in Appendix D of the Final Consent Decree as vehicles with a Gross Vehicle Weight Rating (GVWR) greater than 14,001 lbs used for transporting people. The Decree defines School Buses as a Class 4-8 bus sold or introduced into interstate commerce for purposes that include carrying students to and from school or related events. School buses eligible for mitigation funds include types A-D as shown in Figure 9.

LANGUAGE FROM THE SETTLEMENT…

"GOVERNMENT" SHALL MEAN A STATE OR LOCAL GOVERNMENT AGENCY (INCLUDING A SCHOOL DISTRICT, MUNICIPALITY, CITY, COUNTY, SPECIAL DISTRICT, TRANSIT DISTRICT, JOINT POWERS AUTHORITY, OR PORT AUTHORITY, OWNING FLEETS PURCHASED WITH GOVERNMENT FUNDS), AND A TRIBAL GOVERNMENT OR NATIVE VILLAGE. THE TERM 'STATE' MEANS THE SEVERAL STATES, THE DISTRICT OF COLUMBIA, AND THE COMMONWEALTH OF PUERTO RICO.

Figure 9: School Bus Classification:[61]

TYPE A: A Type "A" school bus is a van conversion or bus constructed utilizing a cutaway front section vehicle with a left-side driver's door. This definition includes two classifications: Type A-I, with a Gross Vehicle Weight Rating (GVWR) less than or equal to 14,500 pounds; and Type A II, with a GVWR greater than 14,500 pounds and less that or equal to 21,500 pounds.
TYPE B: A "type B school bus" is a conversion or body constructed and installed upon a van or front-section vehicle chassis, or stripped chassis, with a gross vehicle weight rating of more than 10,000 pounds, designed for carrying more than ten persons. Part of the engine is beneath or behind the windshield and beside the driver's seat. The entrance door is behind the front wheels.
TYPE C: A Type "C" school bus is constructed utilizing a chassis with a hood and front fender assembly. The entrance door is behind the front wheels. A "type C school bus" also includes a cutaway truck chassis or truck chassis with cab, with or without a left side door, and with a GVWR greater than 21,500 pounds.
TYPE D: A "type D school bus" is a body installed upon a chassis, with the engine mounted in the front, midship or rear, with a gross vehicle weight rating of more than 10,000, designed for carrying more than ten persons. The engine may be behind the windshield and beside the driver's seat; it may be at the rear of the bus, behind the rear wheels, or midship between the front and rear axles. The entrance door is ahead of the front wheels. A type D school bus has a maximum length of 45 feet.

Table 4 provides an illustrative example of expected NO_X reductions per year achieved by replacing older model school buses with new diesel and alternate-fuel school buses in St.Francis, Minnesota. Table 5 provides information on the percentage of an eligible school bus project that can be funded through the environmental mitigation trust.

Table 4: Typical Emissions Impact per School Bus per Year – (NO_X pounds)[62]

Anoka County, Minnesota-St. Francis

Replacement Vehicle Year	Repower or Replacement Equipment - School Bus					
		New Diesel	CNG/LNG	Propane	All-Electric (National Average grid mix)	All Electric (clean electricity)
	1992	-466	-477	-458	-464	-487
	1995	-466	-477	-458	-464	-487
	2000	-232	-243	-224	-230	-253
	2005	-179	-189	-170	-177	-199
	2008	-81	-91	-72	-79	-101
	2010+	-12	-22	-3	-10	-33

Table 5: Percentage of Project that can be Funded through Trust – School Buses and Transit Buses

	Government Owned	Non-Government Owned
Repower with new diesel or alternate fueled engine	Up to 100%	Up to 40%
Replace with new diesel or alternate fueled vehicle	Up to 100%	Up to 25%
Repower with all-electric engine (includes infrastructure)	Up to 100%	Up to 75%
Purchase new all-electric vehicle (includes infrastructure)	Up to 100%	Up to 75%

Success Story: Propane School Buses[63]

In the last ten years, a number of schools across the United States have adopted propane as an alternative fuel for their school buses. Propane is an attractive choice for school buses because it is a widely available fuel and requires little investment in infrastructure. A school district in St. Francis, Minnesota tested three propane-powered school buses and found that they were an excellent fit for the district. The district ordered 38 more propane school buses for their fleet of 51 buses for the 2015-2016 school year. The school district found that the propane-powered buses perform better in cold weather: they start more easily, do not need block heaters, and heat up more quickly which allows faster window defrosting. The school district also experienced substantial cost savings due to fewer maintenance needs, and expects to save about $200,000 in fuel costs over the course of the year.[64]

Other school districts have chosen to deploy propane buses for financial and performance reasons as well. A 2014 report by the Department of Energy's Clean Cities program highlighted five school districts that have successfully deployed propane powered school buses. These districts, located in Texas and Virginia, chose propane for financial reasons, but found the performance of the buses to be superior to diesel. Drivers at Alvin independent school district in Texas expressed a preference for driving the propane buses over the conventional diesel buses.[65]

3) Freight Switchers

The third eligible mitigation action is the repower or replacement of pre-Tier 4 freight switcher locomotives that operate 1,000 or more hours per year. A freight switcher is a locomotive that moves rail cars around a rail yard as compared to a line-haul engine that moves freight long distances. Eligible diesel freight switchers must be scrapped and can be repowered or replaced with one of several options.[66] One repower and replacement option is a new diesel freight switcher. Another option is a generator set, which is a switcher locomotive that is equipped with multiple engines. A generator set can reduce emissions and fuel consumption by matching the power it needs to the power it produces. It does this by turning off one or more engines depending on the size of the load it is moving. This way, it is not burning fuel to produce power that is not needed to move "light" loads. Other freight switcher replacement options include LNG, diesel electric hybrid and all-electric (in which case fueling infrastructure would be included). Estimates of emissions reductions can be found in Table 6. Table 7 illustrates the percentage of an eligible mitigation action that can be funded through the trust.

Recently, hybrid and all-electric mobile railcar movers have been introduced into the North American market. These railcar movers can work both on and off of railroad tracks and are available in all-electric and hybrid-electric models. Figure 10 illustrates fuel consumption and NOX emissions from two hybrid-electric railcar movers compared to an older diesel freight switcher.

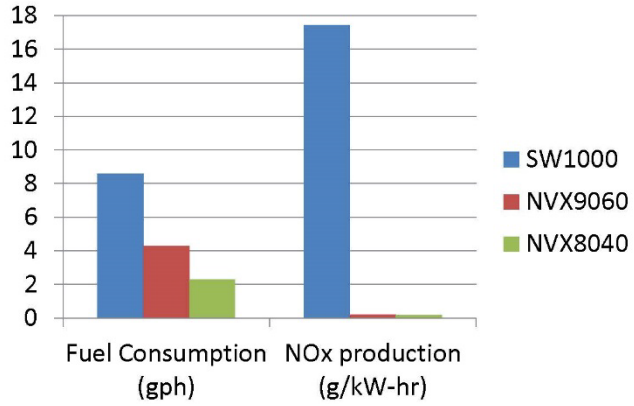
Table 6: Typical Emission Impact per Freight Switcher Locomotive per Year –NO_x pounds[67]

Old Equipment	Freight Switcher Locomotive	Repower or Replacement Equipment						
		Tier 0+	Tier 1+	Tier 2+	Tier 3	Tier 4	Tier 3 GenSet	Tier 4 GenSet
	Pre-Tier 0	-15,591	-17,196	-23,157	-29,577	-37,602	-33,016	-39,207
	Tier 0	-4,586	-6,191	-12,152	-18,572	-26,596	-22,011	-28,201
	Tier 0+		-1,605	-7,566	-13,986	-22,011	-17,425	-23,616
	Tier 1		0	-5,961	-12,381	-20,406	-15,820	-22,011
	Tier 1+			-5,961	-12,381	-20,406	-15,820	-22,011
	Tier 2			0	-6,420	-14,445	-9,859	-16,049
	Tier 2+				-6,420	-14,445	-9,859	-16,049
	Tier 3					-8,025	-3,439	-9,630
	Tier 4							-1,605
	Tier 3 GenSet							-6,191
	Tier 4 GenSet							

Table 7: Percentage of Project that can be Funded through Trust – Freight Switchers

	Government Owned	Non-Government Owned
Repower with new diesel or alternate fueled engine or generator sets	Up to 100%	Up to 40%
Replace with new diesel or alternate fueled freight switcher certified to meet U.S. EPA emissions standards (or more stringent State standards, if applicable)	Up to 100%	Up to 25%
Repower with all-electric engine (includes infrastructure)	Up to 100%	Up to 75%
Purchase new all-electric freight switcher (includes infrastructure)	Up to 100%	Up to 75%

Figure 10: Hybrid-Electric Fuel Consumption and Emissions Compared to Older Diesel Switcher[68] (SW1000: Conventional diesel; NVX9060: hybrid; NVX8040: all-electric)[69]



Success Story: Repowered Freight Switcher with Generator Sets[70]

In Washington, D.C., a project funded jointly by a $1.8 million DERA grant and Amtrak ($600,000) and managed by the Metropolitan Washington Council of Governments in conjunction with the Brotherhood of Locomotive Engineers and Trainmen resulted in the repowering of two older (circa 1970's) switching locomotives into GenSet locomotives. The GenSet locomotives improve air quality and reduce emissions in the vicinity of the locomotives. Passengers, local residents and rail employees will recognize the greatest benefits from the repowered locomotives. The old locomotives relied on a large diesel engine that operated continuously while the vehicle was in operation, and the engine was required to idle continuously throughout the shift. The new GenSet technology relies on two or three smaller engines that can be operated independently and turned off when not in use. The new locomotives are in daily use and are estimated to reduce diesel consumption and emissions by about 50 percent.

4) Ferries and Tugs

Ferries or tugs equipped with unregulated, Tier 1, or Tier 2 marine engines may be repowered under eligible mitigation action 4. These tugs and ferries may be repowered with any new Tier 3 or Tier 4 diesel or alternate fueled engine, or with all-electric engines, or may be upgraded with a U.S EPA Certified Remanufacture System or a U.S. EPA Verified Engine Upgrade. Eligible vessels include "tugs," which refers to dedicated vessels that push or pull other vessels in ports, harbors, and inland waterways (e.g., tugboats and towboats). Ferries can include passenger and vehicle ferries. Table 8 illustrates the expected emissions reduction from different repower or replacement options for tug boats. Table 9 illustrates these values for ferry repower or replacements. The amount of each project that can be funded by the mitigation trust is shown in Table 10.

Table 8: Typical Emission Impact per Tug per Year –NO_x pounds[71]

Old Equipment	Tug	Repower or Replacement Equipment			
		Tier 3	Tier 4	Hybrid	LNG
	Pre-Control	-61,798	-96,840	-100,733	-100,084
	Tier 1	-43,828	-78,870	-82,763	-82,114
	Tier 2	-11,880	-46,922	-50,816	-50,167

Table 9: Typical Emission Impact per Ferry per Year –NO_x pounds[72]

Old Equipment	Ferry	Repower or Replacement Equipment		
		Tier 3	Tier 4	Hybrid
	Pre-Control	-38,198	-62,336	-64,352
	Tier 1	-23,973	-47,812	-49,828
	Tier 2	-12,198	-36,337	-38,353

Table 10: Percentage of Project that can be Funded through Trust – Ferries and Tugs

	Government Owned	Non-Government Owned
Repower with new diesel or alternate fueled engine (includes installation costs)	Up to 100%	Up to 40%
Repower with all-electric engine (includes infrastructure)	Up to 100%	Up to 75%

Success Story: Cross Sound Ferry Repower[73]

Cross Sound Ferry Services, Inc. is a passenger and road vehicle ferry service that connects New London, CT and Orient Point, NY. It maintains a fleet of eight vessels. Thanks in part to an $800,000 grant from the U. S. EPA DERA program, the Cross Sound Ferry was able to repower one of their high-power passenger ferries, the Jessica W, with four new lower-emission diesel engines. The Jessica W is one of the largest passenger ferries on the east coast. It provides year-round ferry service between New London, Connecticut and Orient Point, New York and seasonal service to Block Island, Rhode Island. According to the U.S. EPA press release, replacement of the Jessica W's engines is expected to reduce the vessel's annual emissions of nitrogen oxides by 35.2 tons and particulate matter emissions by .36 tons. The Jessica W is the fourth vessel Cross Sound Ferry has repowered since 2010, and they plan to repower more utilizing the DERA grant program.[74]

5) Ocean Going Vessels (OGV) Shorepower

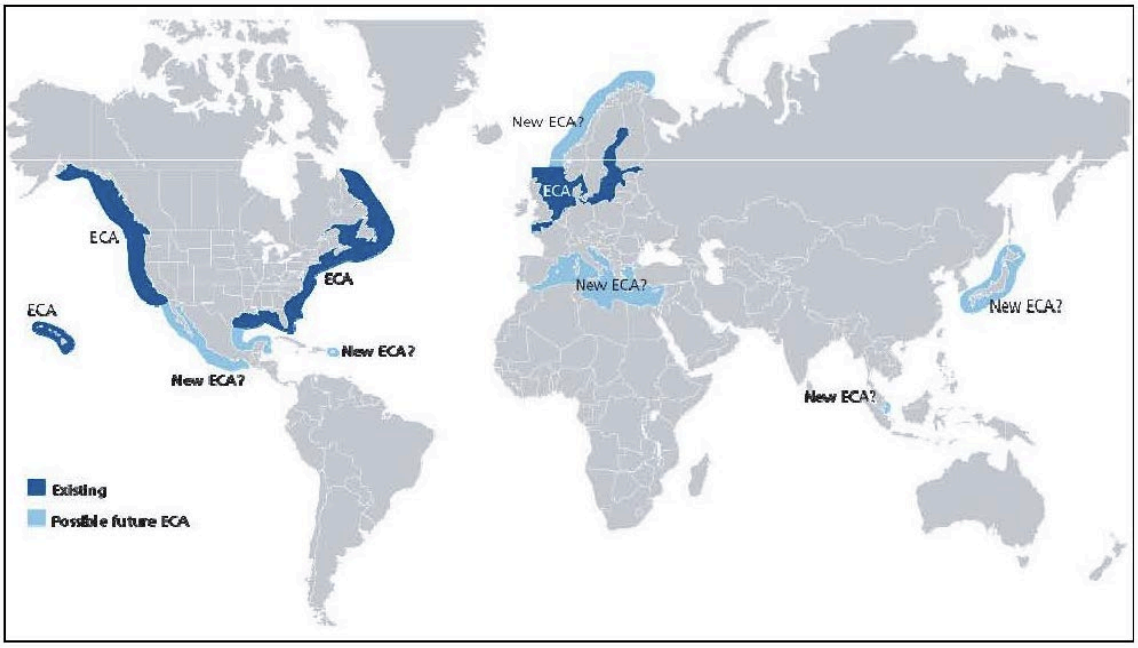
The fifth eligible mitigation action is marine shorepower. Eligible marine shorepower systems provide electric auxiliary power from shore while a boat is docked to allow a vessel's engines to turn off and remain off while the vessel is at berth. It is sometimes known as "hoteling" or "cold-ironing." Several components of marine shorepower systems are eligible for reimbursement. These are limited to cables, cable management systems, shore power coupler systems, distribution control systems, and power distribution. According to the Final Consent Decree, "Marine shore power systems must comply with international shore power design standards (ISO/IEC/IEEE 80005-1-2012 High Voltage Shore Connection Systems or the IEC/PAS 80005-3:2014 Low Voltage Shore Connection Systems) and should be supplied with power sourced from the local utility grid."

Eligible marine shorepower includes equipment for vessels that operate within the Great Lakes as well as along U.S. coastlines. Most marine fuel consumption is made up of low-quality, low-price residual fuel referred to as Heavy Fuel Oil or Bunker Fuel. Heavy Fuel Oil tends to be high in sulfur content. Only 25 percent of vessels in the world's fleet run on Heavy Fuel Oil, but it accounts for 77 percent of global marine fuel consumption.[75] Large vessels run their engines when docked to generate power to run auxiliary systems. This contributes to high levels of pollution in ports. On January 1, 2015 Emission Control Areas (ECAs) came into effect in the United States, Canada, the North Sea, and the Baltic. China, in a separate action, voluntarily imposed ECAs to reduce pollution (Figure 11).[76] The environmental mitigation trust may help states within these emission control areas meet compliance. Table 11 illustrates the percent of eligible mitigation actions that can be funded through the trust.

Table 11: Percentage of Project that can be Funded through Trust – Marine Shorepower

	Government Owned	Non-Government Owned
Shore-side system connected with local utility grid	Up to 100%	Up to 25%

Figure 11: Current and possible Future Emission Control Areas[77]



Success Story: Port of Galilee, Rhode Island[78]

Thanks to a DERA grant from the Rhode Island Clean Diesel Program, the Port of Galilee was able to install dock-side facilities for docked vessels to obtain power from and turn off their onboard diesel equipment. These upgrades cost approximately $295,000, and are estimated to significantly reduce the health impacts from diesel particulate matter at the port. Additionally, these upgrades support the local commercial fishing industry by providing shore-based energy and providing onboard fuel savings.[79] Table 12 illustrates the emissions reductions reported from this project.

Table 12: Emissions Reduction from Port of Galilee Project[80]

Annual PM10 Reduction pounds /year*	Annual VOC Reduction pounds /year*	Annual CO Reduction pounds /year*	Annual NO_X Reduction pounds/year*
695	869	2321	10,428

6) Class 4-7 Local Freight Trucks (Medium Trucks)

The sixth eligible mitigation action is the repower or replacement of Class 4-7 local freight trucks. Vehicles eligible for scrappage and repower or replacement include those with engine model years 1992–2009. For states which already require replacement of these vehicles, trucks using engines from model years 2010–2012 will also be eligible. Vehicles eligible for funding under this mitigation action include commercial trucks with a Gross Vehicle Weight Rating (GVWR) between 14,001 and 33,000 lbs. used to deliver cargo and freight such as delivery trucks, box trucks moving freight, trucks used for courier services, waste haulers, and bucket trucks (as shown in Figure 12). Repower and replacement options for these vehicles include new diesel, CNG, propane, diesel-electric Hybrid, or all-electric. Table 13 illustrates estimates of NO_X reductions achieved by replacing a step van with several replacement fuel options. Table 14 shows the percentage of local freight truck repower or replacement projects that can be funded through trust.

Figure 12: Examples of local freight trucks eligible for repower or replacement (please note that school buses and transit buses are covered in mitigation action #2)

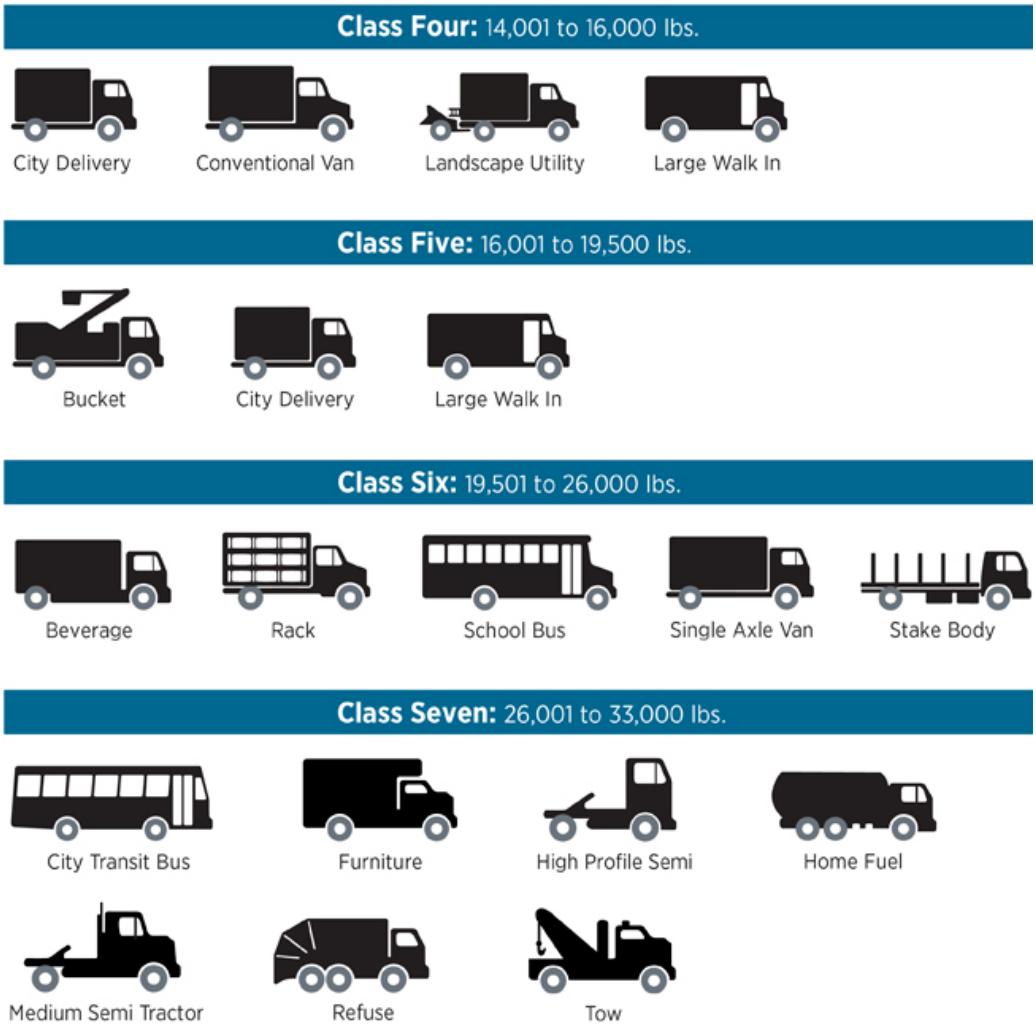


Table 13: Typical Emissions Impact per Step Truck replacement - NO_X pounds per year [81]
Location: San Antonio, Texas

Replacement Vehicle Year	Step Van					
		New Diesel	CNG/LNG	Propane[82]	All-Electric (National Average grid mix)	All Electric (clean electricity)
	1992	-462	-473	-479	-462	-485
	1995	-462	-473	-479	-462	-485
	2000	-255	-265	-272	-255	-278
	2005	-190	-201	-207	-190	-213
	2008	-91	-101	-108	-91	-114
	2010+	-14	-25	-31	-14	-37

Table 14: Percentage of Project that can be Funded through Trust – Local Freight Trucks (Medium Trucks)

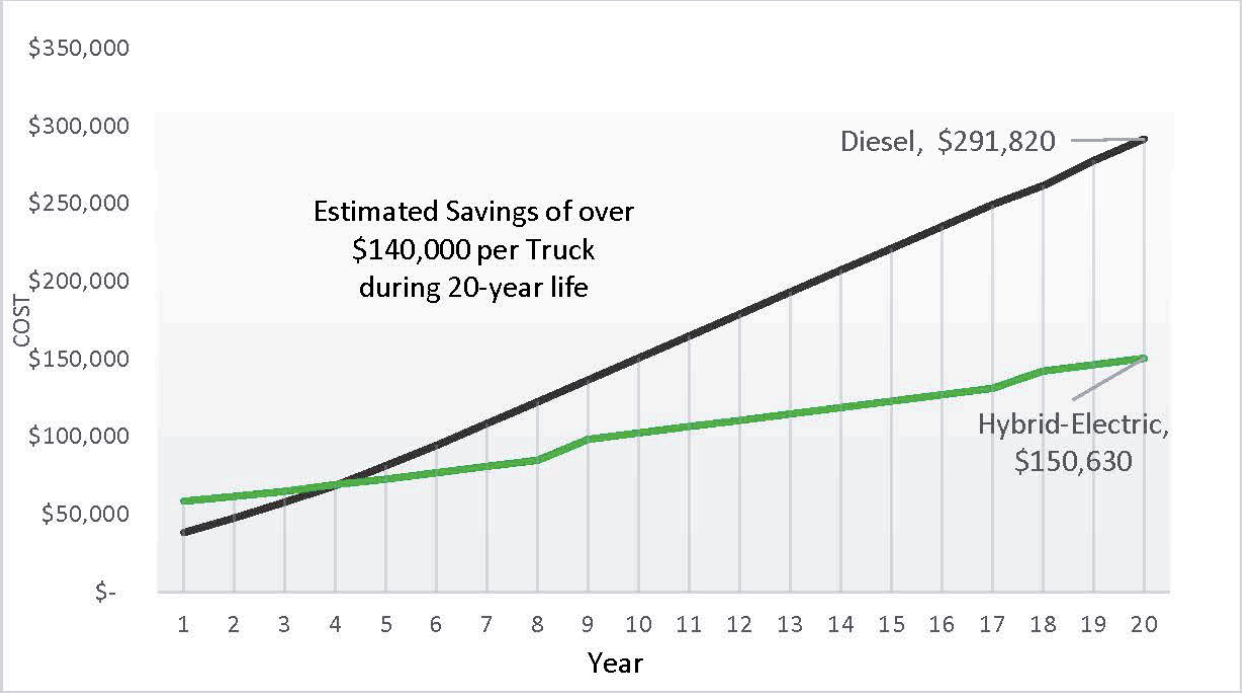
	Government Owned	Non-Government Owned
Repower with new diesel or alternate fueled engine	Up to 100%	Up to 40%
Replace with new diesel or alternate fueled vehicle	Up to 100%	Up to 25%
Repower with all-electric engine (includes infrastructure)	Up to 100%	Up to 75%
Purchase new all-electric vehicle (includes infrastructure)	Up to 100%	Up to 75%

Success Story: UPS Hybrid and All-Electric Delivery Vehicles[83]

UPS's fleet currently consists of more than 7,200 alternative fuel and advance technology vehicles. Of these vehicles, 110 are all-electric delivery trucks deployed in California, New York, and Texas as well as 98 deployed internationally. Some of these vehicles were purchased outright by UPS while others were supported by funding from the U.S. Department of Energy. Additionally, UPS's fleet has 125 hybrid electric delivery trucks. In 2016, UPS updated these trucks in order to extend their range and improve their fuel economy.

Hybrid electric and all-electric vehicles make excellent delivery vehicles in congested areas because every time a driver applies the brakes, power goes back into the vehicle's battery. UPS's U.S. Domestic Package and U.S. Freight Operations sustainability measures have resulted in a 44 percent reduction per ground vehicle in NO_X emissions between 2012 and 2015.[84] Total cost of ownership of hybrid-electric step vans is significantly lower than that of diesel vehicles. According to Workhorse trucks (step van manufacturer), the vehicles have demonstrated the potential to save more than $150,000 per truck (see figure 13). The vehicles offer a 400 percent improvement in fuel efficiency and at least a 60 percent reduction in maintenance expenses.[85]

Figure 13: Total Cost of Ownership: Hybrid-Electric Step Van vs. Diesel Step Van[86]



7) Airport Ground Support Equipment

To focus on concentrated emissions reductions at airports, the mitigation trust is authorized to support fuel switching of diesel and gasoline airport ground support equipment. This type of equipment includes all vehicles and equipment used at airports to service aircraft between flights. To be eligible for funding, airport ground support equipment must be repowered or replaced with all-electric equipment. Per the final consent decree, "all-electric" shall mean powered exclusively by electricity provided by a battery, fuel cell, or the grid. Electric infrastructure necessary to charge the replacement equipment is also eligible for funding. Table 15 outlines NO_X emission factors for 2011 diesel ground support equipment from the Transportation Research Board and Table 16 includes the percentage of airport ground support equipment projects that can be funded through the trust.

Table 15: 2011 Emissions Factors for Common Airport Ground Support Equipment[87]

GSE Type	Fuel	Ambient NO_X Emission Factors (pounds of NO_X produced per year by equipment)
Mobile Preconditioned Air Unit	Diesel	3.66
Aircraft Pushback Tractor	Diesel	4.22
	Gasoline	5.46
Baggage Tractors	CNG	5.42
	Diesel	4.02
	Gasoline	4.69
	LPG	5.42
Belt Loaders	CNG	4.54
	Diesel	4.27
	Gasoline	3.13

	LPG	4.54
Bobtail	Diesel	4.14
	Gas	3.68
Cabin Service truck	CNG	5.51
	Diesel	.74
	Gasoline	1.98
	LPG	5.51
De-icing vehicles	Gasoline	5.31
Forklift	CNG	4.55
	Diesel	5.67
	Gasoline	5.46
	LPG	4.55
Fuel Trucks	CNG	6.55
	Diesel	1.84
	Gasoline	2.45
	LPG	6.55
Generator	Gasoline	5.32
	Diesel	5.06
Ground Power Units	Gasoline	5.25
	Diesel	3.80
Hydrant Truck	Gasoline	2.10
	Diesel	2.61
Lavatory Truck	CNG	6.55
	Diesel	2.41
	Gasoline	1.36
	LPG	6.55
Lift Truck	CNG	6.55
	Diesel	5.66
	Gasoline	3.98
	LPG	6.55
Passenger Stairs	CNG	6.51
	Diesel	2.60
	Gasoline	2.67
	LPG	6.51
Service truck	CNG	6.56
	Diesel	2.09
	Gasoline	2.67
	LPG	6.56
Sweeper	CNG	4.68
	Diesel	4.89
	Gasoline	5.46
	LPG	4.68
Water Service	Gasoline	2.67

Table 16: Percentage of Project that can be Funded through Trust – Airport Ground Support Equipment

	Government Owned	Non-Government Owned
Repower with all-electric engine or replace with all-electric equipment (includes charging infrastructure)	Up to 100%	Up to 75%

Success Story: Airport Ground Support Equipment Seattle-Tacoma International Airport[88]

In a joint effort between the Seattle-Tacoma International Airport, Alaska Airlines, and Western Washington Clean Cities Coalition, Sea-Tac airport launched a $31 million project to convert all of its airport ground support equipment from fossil fuel to electric power. The project is expected to save $2.8 million in airline fuel costs each year and to prevent 10,000 tons of GHG emissions from entering the atmosphere each year. To support the transition to electric ground support equipment, the airport installed 159 charging stations which allow a vehicle to fully charge in under four hours.[89] Alaska Airlines operates 203 electric vehicles at Sea-Tac (145 with Alaska Airlines and 58 with Horizon Airlines) including bag tugs, belt loaders, and pushback tugs. The airline expects to save $300,000 a year in fuel costs and 1000 tons of carbon dioxide emissions as a result of the project.[90]

8) Forklifts and Port Cargo Handling Equipment

The eighth eligible mitigation action is the scrappage and repower or replacement of forklifts and port cargo handling equipment. Eligible repower or replacement includes electric charging infrastructure. A significant portion of forklifts, or lift trucks as they are sometimes referred to, are currently powered with electricity. Worldwide, 45 percent of forklifts in operation are powered by electricity.[91] In the Asian market 35 percent of forklifts are electric, 60 percent of forklifts in North American are electric and 80 percent of forklifts in Europe are electric. Forklifts eligible for repower and replacement must have greater than 8,000 pounds lift capacity.

LANGUAGE FROM THE SETTLEMENT…

"FORKLIFT" SHALL MEAN NON-ROAD EQUIPMENT USED TO LIFT AND MOVE MATERIALS SHORT DISTANCES; GENERALLY INCLUDES TINES TO LIFT OBJECTS. ELIGIBLE TYPES OF FORKLIFTS INCLUDE REACH STACKERS, SIDE LOADERS, AND TOP LOADERS.

Port cargo handling equipment includes rubber-tired gantry cranes, straddle carriers, shuttle carriers, and terminal tractors, including yard hostlers and yard tractors that operate within ports. Electric port cargo handling equipment can be powered exclusively by electricity provided by a battery, fuel cell or the grid. The eligible cost of electric port handling equipment includes infrastructure needed to support the equipment. Table 17 illustrates life cycle emissions from electric and diesel port tractors from a study using the Port of Los Angeles. Tables 18, 19 and 20 illustrate expected NOx emissions from repowering and replacing port equipment including yard trucks, cranes, and container handlers. Table 21 illustrates the percentage of forklifts and port cargo handling equipment projects that can be funded through the trust.

Table 17: Life Cycle Emissions for Electric versus Diesel Tractors (pounds/10 year lifetime)[92]

Vehicle Type		Production	Use	Disposal	Total
Electric	CO2e	137,813	564,480	18,390	721,035
	SO_X	662	2,800	40	3,506
	NO_X	86	1,427	26	1,544
	PM	216	3,616	40	3,881
Diesel	CO2e	7,718	1,713,285	816	1,722,105
	SO_X	141	20	2	163
	NO_X	71	11,246	2	11,312
	PM	26	937	0	970

Table 18: Typical Emission Impact per Yard Truck per Year NO_X (pounds)[93]

Old Equipment	Yard Truck	Repower or Replacement Equipment
		Electric
	Tier 1	-3,769
	Tier 2	-2,704
	Tier 3	-1,639
	Tier 4	-164

Table 19: Typical Emission Impact per RTG Crane per Year-NO_X Pounds[94]

Old Equipment	RTG Crane	Repower or Replacement Equipment
		Electric
	Tier 1	-7,781
	Tier 2	-5,413
	Tier 3	-3,383
	Tier 4	-338

Table 20 Typical Emission Impact per Container Handler per Year-NO_X Pounds[95]

Old Equipment	Container Handler	Repower or Replacement Equipment
		Electric
	Tier 1	-4,920
	Tier 2	-3,529
	Tier 3	-2,139
	Tier 4	-214

Table 21: Percentage of Project that can be Funded through Trust – Forklifts and Port Cargo Handling Equipment

	Government Owned	Non-Government Owned
Repower with all-electric engine or replace with all-electric equipment (includes charging infrastructure)	Up to 100%	Up to 75%

Success Story: DHL Supply Chain replacing Diesels with Electric Yard Tractors

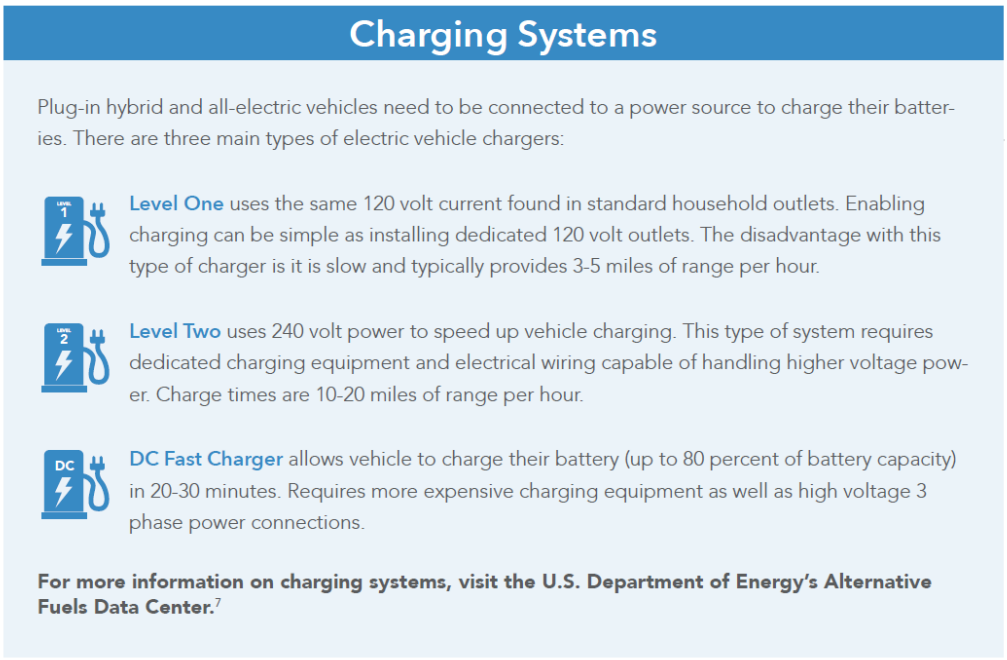
As a result of DHL Supply Chain's global initiative to use more fuel-efficient vehicles, the company has replaced 75 percent of its U.S. fleet with alternative fuel vehicles since 2014.[96] In Chicago, DHL's subsidiary Exel (now rebranded DHL Supply Chain), has reduced fuel use by deploying repowered yard tractors built with all-electric power train from Orange EV, an OEM that builds all-new trucks while also repowering existing diesel vehicles. The repowered Class 8 vehicle demonstrated operational excellence, keeping pace with or exceeding diesel yard truck performance while reducing 2015 fuels costs by 85-90 percent and completely eliminating tailpipe emissions from the repowered vehicles in the yard. These repowered yard tractors are a viable option throughout goods movement and container handling sites like distribution centers, railyards, waste transfer stations, manufacturing plants, and seaports looking to renew their fleets while eliminating on-site emissions and saving on fuel costs.

In addition to DHL's Chicago fleet, Orange EV's all-electric yard trucks (i.e., hostlers, spotters, terminal trucks, and switchers) are operating near Kansas City, Missouri and in Los Angeles, California with several other markets projected in 2017. Showing the viability of electric repowers, Nolan Logistics just added its eighth electric repower and in Chicago, Moran Transportation re-ordered in May of 2016 to go 100 percent electric in its yard truck fleet. While the current design of these electric repowers are capable of handling most major yard cargo transport requirements, the largest international seaports have yard trucks that are required to pull roughly twice the weight of standard cargo handling applications. Within the next two years Orange EV plans to build on their success by offering electric terminal trucks that can pull this higher weight as well as run at twice the speed of standard trucks to handle the largest cargo loads at major international seaports and fill other related truck roles, like day cabs for local delivery around our cities and towns.

9) Light Duty Zero Emission Vehicle Supply Equipment

Beneficiaries may use up to 15 percent of their allocation of trust funds for the acquisition, installation, operation and maintenance of new light duty zero emission vehicle supply equipment. Eligible equipment includes Level 1, Level 2 or DC Fast Charging equipment (or analogous successor technologies) that is located in a public place, workplace, or multi-unit dwelling and is not located at a private residential dwelling that is not a multi-unit dwelling (see figure 14). Light duty hydrogen fuel cell vehicle supply equipment is also eligible, and includes hydrogen dispensing equipment capable of dispensing hydrogen at a pressure of 70 megapascals (or analogous successor technologies) that is located in a public place. Trust funds may not be made available or used to purchase or rent real-estate, other capital costs (e.g., construction of buildings, parking facilities, etc.) or general maintenance (i.e., maintenance other than of the supply equipment).

Figure 14: Light Duty Electric Vehicle Charging Systems



There is a range of zero emission vehicle supply equipment available on the market and the costs of equipment, installation, and maintenance vary widely. The cost of a single port electric vehicle supply equipment unit ranges from $300 - $1,500 for Level 1; $400-$6,500 for Level 2; and $10,000 - $40,000 for DC fast charging.[97] Installation costs also vary greatly with a general range of up to $3,000 for Level 1; $600 - $12,700 for Level 2; and $4,000 - $51,000 for DC fast charging. Although the industry consensus is that the cost of EVSE units are trending downwards, the installation costs are highly variable. Table 22 illustrates the percentage of ZEV projects that can be covered through the trust.

Table 22: Percentage of Project that can be Funded through Trust – Zero Emission Vehicle Supply Equipment

Project	Percentage Funded through Trust
Electric Vehicle Supply Equipment - publicly available at government owned property	Up to 100%
EVSE - publicly available at non-government owned property	Up to 80%
EVSE - at workplace but not available to general public	Up to 60%
EVSE - at multi-unit dwelling but not available to general public	Up to 60%
Fuel Cell Vehicle Supply Equipment - publicly available and able to dispense at least 250kg/day	Up to 33%
FCVSE - publicly available and able to dispense at least 100kg/day	Up to 25%

Success Story: Tufts Health Plan[98]

Tufts Health Plan is a regional health organization in the northeast states with 3,000 employees in Massachusetts. Eighty-five percent of employees drive to work, and employees recently requested the installation and use of charging stations. Using funds from the Massachusetts Electric Vehicle Incentive Program (MassEVIP), Tufts Health Plan installed three dual Level 2 charging stations for six dedicated charging spaces. After the MassEVIP grant, the average installation cost per unit was $9,000. All six spaces are used daily, and the company has implemented charging etiquette rules enforced by parking security.

Similar projects were funded across Massachusetts through MassEVIP, which has allocated $1.4 million in grants for workplace charging installations. The Massachusetts Department of Energy Resources (the State Energy Office), administers a complimentary rebate program, MOR-EV, which offers rebates of $2,500 to customers purchasing or leasing an EV or zero-emission motorcycle. These programs, combined with regulatory exemptions and support from local non-profits have led to significant EV adoption and petroleum displacement in Massachusetts.

EMISSIONS SAVINGS FROM EV INFRASTRUCTURE

ALL "WORKPLACE CHARGING CHALLENGE" PARTNER CHARGING STATIONS IN OPERATION SAVE 800,000 GALLONS OF GASOLINE AND 5.5 MILLION POUNDS OF GREENHOUSE GASSES – THE EQUIVALENT OF REMOVING NEARLY 1,500 AVERAGE CARS FROM U.S. ROADS.[1]

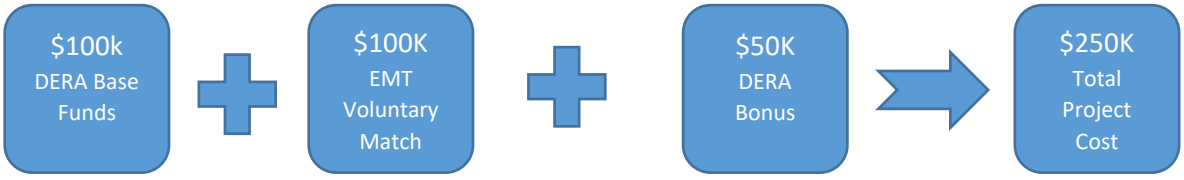
10) Diesel Emission Reduction Act (DERA) Option

DERA provides funding for projects that reduce emissions from existing diesel engines. Authorized under the Energy Policy Act of 2005 and administered by U.S. EPA, DERA is designed to help replace or retrofit older, dirtier engines still in use with clean diesel or alternative fuel engines, reducing exposure to diesel exhaust and improving human health and the environment.

For Fiscal Year 2016, U.S. EPA had approximately $49.5 million for the DERA Program.[99] Seventy percent of the DERA appropriation is to be used for national competitive grants and rebates to fund projects that use U.S. EPA- or California Air Resources Board-verified or-certified diesel emission reduction technologies. Thirty percent (approximately $14.8 million for FY 2016) of the DERA appropriation is allocated to states and territories in the form of assistance agreements under the State Clean Diesel Grant Program. Funding can support grant, rebate, and loan programs administered by eligible states or territories that are designed to achieve significant reductions in diesel emissions. Under the State Clean Diesel Grant Program, base funding is distributed to states and territories using a formula based on overall participation, and additional incentive funding is available to states and territories that provide voluntary matching funds. A table of state DERA allocations for earlier years is included in Appendix 5.

The DERA option under the Volkswagen Settlement provides states with an opportunity to increase their funding by using environmental mitigation trust funds as a voluntary match. For example, if State X receives $100,000 in formula DERA funds this year, the state can use environmental mitigation trust

funds to provide a $100,000 voluntary match. Because State X provided a 1-1 voluntary match, they are eligible to receive an additional $50,000 from DERA, bringing the project total to $250,000.



The DERA option also allows beneficiaries to use trust funds for actions not specifically enumerated in the consent decree, but otherwise eligible under DERA pursuant to all DERA guidance documents available through U.S. EPA. States may use the DERA option to fund grant, rebate, and loan programs for clean diesel projects that use: U.S. EPA -verified retrofit technologies or certified engine configurations; California Air Resources Board-verified retrofit technologies or certified engine configurations; idle-reduction technologies that are U.S. EPA-verified; aerodynamic technologies and low rolling resistance tires that are U.S. EPA verified, and; early engine, vehicle, or equipment replacements with certified engine configurations. While some of these options are covered under the preceding eligible mitigation actions, others (such as idle reduction technologies) are not specifically outlined in the final consent decree, but are eligible for funding under the DERA option.

The DERA option also provides some administrative flexibility to beneficiaries. Beneficiaries may use their final approved DERA workplan as their beneficiary mitigation plan as to those eligible mitigation actions funded through the DERA option. Beneficiaries may use their DERA proposal as their funding request for those eligible mitigation actions funded through the DERA option as well. Beneficiaries may also submit their DERA quarterly programmatic reports in satisfaction of its obligations under the beneficiary reporting obligations as to those eligible mitigation actions funded through the DERA option. Table 23 compares the actions covered under the VW mitigation trust compared to the actions covered under the DERA option.

Table 23: Vehicles Eligible for Emission Reduction Actions under DERA

Vehicles Eligible for Emission Reduction Actions	
VW	**DERA**
Many vehicles in both programs are eligible for **repower** options as well as replacement	
Class 8 **Local** Freight* > 33,000lbs (includes waste haulers, dump trucks and concrete mixers)	
Class 8 Drayage* trucks > 33,000lbs used for hauling cargo to and from ports and intermodal rail yards.	Drayage vehicles covered at a higher rate than highway vehicles
Class 4-8 School Buses*	Type A,B,C,D School Buses*
Class 4-8 Shuttle Buses*	
Class 4-8 Transit Buses*	Class 5-8 Transit Buses*
Pre-Tier 4 Freight Switcher (operates ≥1000 hours	Unregulated, Tier 1 or Tier 2 Locomotives

a year) (no long-distance line-haul locomotives)	(operates ≥1000 hours a year)** appears to include line-haul locomotives
Unregulated, Tier 1, or Tier 2 Ferries	Unregulated, Tier 1, or Tier 2 Marine Engine No other specifications-must be in use .1000 hours a year)
Unregulated, Tier 1, or Tier 2 Tugs	
Marine Shorepower	Marine Shorepower (falls under idle reduction technologies)
Class 4-7 Local Freight Trucks* trucks, including commercial trucks, used to deliver cargo and freight (e.g., courier services, delivery trucks, box trucks moving freight, waste haulers, dump trucks, concrete mixers) with a Gross Vehicle Weight Rating (GVWR) between 14,001 and 33,000 lbs.	Class 5-8 Heavy Duty Highway Vehicles
Tier 0, Tier 1 or Tier 2 diesel-or spark-ignition engine powered Airport Ground Support Equipment	Non-road engines for handling of cargo at port or airport
Forklifts with >8000 capacity (can be replaced with electric)	
Port Cargo Handling Equipment rubber-tired gantry cranes, straddle carriers, shuttle carriers, and terminal tractors, including yard hostlers and yard tractors that operate within ports.	Non-road engines equipment or vehicles used for handling of cargo at port or airport
	Non-road engines equipment or vehicles used for -Construction
	Non-road engines equipment or vehicles used for -Agriculture
	Non-road engines equipment or vehicles used for -Mining
	Non-road engines equipment or vehicles used for-energy production including stationary generators or pumps
Level 1 EVSE	
Level 2 EVSE	
DC Fast Charging	
Hydrogen Fuel Cell Supply Equipment	
	Exhaust Controls on diesel engines
	Engine upgrades
	Can cover cost differential of Cleaner Fuel Use (including biodiesel, NG, propane and others) if combined with eligible engine upgrade, repower or replacement or exhaust control.
	Locomotive Idle reduction technologies
	Truck Stop Electrification
	School Bus Idle reduction technologies
	Other idle reduction technologies when

	combined with exhaust reduction technologies
	Long Haul Class 8 trucks-Aerodynamic technologies and Low Rolling resistance tires
*1992-2009 engine model year (if states already require upgrades then 2010-2012)	*1994-2006 eligible for all program offerings, 2007-2010 eligible for limited program offerings

** Some vehicles are eligible for exhaust control and idle-reduction retrofits within this category beyond those listed.

Success Story: Emergency Response Vehicle Idling Reduction Technology

The Vermont Department of Environmental Conservation's Air Quality and Climate Division, through its Clean Diesel Grant Program, provides funding and technical support to install idle-reduction technology to eliminate the need for ambulance idling at a hospital. Funding from this program has been used to install seven electrically powered "kiosks" at three Vermont hospitals – Brattleboro Memorial Hospital, Porter Medical Center, and Regional medical Center.[100] Ambulances require energy to maintain onboard power equipment, provide a stable temperature for medicines, and transport patients. To provide this energy ambulances often idle for an extended period of time. The kiosks funded through this program power onboard equipment and provide climate control for an ambulance without needing to run the engine, thereby reducing exhaust fumes, saving fuel, and reducing air pollution and greenhouse gas emissions.

Conclusion

The environmental mitigation trust fund is a unique opportunity for states, tribes and territories to significantly reduce NO_X emissions from the transportation sector while also achieving complimentary energy, environmental, health and economic development goals. To access allocated funds under the environmental mitigation trust, states must apply to become a beneficiary and develop a beneficiary mitigation plan that provides a high-level summary of how they intend to use their allocated funds. Based on the partial consent decree and the research conducted for this paper, the following policy considerations are recommended when developing a mitigation plan for your jurisdiction.

Invest in Projects that Result in NO_X Reductions and Support Longer Term Goals

The goal of the mitigation trust is to reduce emissions of NO_X. States can inventory mobile sources of NO_X emissions using U.S. EPA National Emissions Inventory data and other emissions calculations tools, and align their mitigation plan to target the emitting sources. Replacing the heaviest-polluting vehicles is a good start.

Align Beneficiary Plan with State Goals

The VW mitigation trust can be used in such a way that it can help your state meet its energy goals, air quality and GHG emissions goals, and renewable portfolio standards.

Improve Energy Security

Some fuel sources have more supply and price volatility than others, choosing reliable and, if possible, domestic fuel sources for mitigation actions can reduce reliance of foreign oil.

Drive Economic Development

Different vehicle and fuel decisions will result in different levels of economic development in your state. Supporting start-up industries in your state, building on existing infrastructure, and selecting domestically produced fuel options has the potential to maximize economic development from the VW trust.

Improve Health

Using mitigation trust funds for mitigation actions in areas of concentrated development or near vulnerable populations can make the most of positive health outcomes associated with NO_X reduction.

Target Mitigation Actions to Disproportionately Affected Communities

The partial consent decree requires beneficiaries to take into consideration how their plan will impact air quality in areas that bear a disproportionate air pollution burden. Ensuring that mitigation actions address non-attainment areas, microenvironments with poor air quality, and vulnerable communities will help equalize damage mitigation.

Base Decision-Making on Total Cost of Ownership

The replacement vehicle with the lowest sticker price may not be the least expensive once fuel and maintenance are factored into the cost. Purchasing an alternative fuel vehicle might cost more up front, but it may be a better investment in the long run and keep more money in your local economy.

Appendix 1: List of Resources:

Volkswagen 2.0 Liter Settlement: Order Granting the United States' Motion To Enter Proposed Amended Consent Decree
https://www.cand.uscourts.gov/filelibrary/2869/Order-Granting-Entry-of-Consent-Decree.pdf
This document contains the full text of the Volkswagen 2.0 Liter Vehicle Settlement with U.S. EPA. Appendix D of the VW Settlement includes the initial allocation of funds to states, territories and tribes, and also describes the mitigation trust, the timeline for activating the trust and what mitigation actions are eligible for funding (and at what levels) from the trust.

Alternative Fuels Data Center:
http://www.afdc.energy.gov/data/10381
The Alternative Fuels Data Center is a resource of the U.S. Department of Energy's Clean Cities program. It offers comprehensive information, statistics, fuel prices, maps, calculators and tools to support a community's transition to alternative fuels. For anyone interested in transitioning fleets to alternative fuels, this is a good place to start.

Alternative Fuel and Advanced Vehicle Search
http://www.afdc.energy.gov/vehicles/search/

The U.S. Department of Energy Alternative Fuels Data Center has compiled a database of alternative fuel vehicles. The easy-to-use search format allows users to identify alternative fuel vehicles available in different vehicle types. Since not all vehicles eligible through VW mitigation actions are available in all fuel technologies, this is a good starting point for states, territories and tribes to identify available technologies for vehicles they wish to replace. Keep in mind that not all available alternative fuel vehicles are listed here. Some of the newest technologies might not be listed here.

AVoided Emissions and geneRation Tool (AVERT)
https://www.epa.gov/statelocalclimate/avoided-emissions-and-generation-tool-avert
This tool from U.S. Environmental Protection Agency estimates the emissions benefits of energy efficiency and renewable energy policies and programs. The tool provides resolution by estimating marginal emission impacts, and also allows temporal data (i.e. model impacts of charging EV certain hours rather than other hours of the day).

Clean Cities Coalitions
https://cleancities.energy.gov/coalitions/contacts/
Clean Cities Coalitions work with local fleets to develop and implement strategic plans to reduce petroleum use in the cities and counties they serve. Clean Cities Coordinators lead nearly 100 local coalitions in communities across the country.

Clean Diesel Clearinghouse
http://www.cleandieselclearinghouse.org/
For jurisdictions interested in repowering or replacing older diesel vehicles with new diesel vehicles or those interested in reducing NO_X emissions through retrofits as included in the DERA mitigation action,

the Clean Diesel Clearinghouse offers resources about best available technologies for diesel-powered vehicles and equipment. This website is developed and maintained by Emissions Advantage, a nonprofit corporation focused on reducing emissions from existing diesel-powered engines and equipment.

Costs Associated with Non-Residential Electric Vehicle Supply Equipment
Prepared by New West Technologies for the U.S. Department of Energy Vehicle Technologies Office. (November 2015)
http://www.afdc.energy.gov/uploads/publication/evse_cost_report_2015.pdf
This is a resource developed by the U.S. Department of Energy for the Clean Cities program. This guide provides a clear, concise overview of factors for entities to consider in the implementation of electric vehicle charging infrastructure design and development. In addition to describing the different levels of EVSE and their costs and attributes, it discusses operation and maintenance costs, planning strategies, and additional costs associated with EV charging infrastructure.

Emissions & Generation Resource Integrated Database (eGRID)
https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid
This database, developed and maintained by the U.S. EPA provides detailed information about pollution emitted from electric power generation throughout the United States in 2014. In the eGRID2014 Data Files (accessible from this page) Tab "ST14" contains "annual NO_X total output emission rate (lb/MWh)" in column "S". This number can be used to calculate potential NO_X emissions from electricity generation in your state which should be taken into account when determining NO_X emissions from vehicle electrification.

EPA National Emissions Inventory Data
https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-data
The 2014 National Emissions Inventory Data provides an easy-to-use resource for beneficiaries to use to assess pollutants (including NOx) by sector. This may a useful starting point for jurisdictions to use when determining how to optimize benefits from their VW settlement funds. It will to help states, territories and tribes understand sources of NOx pollution and inform actions that will have the greatest impact in mitigating NOx from these sources.

EPA DERA Option Factsheet for Mitigation Action #10
https://www.epa.gov/sites/production/files/2017-01/documents/vw-dera-option-factsheet-2017-01.pdf
The U.S. EPA has developed this factsheet for jurisdictions interested in using settlement funds for mitigation action #10, leveraging funds under the Diesel Emissions Reduction Act (DERA). This fact sheet provides a comparison between the funding limits of eligible mitigation actions one through nine to the DERA funding limits. It also highlights (literally) vehicles and activities eligible for funding under the DERA program that are not covered under the other eligible mitigation actions in the VW settlement including retrofits, line haul locomotives, truck hoteling, construction equipment, agricultural equipment, mining equipment and others. The resource explains the cost-share requirements for beneficiaries and voluntary match opportunities through the DERA program.

Federal Highway Administration Alternative Fuel Corridors Maps

http://www.fhwa.dot.gov/environment/alternative_fuel_corridors/maps/

For jurisdictions considering mitigation action #9, the build out of light-duty zero emissions vehicle infrastructure, this map, developed by the Federal Highway Administration, outlines alternative fuel corridors designated by the FHWA. Opportunities for multi-state collaboration and regional cooperation exist for states, tribes and territories interested in the build-out of a national network for ZEV infrastructure.

National Ports Strategy Assessment: Reducing Air Pollution and Greenhouse Gases at U.S. Ports

https://www.epa.gov/sites/production/files/2016-09/documents/420r16011.pdf

For states, territories and tribes that have ports, the Environmental Protection Agency Office of Transportation Air Quality has developed an assessment of current air pollution sources at ports as well as strategies for reducing air pollution and greenhouse gases at ports. The assessment develops scenarios estimates emissions reductions based on different scenarios and strategies. The document also provides estimated NOx (and other pollutants and greenhouse gases) reduction for vehicles that are eligible mitigation actions in the VW settlement including drayage trucks, rail switchers, cargo handling equipment, and harbor craft (tugs and ferries).

NGVAmerica Website

http://www.ngvamerica.org/

NGVAmerica is a national trade organization focused on the development of a market for vehicles powered by natural gas and biomethane. Their website offers resources for entities interested in repowering or replacing fleet vehicles with natural gas. The website includes lists of vehicles available that are powered by natural gas or biomethane, aftermarket conversion systems, and cost calculators.

Plug-In Electric Vehicle Readiness Scorecard

https://www.afdc.energy.gov/pev-readiness

This online tool, developed by the U.S. Department of Energy for the Clean Cities program is designed to help communities assess how prepared they are for market growth of plug-in electric vehicles. Communities can expect to use roughly 20.5 hours to use this tool and obtain results including reviewing instructions, gathering and maintaining data needed and reviewing results.

Propane Clean Energy America Website

http://www.propane.com/

The Propane Education and Research Council maintains a website offering information about propane vehicles, case studies, propane retailers and calculators. Also includes information about U.S. EPA- and CARB- certified propane autogas conversions. For jurisdictions interested in transitioning to propane vehicles, this website offers a good starting point.

Appendix 2: Initial Allocation of Mitigation Trust Funds

INITIAL SUBACCOUNTS	INITIAL ALLOCATIONS ($) 2.0 LITER SETTLEMENT	INITIAL ALLOCATIONS ($) 3.0 LITER SETTLEMENT	TOTAL INITIAL ALLOCATION ($)
Alabama	$ 24,084,727	$ 1,396,241	$ 25,480,968
Alaska	$ 7,500,000	$ 625,000	$ 8,125,000
Arizona	$ 53,013,862	$ 3,646,216	$ 56,660,078
Arkansas	$ 13,951,016	$ 696,693	$ 14,647,709
California	$ 381,280,175	$ 41,356,145	$ 422,636,320
Colorado	$ 61,307,576	$ 7,432,342	$ 68,739,918
Connecticut	$ 51,635,238	$ 4,085,932	$ 55,721,170
Delaware	$ 9,051,683	$ 625,000	$ 9,676,683
District of Columbia	$ 7,500,000	$ 625,000	$ 8,125,000
Florida	$ 152,379,151	$ 13,899,594	$ 166,278,745
Georgia	$ 58,105,433	$ 5,519,292	$ 63,624,726
Hawaii	$ 7,500,000	$ 625,000	$ 8,125,000
Idaho	$ 16,246,892	$ 1,102,145	$ 17,349,037
Illinois	$ 97,701,054	$ 10,978,623	$ 108,679,677
Indiana	$ 38,920,040	$ 2,015,841	$ 40,935,881
Iowa	$ 20,179,541	$ 1,022,197	$ 21,201,738
Kansas	$ 14,791,373	$ 870,866	$ 15,662,239
Kentucky	$ 19,048,080	$ 1,330,569	$ 20,378,650
Louisiana	$ 18,009,993	$ 1,838,812	$ 19,848,805
Maine	$ 20,256,436	$ 796,628	$ 21,053,064
Maryland	$ 71,045,825	$ 4,668,413	$ 75,714,238
Massachusetts	$ 69,074,008	$ 5,990,416	$ 75,064,424
Michigan	$ 60,329,906	$ 4,477,108	$ 64,807,015
Minnesota	$ 43,638,120	$ 3,363,542	$ 47,001,661
Mississippi	$ 9,249,414	$ 625,000	$ 9,874,414
Missouri	$ 39,084,816	$ 2,067,236	$ 41,152,052
Montana	$ 11,600,215	$ 1,002,210	$ 12,602,425
Nebraska	$ 11,528,812	$ 719,535	$ 12,248,347
Nevada	$ 22,255,715	$ 2,618,309	$ 24,874,024
New Hampshire	$ 29,544,298	$ 1,370,543	$ 30,914,841
New Jersey	$ 65,328,105	$ 6,886,980	$ 72,215,085
New Mexico	$ 16,900,503	$ 1,082,158	$ 17,982,661
New York	$ 117,402,745	$ 10,299,062	$ 127,701,807
North Carolina	$ 87,177,374	$ 4,868,284	$ 92,045,658
North Dakota	$ 7,500,000	$ 625,000	$ 8,125,000
Ohio	$ 71,419,317	$ 3,883,206	$ 75,302,523

Oklahoma	$	19,086,528	$	1,835,957	$	20,922,485
Oregon	$	68,239,144	$	4,728,375	$	72,967,518
Pennsylvania	$	110,740,311	$	7,829,229	$	118,569,540
Puerto Rico	$	7,500,000	$	625,000	$	8,125,000
Rhode Island	$	13,495,137	$	873,721	$	14,368,858
South Carolina	$	31,636,950	$	2,258,541	$	33,895,491
South Dakota	$	7,500,000	$	625,000	$	8,125,000
Tennessee	$	42,407,794	$	3,352,121	$	45,759,914
Texas	$	191,941,816	$	17,377,347	$	209,319,164
Utah	$	32,356,471	$	2,821,035	$	35,177,506
Vermont	$	17,801,277	$	890,853	$	18,692,130
Virginia	$	87,589,313	$	6,044,667	$	93,633,980
Washington	$	103,957,041	$	8,788,609	$	112,745,650
West Virginia	$	11,506,842	$	625,000	$	12,131,842
Wisconsin	$	63,554,019	$	3,523,438	$	67,077,458
Wyoming	$	7,500,000	$	625,000	$	8,125,000
Tribal Administration Cost Subaccount	$	993,057	$	95,901	$	1,088,958
Tribal Allocation Subaccount	$	49,652,858	$	4,795,064	$	54,447,921
Trust Administration Cost Subaccount	$	27,000,000	$	2,250,000	$	29,250,000
TOTAL	$	2,700,000,000	$	225,000,000	$	2,925,000,000

Appendix 3: Certification Form

Appendix 4: NO_X Emissions by State from Electricity Generation[101]

State Abbreviation	Annual NO_X output per lb/MWh	
VT	0.0599	Lowest NO_X Emission Rate
ID	0.0839	
WA	0.1172	
OR	0.1492	
CA	0.1834	
RI	0.1835	
NJ	0.1991	
CT	0.2467	
NY	0.3408	
NH	0.3736	
SC	0.4391	
NV	0.5553	
DE	0.5588	
IL	0.5941	
MA	0.6124	
TN	0.6169	
ME	0.6292	
GA	0.6320	
AL	0.6446	
FL	0.6565	
TX	0.6989	
VA	0.7047	
MS	0.7671	
NC	0.8345	
WI	0.8588	
AZ	0.8863	
MD	0.9396	
U.S. Average	0.9461	
LA	1.1146	
AR	1.1494	
MN	1.1684	
PA	1.1942	
DC	1.2636	
MT	1.3014	
IA	1.3055	
MI	1.3151	
OH	1.3466	
WV	1.3779	
KS	1.5494	
MO	1.5855	
NE	1.6631	
OK	1.7597	
KY	1.7889	
SD	1.8056	
IN	1.8591	
CO	1.9442	
WY	2.0002	
UT	2.6376	
ND	2.7014	
HI	2.9292	Highest NO_X Emission Rate
NM	3.2921	
AK	3.3856	

Appendix 5: DERA Allocations by State

State	DERA 2016	DERA 2015	DERA 2014	DERA 2013	DERA 2012
Alabama	$209,623	$133,273	$86,497	$118,698	$137,063
Alaska	$286,241	$172,879	$76,467	did not participate	did not participate
American Samoa	$70,715	$42,480	did not participate	$17,781	$28,494
Arizona	$217,069	did not participate	did not participate	$81,993	did not participate
Arkansas	$301,522	$187,678	$122,855	$113,736	$191,286
California	$539,412	$418,650	$249,792	$205,152	$454,899
Colorado	$210,775	$134,912	$87,111	$79,575	$138,339
Connecticut	$204,054	$127,883	$83,525	$76,992	$130,892
Delaware	$191,694	$174,106	$115,395	$108,363	see footnote
District of Columbia	did not participate	did not participate	did not participate	$71,717	$115,680
Florida	did not participate	did not participate	did not participate	did not participate	did not participate
Georgia	$348,436	$234,726	$147,888	$131,764	$243,273
Guam	did not participate	did not participate	did not participate	$26,966	$29,060
Hawaii	$194,787	$117,902	$78,000	see footnote	see footnote
Idaho	$370,210	$119,066	$78,580	$73,431	$120,623
Illinois	$326,240	$255,136	$159,507	$140,131	$267,401
Indiana	$302,426	$211,444	$136,044	$123,234	$218,676
Iowa	$200,725	$125,625	$82,225	$76,055	$128,191
Kansas	$301,087	did not participate	did not participate	$113,569	$190,803
Kentucky	did not participate	did not participate	did not participate	$78,350	$134,809
Louisiana	$193,682	$132,376	$85,889	$78,695	see footnote
Maine	$214,213	$117,960	$77,991	$109,509	$179,098
Maryland	$217,788	$137,789	$88,946	$121,344	$142,149
Massachusetts	$349,794	$212,694	did not participate	$123,404	see footnote
Michigan	$318,066	$234,879	$148,612	$132,286	$244,777
Minnesota	$301,878	$203,680	$131,682	$120,093	$209,619
Mississippi	$322,811	$188,016	$123,045	$113,873	$191,680
Missouri	$192,117	$139,019	$134,215	$121,917	$214,877
Montana	$195,982	$116,468	$77,155	$108,607	$176,496
Nebraska	$200,020	$120,192	$79,218	$73,890	see footnote
Nevada	$193,627	$123,974	did not participate	$75,442	$126,421
New Hampshire	$228,153	$118,007	did not participate	$72,985	see footnote
New Jersey	$342,230	$226,822	$144,576	$129,379	see footnote
New Mexico	$197,058	$121,191	$79,792	$74,303	$123,139
New York	$277,047	$299,731	$122,474	$157,562	see footnote
North Carolina	$231,588	$231,704	$147,325	$131,359	$242,104
North Dakota	$190,654	$115,007	$76,375	$107,764	$174,063
N. Mariana Islands	did not participate	did not participate	did not participate	$26,678	$42,756
Ohio	$240,830	$245,642	$154,722	$136,686	$257,466

Oklahoma	did not participate	did not participate	$154,722	see footnote	$197,699
Oregon	$307,862	$194,034	$126,238	$116,172	$132,207
Pennsylvania	$246,214	$168,694	$106,022	$93,193	$177,611
Puerto Rico	$204,755	did not participate	did not participate	$115,892	$197,503
Rhode Island	$192,409	did not participate	did not participate	see footnote	see footnote
South Carolina	$313,365	$199,018	$129,174	$118,287	$204,409
South Dakota	$191,308	$115,751	$76,724	$72,094	$116,767
Tennessee	$216,857	$140,482	$90,357	$81,912	$145,079
Texas	did not participate	$225,079	$136,688	$115,278	$241,295
Utah	$300,469	$187,144	$122,293	$113,331	$190,119
Vermont	$190,437	$114,865	$76,259	$107,639	$115,803
Virginia	$224,501	$147,716	$94,435	$84,849	$153,549
Virgin Islands	did not participate	did not participate	did not participate	$26,785	$28,712
Washington	$327,908	$213,467	did not participate	did not participate	did not participate
West Virginia	did not participate	did not participate	did not participate	see footnote	$122,084
Wisconsin	$320,720	$206,222	$133,098	$121,113	$212,559
Wyoming	$190,150	did not participate	did not participate	$107,473	$173,227

Footnote: These states have elected to concentrate on grants from previous years

[1] "Volkswagen to Spend Up To $14.7 Billion to Settle Allegations of Cheating Emissions Tests and Deceiving Customers on 2.0 Liter Diesel Vehicles." U.S. Department of Justice, Office of Public Affairs, Justice News. June 28, 2016. https://www.justice.gov/opa/pr/volkswagen-spend-147-billion-settle-allegations-cheating-emissions-tests-and-deceiving

[2] Barret, Steven et al. "Impact of the Volkswagen Emissions Control Defeat Device on US Public Health." *2015 Environmental Research Letters*. 10 (2015) 114005. http://iopscience.iop.org/article/10.1088/1748-9326/10/11/114005/pdf

[3] Gates, Gilbert et al. "How Volkswagen Has Grappled With Its Diesel Scandal." *New York Times*. January 11, 2017. http://www.nytimes.com/interactive/2015/business/international/vw-diesel-emissions-scandal-explained.html

[4] Kodjak, Drew. "Taking Stock of the VW Settlement Agreement." *International Council on Clean Transportation*, July 15, 2016. http://www.theicct.org/blogs/staff/taking-stock-vw-settlement-agreement

[5] "Second Partial Consent Decree." *In RE: Volkswagen "Clean Diesel" Marketing, Sales Practices, and Products Liability Litigation*. Case No: MDL No. 2672 CRB (JSC). December 20, 2016. https://www.epa.gov/sites/production/files/2016-12/documents/30literpartialconsentdecree.pdf

[6] "Order Granting the United States' Motion To Enter Proposed Amended Consent Decree." *In RE: Volkswagen "Clean Diesel" Marketing, Sales Practices, and Products Liability Litigation*. MDL No. 2672 CRB (JSC). October 25, 2016. Appendix D. https://www.cand.uscourts.gov/filelibrary/2869/Order-Granting-Entry-of-Consent-Decree.pdf

[7] *Ibid.*

[8] "Nitrogen Oxides (NO_X): Why and How they are Controlled." *Clean Air Technology Center, EPA Technical Bulletin*. November 1999. Page 1. https://www3.epa.gov/ttncatc1/dir1/fnoxdoc.pdf

[9] "Integrated Science Assessment for Particulate Matter." *U.S. Environmental Protection Agency*. EPA 600/R-08/139F, December, 2009. Pages 2-10, 2-11. https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=216546

[10] Barret, Steven. Page 1. http://iopscience.iop.org/article/10.1088/1748-9326/10/11/114005/pdf

[11] "Nitrogen Oxides (NO_X): Why and How they are Controlled." Page 1. https://www3.epa.gov/ttncatc1/dir1/fnoxdoc.pdf

[12] *Ibid*, Page 7.

[13] "Fact #951: November 14, 2016 Medium and Heavy Trucks Account for About A Quarter of Highway Vehicle Fuel Use." U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. November 14, 2016. http://energy.gov/eere/vehicles/fact-951-november-14-2016-medium-and-heavy-trucks-are-responsible-disproportionate

[14] "Greenhouse Gas Emissions Targets." *Center for Climate and Energy Solutions*. September, 2016. https://www.c2es.org/us-states-regions/policy-maps/emissions-targets

[15] Durkay, Jocelyn. "State Renewable Portfolio Standards and Goals." *National Conference of State Legislatures*. December 28, 2016. http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx

[16] Most "vehicle to grid" projects are still in the pilot phase, and the technology is not yet commercially available.

[17] "Hydrogenation-Derived Renewable Diesel." *U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy*. http://www.afdc.energy.gov/fuels/emerging_green.html

[18] "Mayor Lee Announces San Francisco to Use Renewable Diesel in City Fleet." *City and County of San Francisco, Office of the Mayor.* July 21, 2015. http://sfmayor.org/article/mayor-lee-announces-san-francisco-use-renewable-diesel-city-fleet

[19] "Renewable Fuel Standard." *U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Alternative Fuels Data Center.* http://www.afdc.energy.gov/laws/RFS

[20] "Environmental Benefits." *Natural Gas Vehicles for America*. https://www.ngvamerica.org/natural-gas/environmental-benefits/

[21] "Natural Gas Benefits and Considerations." *U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Alternative Fuels Data Center.* http://www.afdc.energy.gov/fuels/natural_gas_benefits.html

[22] "Average Retail Fuel Prices in the U.S." *U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Alternative Fuels Data Center.* March, 2017. http://www.afdc.energy.gov/data/10326

[23] Electricity prices are reduced by a factor of 3.4 because electric motors are approximately 3.4 times as efficient as internal combustion engines. Propane prices reflect the weighted average of "primary" and "secondary" stations.

[24] "IARC: Diesel Engine Exhaust Carcinogenic." *World Health Organization, International Agency for Research on Cancer*. June 12, 2012. Page 1. https://www.iarc.fr/en/media-centre/pr/2012/pdfs/pr213_E.pdf

[25] *Ibid*. Page 1.

[26] "Health Effects of Diesel Exhaust." *Cal/EPA's Office of Environmental Health Hazard Assessment and The American Lung Association of California.* Page 2. http://oehha.ca.gov/media/downloads/calenviroscreen/indicators/diesel4-02.pdf

[27] "Integrated Science Assessment for Particulate Matter." Pages 2-10, 2-11. https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=216546

[28] Caiazzo, Fabio, et al. "Air Pollution and Early Deaths in the United States. Part 1: Quantifying the Impact of Major Sectors in 2005." *Atmospheric Environment*. 79 (2013) 198-208. May, 2013. Page 203. http://lae.mit.edu/wordpress2/wp-content/uploads/2013/08/US-air-pollution-paper.pdf

[29] "School Bus Emissions and Retrofits Factsheet." *Vermont Air Quality and Climate Division*. April, 2016. Page 1. http://dec.vermont.gov/sites/dec/files/aqc/mobile-sources/documents/SchoolBus_FactSheet.pdf

[30] "Order Granting the United States' Motion To Enter Proposed Amended Consent Decree." Appendix D, 5.2.10. https://www.cand.uscourts.gov/filelibrary/2869/Order-Granting-Entry-of-Consent-Decree.pdf

[31] "Counties Designated 'Nonattainment' or 'Maintenance.'" *U.S. Environmental Protection Agency* https://www3.epa.gov/airquality/greenbook/mapnmpoll.html

[32] "Current Nonattainment Counties for All Criteria Pollutants." U.S. Environmental Protection Agency. February 13, 2017. https://www3.epa.gov/airquality/greenbook/ancl.html

[33] Hopkins, Jamie Smith. "The Invisible Hazard Afflicting Thousands of Schools." *The Center for Public Integrity.* February 20, 2017. https://www.publicintegrity.org/2017/02/17/20716/invisible-hazard-afflicting-thousands-schools

[34] *Ibid.*

[35] Zubak-Skees, Chris. "Is Your School Near a Busy Road and Its Air Pollution?" *The Center for Public Integrity.* February 17. 2017. https://www.publicintegrity.org/2017/02/17/20723/your-school-near-busy-road-and-its-air-pollution

[36] "Order Granting the United States' Motion To Enter Proposed Amended Consent Decree." Appendix D2, Page 12. https://www.cand.uscourts.gov/filelibrary/2869/Order-Granting-Entry-of-Consent-Decree.pdf

[37] *Ibid.*

[38] "What Is Clean Diesel?" *Diesel Technology Forum*. http://www.dieselforum.org/about-clean-diesel/what-is-clean-diesel

[39] O'Keefe, Bob. "Diesel Exhaust and Health Remarkable Progress, Lingering Concerns." Health Effects Institute, Clean Air Act Advisory Committee. September, 2012. https://www.epa.gov/sites/production/files/2014-09/documents/2012_09_okeefe.pdf

[40] Calculated by comparing lifetime mileage-weighted average NOx emission factors (g/mile) for 1995 model year school bus with NOx emission factors from 2015 model year school bus. Cai, Hao et al. "Updated Emission Factors of Air Pollutants from Vehicle Operations in GREET Using MOVES." September 2013. Table A12. https://greet.es.anl.gov/publication-vehicles-13

[41] O'Keefe.

[42] "Propane Prices: What Consumers Should Know." U.S. Energy Information Administration. April 2007. https://www.npga.org/files/public/Propane%20Prices%20What%20Consumers%20Should%20Know.pdf

[43] Smith, Margaret et al. "Costs Associated with Propane Vehicle Fueling Infrastructure." *U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy.* August, 2014. Pages 6-7. http://www.afdc.energy.gov/uploads/publication/propane_costs.pdf

[44] "Costs Associated with Propane Vehicle Fueling Infrastructure." *U.S. Department of Energy*. 2014. Page 2. http://www.afdc.energy.gov/uploads/publication/propane_costs.pdf

[45] "Environmentally Friendly." *Roush CleanTech.* http://www.roushcleantech.com/environmental-2/

[46] "State of Charge." *Union of Concerned Scientists.* September, 2014. http://www.ucsusa.org/clean-vehicles/electric-vehicles/emissions-and-charging-costs-electric-cars#.WLncyvnytPY

[47] "Emissions from Hybrid and Plug-In Electric Vehicles." *U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Alternative Fuels Data Center.* http://www.afdc.energy.gov/vehicles/electric_emissions.php

[48] "Power Plant Emission Trends." *U.S. Environmental Protection Agency.* https://www3.epa.gov/airmarkets/progress/datatrends/index.html

[49] "The Greenhouse gases, Regulated Emissions, and Energy use in Transportation Model." *Argonne National Laboratory.* https://greet.es.anl.gov/

[50] "Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) Tool." *Argonne National Laboratory*. https://greet.es.anl.gov/afleet

[51] "MOtor Vehicle Emission Simulator." *U.S. Environmental Protection Agency.* https://www.epa.gov/moves/moves2014a-latest-version-motor-vehicle-emission-simulator-moves#manuals

[52] DEQ: https://www.epa.gov/cleandiesel/diesel-emissions-quantifier-deq The Clean Diesel Helpline is a useful resource for users of the DEQ and can be reached at 1-877-623-2322 or cleandiesel@epa.gov.

[53] An updated version of the DEQ will be released in 2017, and will include a more robust set of alternative fuel input options.

[54]"Order Granting the United States' Motion To Enter Proposed Amended Consent Decree." Appendix D, Page 2. https://www.cand.uscourts.gov/filelibrary/2869/Order-Granting-Entry-of-Consent-Decree.pdf

[55] "U.S. EPA National Port Strategy Assessment." *U.S. Environmental Protection Agency, Office of Transportation and Air Quality.* September 2016. Page 14. https://www.epa.gov/ports-initiative/national-port-strategy-assessment

[56] "Types of Vehicles by Weight Class." *U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Alternative Fuels Data Center.* http://www.afdc.energy.gov/data/10381

[57] "National Port Strategy Assessment: Reducing Air Pollution and Greenhouse Gases at U.S. Ports." *U.S. EPA. Office of Transportation and Air Quality*. Page 43, Table 5-3. https://www.epa.gov/ports-initiative/national-port-strategy-assessment

[58] "Case Study – Compressed Natural Gas Refuse Fleets." *U.S. Department of Energy, Office of Efficiency and Renewable Energy.* February 2014. http://www.afdc.energy.gov/uploads/publication/casestudy_cng_refuse_feb2014.pdf photo from City of Milwaukee

[59] These calculations were performed in the AFLEET tool using the default values for mileage (16,500/year), fuel economy, and emission factors. The analysis was done to mirror the case study using data from Milwaukee, Wisconsin.

[60] "Order Granting the United States' Motion To Enter Proposed Amended Consent Decree." Appendix D2, 2e, Page 3. https://www.cand.uscourts.gov/filelibrary/2869/Order-Granting-Entry-of-Consent-Decree.pdf

[61] "Definitions of School Bus Vehicles." *Minnesota Department of Public Safety* https://dps.mn.gov/divisions/msp/forms-reports/Documents/SBTypesPhotos.pdf

[62] These calculations were performed in the AFLEET tool using the default values for mileage (15,000/year), fuel economy, and emission factors. The analysis was done to mirror the case study using data from Anoka County, Minessota.

[63] Photo courtesy of LeSage, Jon. "Minnesota District Opts for Propane." *Fleets and* Fuels. November 3, 2015. http://www.fleetsandfuels.com/fuels/propane/2015/11/minnesota-school-district-chooses-propane/

[64] *Ibid.*

[65] "Case Study – Propane School Bus Fleets." *U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy.* August, 2014. http://www.afdc.energy.gov/uploads/publication/case-study-propane-school-bus-fleets.pdf

[66] As long as each option meets the applicable EPA emissions standards (or other more stringent equivalent State standard) as published in the CFR for the engine model year in which the Eligible Freight Switcher Mitigation Action occurs.

[67] "National Port Strategy Assessment: Reducing Air Pollution and Greenhouse Gases at U.S. Ports." *U.S. EPA. Office of Transportation and Air Quality*. Page 54, Table 5-15. https://www.epa.gov/ports-initiative/national-port-strategy-assessment

[68] Photo and analysis courtesy of Nordco Mobile Railcar Movers. SW1000 is an older diesel freight switcher; http://www.nordco.com/Media/ElectricSpecSheet.compressed1.pdf

[69] Correspondence with Nathan Yoder, Nordco, December 1, 2016.

[70] Photos courtesy of Riley, Alison. "National Clean Diesel Campaign: DERA and Freight." *U.S. Environmental Protection Agency Region 3 Presentation*. August 30, 2016. http://baltometro.org/phocadownload/Events/NTAQS_2016/4.2Riley_NTAQS2016.pdf

"Amtrak Celebrates Earth Day with Repowered Locomotives that Reduce Diesel Emissions." *Amtrak News Release.* April 22, 2014. https://www.amtrak.com/ccurl/593/829/Amtrak-Celebrates-Earth-Day-With-New-Locomotives-that-Reduce-Diesel-Emissions-ATK-14-039,0.pdf

[71] "National Port Strategy Assessment: Reducing Air Pollution and Greenhouse Gases at U.S. Ports." *U.S. EPA. Office of Transportation and Air Quality*. Page 71, Table 5-36. https://www.epa.gov/ports-initiative/national-port-strategy-assessment

[72] *Ibid*, Page 75, Table 5-41.

[73] Photo courtesy of Massa, Krysten. "Cross Sound Ferry Vessel Receives New Low-Emission Engines." *The Suffolk Times*. October 12, 2016. http://suffolktimes.timesreview.com/2016/10/71054/cross-sound-ferry-vessel-receives-new-low-emission-engines/

[74] Civiletti, Denise. "Cross Sound Ferry Repowers High-Speed Ferry With New, Cleaner Engines." *Southold Local.* October 14, 2016. http://southoldlocal.com/2016/10/14/cross-sound-ferry-repowers-high-speed-ferry-new-cleaner-engines/

Massa, Krysten. http://suffolktimes.timesreview.com/2016/10/71054/cross-sound-ferry-vessel-receives-new-low-emission-engines/

[75] McGill, Ralph et al. "Alternative Fuels for Marine Applications." *IEA Advanced Motor Fuels Implementing Agreement.* May, 2013. Page 15. http://www.iea-amf.org/app/webroot/files/file/Annex%20Reports/AMF_Annex_41.pdf

[76] Haynes, John. "Hybrid Technology for Military and Commercial Vessels." *Marine Link.* June 15, 2016. http://www.marinelink.com/news/technology-commercial411276.aspx

[77] McGill, Ralph et al. Page 4.

[78] "Mobile Source Pollution Reduction: Marine Vessels – Shore Power Plug-In." *Rhode Island Department of Environmental Management.* http://www.dem.ri.gov/mobile/pdf/story6.pdf

[79] *Ibid,* Page 2.

[80] Reduction numbers were converted from Kg to pounds. USEPA Diesel Emission Quantifier (version 2009) kg/day emission reduction Note: Assume generator size per vessel 39 kW, 6 vessels, 50 days in port/year AP-42 section 3.3 October 1996 emission factors used for generator.

[81] These data are based on AFLEET calculations using default values. NG data from: Werpy, Marcy et al. "Natural Gas Vehicles: Status, Barriers and Opportunities." *Argonne National Labs, Energy Systems Division*. August 2010. http://www.afdc.energy.gov/pdfs/anl_esd_10-4.pdf.

[82] Propane emissions estimates are based on EPA 2015 emission factors for LPG medium- and Heavy-duty vehicles and include only N_2O emissions.: "Emissions Factors for Greenhouse Gas Inventories." *U.S. Environmental Protection Agency*. November 19, 2015. https://www.epa.gov/sites/production/files/2015-11/documents/emission-factors_nov_2015.pdf

[83] "Rolling Lab Paves Way for Next Generation Vehicles." *UPS*. May 3, 2016. https://pressroom.ups.com/pressroom/ContentDetailsViewer.page?ConceptType=PressReleases&id=1462222330617-569

"Fleet is Part of Clean Air Project with U.S. Department of Energy, Local Governments and Non-Profit." *UPS*. October 28, 2015. https://pressroom.ups.com/pressroom/ContentDetailsViewer.page?ConceptType=PressReleases&id=1446039616630-395

[84] "2015 Corporate Sustainability Report." *UPS.* 2015. Page 78. https://sustainability.ups.com/media/ups-pdf-interactive/UPS_2015_CSR.pdf

[85] "Stepvans." *Workhorse.* http://workhorse.com/stepvans

[86] E-Gen savings based on electricity costs of $0.11 per KWh and $53,000 lifetime maintenance and go-forward diesel prices of $2.50/gallon and lifetime maintenance costs of $120,000. "Savings." *Workhorse.* http://workhorse.com/stepvans

[87] "ACRP Airport Ground Support Equipment: Emission Reduction Strategies, Inventory and Tutorial." *Transportation Research Board,* 2012. Appendix B, Page B-1. https://www.nap.edu/download/22681

[88] "Sea-Tac Airport to Convert all Ground Support Vehicles to Electric Power." *Passenger Terminal Today.* March 20, 2014. http://www.passengerterminaltoday.com/viewnews.php?NewsID=57271

[89] "2015 Annual Clean Cities Awards at the Green Transportation Summit &Expo." *Western Washington Clean Cities*. http://wwcleancities.org/2015-annual-clean-cities-awards-at-the-green-transportation-summit-expo/

[90] "Sea-Tac Airport Unveils Electrification Project to Save Airlines Millions in Fuel and Dramatically Reduce Greenhouse Gas Emissions." *PR Newswire.* March 18, 2014. http://www.prnewswire.com/news-releases/sea-tac-airport-unveils-electrification-project-to-save-airlines-millions-in-fuel-and-dramatically-reduce-greenhouse-gas-emissions-250857101.html

[91] Bond, Josh. "Top 20 Lift Turck Suppliers, 2015." *Modern Materials Handling. August 1, 2015.* http://www.mmh.com/article/top_20_lift_truck_suppliers_2015

[92] Kim, Jae et al. "Life-Cycle Emissions from Port Electrification: A Case Study of Cargo Handling Tractors at the Port of Los Angeles." *International Journal of Sustainable Transportation*, 6:6, 321-337. December 22, 2011. http://urbansustainability.snre.umich.edu/wp-content/uploads/2012/10/Life-Cycle-Emissions-from-Port-Electification-A-Case-Study-of-Cargo-Handling-Tractors-at-the-Port-of-Los-Angeles..pdf

[93] "National Port Strategy Assessment: Reducing Air Pollution and Greenhouse Gases at U.S. Ports." Page 59, Table 5-20.

[94] *Ibid*, Page 63, Table 5-25.

[95] *Ibid*, Page 66, Table 5-30.

[96] "DHL Supply Chain/Exel Fleet Case Study." *Drive Clean Chicago, Chicago Department of Transportation*. http://www.drivecleanchicago.com/assets/DHLExelcasestudy.pdf

[97] "Costs Associated with Non-Residential Electric Vehicle Supply Equipment." *U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy.* November, 2015. http://www.afdc.energy.gov/uploads/publication/evse_cost_report_2015.pdf

[98] "Massachusetts Drive Clean Workplace Charging Guide." *Plug In America.* 2016. http://www.mass.gov/eea/docs/ma-zero-emission-vehicle-commission-and-mass-drive-clean-campaign/pia-ma-wkplcchggd-web6.pdf

[99] "National Clean Diesel Campaign: FY 2014-2016 State Clean Diesel Grant Program Information Guide." *U.S. Environmental Protection Agency, Office of Transportation and Air Quality.* March 1, 2016. https://goo.gl/VpDLIS

[100] "Vermont Clean Diesel Grant Projects." *Vermont Department of Environmental Conservation.* http://dec.vermont.gov/air-quality/mobile-sources/diesel-emissions/clean-diesel-projects

[101] From EPA egrid 2012 data https://www.epa.gov/energy/egrid