West Coast Climate & Materials Management Forum

FUEL

Opportunities to Reduce Carbon Emissions from Diesel

Climate Friendly Purchasing Toolkit

WEST COAST CLIMATE & MATERIALS MANAGEMENT FORUM

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Table of Contents

Opportunities to Reduce Carbon Emissions from Diesel Fuel

Overview

Government institutions are large purchasers of fuel for both direct consumption in daily operations and through the use of fuel by contractors under service agreements. The two largest uses of fuel by government institutions are diesel-fueled vehicles used for the transport of goods[1], and operation of diesel-fueled on-road and off-road construction, renovation, and maintenance equipment and vehicles. The biggest consumers of the construction/renovation/maintenance services are government institutions that manage public works projects, including construction, renovation and maintenance of public buildings, transport infrastructure, public spaces, hazardous waste cleanup sites, and public services.

The primary focus of this guidance is reducing GHG emissions from the operation of diesel-fueled equipment and vehicles in construction and maintenance-related activities. It does not cover Scope 1 impacts related to the use of diesel generators, or the diesel vehicles that are part of government fleets used for travel. It also does not cover Scope 3 impacts from the delivery of goods in diesel-fueled trucks or by rail, or Scope 3 impacts that are not purchasing related (e.g., employee commute in diesel vehicles). Some of the strategies provided are applicable to both off-road trucks and equipment and on-road trucks. For more information on mitigating the impacts of the transportation of goods, please see SPLC's *Guidance for Leadership in Sustainable Purchasing v1.0 - Purchasing Category Guidance for Transportation and Fuels* chapter.[2]

Primary focus of this guidance

1) **Opportunities for reducing diesel emissions from construction, renovation and maintenance activities purchased by government institutions (the supply chain portion of Scope 3) or conducted by government institutions (Scope 1).**

[1] For Fiscal Year 2008, the Federal government spent far in excess of the $24.666 billion budgeted in line items for agencies' transportation of goods. This did not include billions spent on the transportation related to purchasing services, supplies and equipment. Nor would it have included the emissions impacts of non-transport related diesel fueled equipment. USGSA, Transportation Policy Program: http://www.gsa.gov/graphics/ogp/transportation-factsheet.pdf. See also GSA, "2014 Federal Fleet Report" http://www.gsa.gov/portal/category/102859.

[2] The Sustainable Purchasing Leadership Council (SPLC) is a non-profit organization whose mission is to support and recognize purchasing leadership that accelerates the transition to a prosperous and sustainable future. For more information: www.sustainablepurchasing.org.

Scope 3 emissions result from the purchase of goods and services by an institution (e.g., university contracts with a construction company to build new dormitories). Scope 3 would include the emissions resulting from contractor choices of construction equipment as well as how the contractor uses that equipment. **Scope 1 emissions** occur when the construction, renovation and maintenance emissions occur from owned facilities and equipment under the direct control of the institution (e.g., county public works department uses its in-house diesel-fueled equipment to maintain the county wastewater treatment plant). For a detailed discussion of "Scopes," see Toolkit Introduction: (provide link)

2) **Off-road diesel-fueled construction, renovation, and maintenance equipment** – Examples of off-road vehicles and trucks include pavers, loaders, bulldozers, back-hoes, bobcats, and dump trucks. For the purposes of this document, on-road vehicles refer to light and heavy duty trucks used to transport materials and products.

WHY DIESEL?

Diesel exhaust includes both gaseous and particulate elements that contributes to a wide range of environmental and human health impacts, including climate change. Gaseous components also include hazardous air pollutants such as benzene, formaldehyde and other aldehydes, 1,3-butadiene, and other hazardous emissions. In addition, diesel poses:

Significant Climate Impacts: diesel fuel use contributes to GHG emissions through the production lifecycle, direct emissions of CO2 through combustion, and the global warming potential of other constituents in diesel exhaust, especially black carbon.

- Gaseous components of diesel exhaust include carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O), three of the four most important GHGs in terms of climate-forcing impact.
- *Black carbon* – the largest portion of diesel particulate emissions - is ***the second largest human influence on climate change after carbon dioxide.*** Black carbon absorbs sunlight and radiates heat (like a blacktop), darkens snow and ice and directly accelerates melting. It also is a toxic air pollutant, and poses significant health risks in areas near the emissions source (see more on black carbon at 20150817 LINKS for FINAL draft Black Carbon Health Effects.docx
- The particulate emissions from diesel have a lifetime in the atmosphere of days to weeks, compared to 50 to 100 years for carbon dioxide. Thus, reductions in black carbon, and other short lived climate forcers like methane, can result in significant near term climate benefits. ***Near-term action on black carbon can provide climate change relief equivalent to approximately one to two decades of planned emission reduction action on carbon dioxide.***
- Diesel emissions represents a significant source of GHGs from public operations. The Trends Analysis Tool [link] found that construction and maintenance represents between 38 to 56 percent of total supply chain emissions in more than 46 organizations, and **fuel use contributes from 5 – 23% of total construction life-cycle emissions.**
- The California Air Resources Board (CARB) estimated that in 2012, off-road vehicles and equipment accounted for 2.2 MMTCO2e in California (1.3% of all transportation GHG emissions), and on-road heavy-duty vehicles emitted about 32 to 35 MMTCO2e (about 20% of

all transportation GHG emissions). And, according to Caterpillar and *Construction Equipment* magazine, heavy construction equipment can burn 12 gallons of diesel fuel or more per hour.

Pose Significant Health Concerns:

- The particulate and gaseous emissions from diesel exhaust also contribute to acute and chronic health effects. One study found that diesel exhaust is 100 times more toxic than gasoline exhaust.
- Whole diesel exhaust is classified as a known human carcinogen by the World Health Organization (WHO).
- Other human health impacts of diesel emissions include cardiovascular, respiratory and nervous system disorders with both acute and chronic symptoms.

Health effects of diesel emissions

Particulate emissions

Diesel particles have a fine surface area which creates a good medium for absorbing organics, and their small size makes them highly respirable and able to reach the deep lung. The organics that are absorbed to the particulates, in general range from about 20-40 percent of the particle weight. Many of these individually are known to have mutagenic and carcinogenic properties. As noted in the background section, whole diesel exhaust has been classified as a known human carcinogen.

The EPA's *Report to Congress on Black Carbon* and other published papers document the range of health impacts from black carbon exposures, including respiratory and cardiovascular effects. Acute coronary syndrome (i.e., heart attacks) and other blood clotting effects have been tied to diesel exhaust exposure. Acute effects of diesel exhaust exposure include nose and eye irritation, swollen airway, headache, fatigue and nausea. Diesel exhaust causes an increase in allergic reactions and asthma.

Gaseous emissions

Gaseous diesel emissions include over 40 substances which are listed by the U.S. EPA as hazardous air pollutants (HAPs). Gaseous emissions from diesel include carbon monoxide which reduces oxygen delivery to organs such as the heart and brain, and sulfur and nitrogen oxides which can cause asthma and other respiratory symptoms. Nitrogen oxide is also an ozone precursor. Repeated exposure to ozone may cause, among other health effects, permanent damage to the lungs as well as reproductive and genetic damage.

Gaseous emissions also include alkenes, aromatic hydrocarbons, and low molecular weight polycyclic aromatic hydrocarbons (PAH) and PAH-derivatives. Many PAHs have been shown to cause carcinogenic and mutagenic effects and asthma like symptoms, as well as acting as potent immunosuppressants.

Reductions in emissions of black carbon have the co-benefit of reducing emissions of the gaseous hazardous air pollutants. As HAPs are generally persistent once emitted into the environment, reduction in their emissions can be expected to have long-lasting benefits.

Off Road diesel emissions are significant

- Off road vehicles and equipment accounted for 42% of all diesel emissions in 2005.
- Through replacement or installing particulate filters.
- While EPA has been phasing-in regulation of new non-road diesel engines and fuels since 1994, much of the off-road construction vehicles and equipment have been in use 20 or more years.

Many institutions don't have findings from a Scope 3 inventory as a window into the importance of diesel emissions or if they have done an inventory, it may not fully reveal the extent to which their purchasing includes fuel. And a GHG inventory will not provide information on the full climate impacts from diesel emissions due to the additive effects of the gaseous and particulate emissions from diesel exhaust. If you're interested into a bit more on how GHG inventories underestimate the climate impacts of diesel.

Due to the actual deleterious effects of diesel emissions, especially the black carbon portion, as a climate forcing agent and public health concern, opportunities to reduce diesel emissions should be pursued if an institution is responsible for activities that use significant amounts of diesel fuel.

How do GHG inventories consider diesel emissions? Many government and higher education institutions are relying on findings from GHG emissions inventories to inform their carbon reduction strategies. When considering the climate impacts of diesel emissions, **GHG inventories tell only part of the story**. The gaseous portion of diesel emissions (CO2 and other toxic gases) is included as part of a GHG emissions inventory. From a GHG perspective, because diesel cars and trucks get better mileage than their gasoline fueled counterparts, diesels are often regarded as a good strategy for combating climate change. However, an estimation of the climate forcing impact of the particulate portion of diesel emissions, which is primarily black carbon, is not included as part of a GHG emissions inventory. The climate benefits from reduced CO2 emissions from diesel may be more than offset by the black carbon emissions.

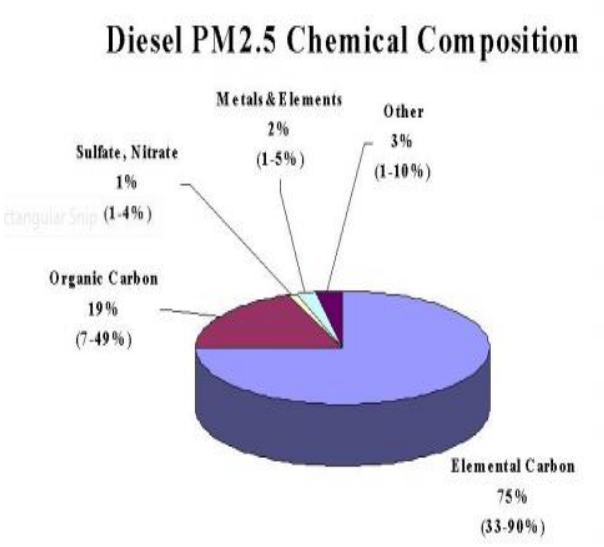
In addition, fuel use may not show up as a discrete category in a GHG inventory. The impact of fuel used by off-road diesel equipment is often embedded within broader categories like construction and maintenance, and the diesel used transporting goods is included as part of the supply chain within categories like IT, food, and building materials. (It is usually possible to dig into the tool used to do a GHG inventory to understand what assumptions were made about the impacts of fuel.)

Emissions from diesel exhaust

A diesel engine releases a complex mixture of hundreds of constituents in either a gas or particle form. Diesel emissions vary significantly in chemical composition and particle size between different engine types, engine operating conditions, and fuel formulations.

Particulate emissions

Diesel particulate matter includes carbon-containing compounds, sulfate, nitrate, and trace elements as well as absorbed organic compounds. The particulate matter is very fine in size (i.e. diameter of 2.5 µm [microns] or less). The majority (80-95 percent) of a diesel engine's pollutants are released as ultrafine (nanoscale) particulates with a diameter of about 0.2 microns (µm). A human hair is about 80 µm in diameter.



Black carbon is a solid form of mostly pure carbon which is part of the mix of particulate matter that is released during the incomplete combustion of fossil fuels, bio-fuels and biomass. It is estimated to represent about 70 percent of the total particulate emissions formed by the incomplete combustion of diesel fuel. Note: For this reason, black carbon is particularly emphasized in this document.

Diesel engines are the largest source of black carbon in North America. In the U.S., mobile sources accounted for about 52 percent of total black carbon emissions in 2005, about 93% of which came from diesel vehicles or engines.

Figure 2-8. Typical chemical composition for diesel particulate matter (PM2.5)

Gaseous emissions

The gaseous pollutants, like the particulates, are released as a result of incomplete combustion. Gaseous components of diesel exhaust include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), three of the four most important GHGs in terms of impact.

They also include hazardous air pollutants such as benzene, formaldehyde and other aldehydes, 1,3-butadiene, and other gaseous emissions discussed further under section IV.

Climate effects of diesel emissions

The black carbon potential for near-term climate responses (within a decade) is one of the strongest drivers of current scientific interest in black carbon.

Particulate emissions

When considering climate change conventionally, we think of greenhouse gases. While black carbon is not a GHG, its effects on climate are significant. Black carbon particulates influence the climate by absorbing sunlight when suspended in the atmosphere or deposited on the Earth's surface. The particulates absorb both incoming and outgoing radiation of all wavelengths which results in warming of the atmosphere, unlike GHGs which mainly trap outgoing infrared radiation from the Earth's surface.

Black carbon's small particulates also darken the surface of snow and ice and decrease reflectivity, thereby increasing the absorption of solar radiation which results in an increased rate of melting. Particulate matter as small as 2.5 µm, including black carbon, is linked to ecosystem damage, visibility impairment, reduced agriculture production (in some parts of world), and materials soiling and damage.

Gaseous emissions

The GHGs released through the burning of diesel, like other sources of GHGs, absorb energy, slowing or preventing the loss of heat to space. This process acts as a blanket over the earth, making the earth warmer and creating what is known as the "greenhouse effect."

Black carbon impacts and regional differences

Unlike carbon dioxide and other greenhouse gases that can spread further, black carbon is not evenly mixed in the air and concentrations can be different from region to region. This uneven distribution means that geographic specific climate impacts tend to occur. In the Arctic, black carbon can accelerate snow melt, exposing the darker land mass and ocean to solar radiation. Recent literature indicates that emissions of black carbon north of the 40th parallel particularly affect the Arctic. In the U.S., the 40th parallel approximately bisects New York City in the East and San Francisco in the West.

Researchers have theorized the Arctic effect could also occur on snow fields and glaciers in the western United States. Researchers since have confirmed the effect in the Cascades and Sierra Nevada mountains.

Early snow melt affects water storage and availability which impacts salmon, irrigators and other water users. Researchers have reported changes in stream flow and temperature in streams throughout the western states from the 1950s to the present that are the result of these types of climate change impacts.

Equity Issues and diesel exhaust A 2012 Yale University study documented major racial and economic differences in exposures to specific particle ingredients, some of which are linked to asthma, cardiovascular problems and cancer. For race/ethnicity, whites generally had the lowest exposures. Non-Hispanic blacks had higher exposures than did whites, and Hispanics generally had the highest exposures. A 10% increase in the proportion unemployed was associated with an 18.3% increase in exposure to elemental carbon. Those with low income or low education were found to be more likely to live in areas with higher exposures to particle pollution.

Key findings from research in the Bay Area included the following:

- Particulate matter emitted from diesel engines (diesel PM) contributed more than 85% of the total inventoried cancer risk;
- Simulated potential cancer risk from [toxic air contaminants] is highest near major diesel PM sources:
- There is a clear correlation between areas of impact and socioeconomic factors such as race, income, and education level."

In a 2012 report, The Oregon Department of Environmental Quality cited high levels of diesel particulate throughout Multnomah County, with elevated levels in areas with higher proportions of residents who are people of color and/or low-income.

Learn how Multnomah County government, working in partnership with local, state and federal jurisdictions, reduced impacts to workers and a neighboring community through a clean diesel retrofit initiative: https://multco.us/file/8232/download

Guidance Highlights

Goal

Reduce carbon emissions from diesel-fueled on-road and off-road construction, renovation, and maintenance equipment and vehicles by first evaluating the need for such activities and second by requiring or incenting the use of lower emissions vehicles and equipment and best management practices during the use stage.

What types of equipment and services are covered in this effort?

- Diesel-fueled vehicles and equipment used for construction, renovation, and maintenance services: Backhoes, cranes, dozers, excavators, loaders, pavers, tractors, etc.
- Services conducted directly by government institutions or vis-à-vis a procurement process.
- Use of diesel engine equipment and vehicles is common in state and local government agencies and higher education institutions, directly by agency fleets or indirectly by their contractors
- A number of options are currently available to significantly reduce emissions
    - Replace old equipment & engines with new, less polluting versions
    - Retrofits (diesel particulate filters reduce 90% of emissions; diesel oxidation catalysts can cut emissions by 20% but do not remove black carbon, the climate-forcing component of diesel particulate matter)[3]
    - Repowering through replacement of old engines with newer engines
- Best practices (e.g., anti-idling, controlling engine speeds, and maintaining tire pressure, clean air filters, and lubrication) and switching to alternative fuels (biodiesel, liquefied natural gas, compressed natural gas) can also help reduce emissions

Key purchasing strategies to reduce GHG impacts

Introduction

One of the essential elements in devising a purchasing strategy is figuring out who needs to be engaged and at what stage of the process. Specifications are written by project managers, designers, architects, engineers and consultants for construction, renovation, and maintenance projects. While specifications need to be specific to timeframe, project goals, budget or other demands of job completion, they should also address environmental considerations. Increasingly, government infrastructure, particularly buildings, incorporates effective design and technologies to reduce the carbon footprint of the project. However, potential diesel emissions attributable to construction, renovation and maintenance are often not explicitly addressed during the design or implementation stages. Many opportunities for reducing diesel emissions are missed because decisions such as what equipment to use to repair a bridge or upgrade a water treatment plant are often left up to the awarded vendor.

These considerations should start at the front end of the project (e.g., design or maintenance plan) and should include all diesel emissions reduction possibilities such as requiring diesel emission control technology, and anti-idling policies. Many jurisdictions are now leading the way by requiring their

3 Clean Air Task Force: http://www.catf.us/methane/black_carbon/diesel/

contractors to reduce their diesel fuel consumption. In addition, the U.S. Green Building Council published a credit toward achieving LEED (Leadership in Energy and Environmental Design) certification for buildings for clean construction focusing on managing and reducing diesel emissions from construction equipment and trucks. Strategies for reducing diesel emissions will be discussed later in this chapter.

Top Opportunities for Reducing Diesel Use

Reducing the need for carbon-intensive materials or services is the first consideration when developing plans for government activities and services whether conducted in-house or vis-à-vis a procurement process.

When considering how to reduce the use of diesel fuel, always start with the following questions:

1) Is the construction, renovation or maintenance necessary to meet service needs?
2) If so, will there be a net benefit to the environment or an equity improvement?
3) Are there opportunities to reduce the use of diesel fuel through more efficient staging of the project?
4) Are there opportunities to reduce the amount of diesel used by implementing anti-idling requirements, idling measurement tools, and improved driver training?
5) Will improvements in equipment maintenance reduce the amount of diesel used as well as increase the life of equipment (assuming it shouldn't be replaced by more efficient equipment)?
6) Are alternative, lower-carbon impact fuels available at reasonable cost for on-site equipment?

Here is a link to how to think up front about how to reduce diesel fuel use and all the questions that might be considered. *(Note: provide same link for all guidance pieces but a few questions in this box like #1-5 above that are more appropriate for each specific guidance material or service).*

Specific strategies to reduce fuel consumption:

- Right sizing – Buying and using the correct size and type of equipment for the size of the project.
- Route optimization – Truck route management is another key factor in fuel efficiency. A Global Positioning System (GPS) navigation system can be used to optimize routes.
- Fuel use tracking – In addition, diesel equipment users and owners can develop a tracking system to record fuel consumption by vehicle and equipment item, to help identify fuel leaks and inefficient trucks and machinery.

If it is determined that complete avoidance of an emissions scenario cannot be avoided – in other words the project or service will meet some significant need for the government institution and its constituency – identifying opportunities for reducing diesel emissions is the next step. [LINK TO TABLE SHOWING REDUCTION OPPORTUNITIES, IF IT LOOKS LIKE A GOOD FIT]

Modernizing, retrofitting, and properly maintaining trucks and equipment

Because of the lack of emission control regulations for off-road diesel construction equipment until 1996, diesel engines used in construction equipment are more polluting than those used for on-road applications.[4] EPA regulations have dramatically improved the emissions of on- and off-road vehicles over the past 20 years. Recently-manufactured off-road diesel-fueled vehicles (compliant with Tier 4 standards) must now be far cleaner than the older vehicles (Tier 1) - 96 percent reductions in particulate matter and nitrogen oxides; 86 percent reductions in hydrocarbons; and 74 percent for carbon monoxide.[5]

Despite these EPA standards and the availability of cleaner vehicles, many fleet operators continue using older, highly polluting diesel-fueled vehicles. A California study estimated that half of paving equipment will be in use after 24 years, and half of excavators will be in use after 17 years. Other studies have also emphasized the delayed replacement of off-road diesel vehicles and equipment.[6]

Organizations can significantly reduce their diesel emissions by modernizing their fleets, upgrading older equipment, and improving ongoing maintenance. Several programs, including the National Clean Diesel Funding Assistance Program and state programs like the Carl Moyer program in California and the Oregon Clean Diesel Initiative, assist fleets with grants to reduce emissions from existing diesel engines through a variety of strategies, such as add-on emission control retrofit technologies; idle reduction technologies; cleaner fuel use; engine repowers; engine upgrades; and/or vehicle or equipment replacement; and the creation of innovative finance programs to fund diesel emissions reduction projects. The National Clean Diesel Funding Assistance Program includes funding for non-road engines, equipment or vehicles used in construction.

From a purchasing perspective, these strategies can be employed in two main areas:

- Replacing older equipment in their own fleet.
- Rewarding or assisting contractors that have newer, low emissions equipment. Public bodies can include terms in contract solicitations establishing preferences for low emission vehicles and equipment to be used on their project. In these cases, the terms of a contract solicitation can help induce a construction contractor to replace older, heavily polluting vehicles.

Modernizing Fleets with Newer Equipment:

4 Footnote: State and Local Green Construction Regulations October, 2010, Manufacturers of Emission Controls Association

[5] Associates Environmental, "Evolution of Tier 4 Regulations & Project Specific Diesel Engine Emissions Requirements" at 10 (2014) http://www.associatesenvironmental.com/CONEXPO_2014_PPT_AEM.pdf.

[6] CARB, "Off-road Equipment Rule - Inventory Updates" at 9-10 (2006) http://www.arb.ca.gov/msprog/ordiesel/documents/Inventory_Updates_OffRdEquip_07_12.pdf. See also Mitchell, "From Browsing to Buying: Construction fleet managers aren't just kicking the tires anymore" (2013) (almost half of construction fleets surveyed had trucks that were one to six years beyond normal replacement age, and anticipated that the age of their fleet would continue to increase) http://www.theconcreteproducer.com/fleets-trucks-and-accessories/from-browsing-to-buying.aspx; Bennink, "How To Decide to Trade or Rebuild Your Heavy Trucks" (2012) ("average age of heavy-duty construction trucks has increased by almost three years") http://www.forconstructionpros.com/article/10733058/trade-remanufacture-or-keep-your-trucks

To help shorten the use period of older vehicles and equipment, several federal and state grant programs provide financial incentives to accelerate owners' replacement or retrofit of construction vehicles and equipment.[7]

Retrofits

All new engines are certified to comply with EPA emission standards in place at the time of certification. Retrofit technologies are products that may be added to further reduce emissions from certified engine configurations. The two common emission-reduction retrofits available for diesel vehicles and equipment are diesel particulate filters (DPFs) and diesel oxidation catalysts (DOCs). DPFs remove up to 95% of particulate matter, including black carbon, from the exhaust gas produced in the combustion of diesel fuel. These work best on engines built after 1995 and require the use of ultra-low sulfur diesel (ULSD). DOCs are a flow-through honeycomb device treated with a precious metal catalyst, like the catalytic convertor on a car that reduces hydrocarbon emissions by up to 70%. DOCs also reduce fine particulate emissions between 20 to 40%. However, they do not remove black carbon, the climate-forcing component of diesel particulate matter. Although the climate benefits of DPFs are far superior, DOCs are less expensive, require little to no maintenance, and have a more universal fit and are therefore used more frequently.

Pictures - The first is of a diesel particulate filter installed on a reach stacker, the second picture is of a reach stacker itself. The third is of Gina McCarthy, EPA Administrator, examining two pillow cases that had been attached to the tailpipes of two reach stackers, one with a DPF and the other without, and run for 30 seconds.

Below is a list of diesel retrofit technologies, typical emissions reductions, and costs from EPA. For more information, see: http://www.epa.gov/cleandiesel/technologies/retrofits.htm

[7] http://www.epa.gov/cleandiesel/sector-programs/construct-overview.htm http://www.arb.ca.gov/msprog/moyer/moyer%20staff%20report.pdf

	Typical Emission Reductions (percent)				Typical Costs ($)
Technology	PM	NOx	HC	CO	
Diesel Oxidation Catalyst (DOC)	20-40		40-70	40-60	material: $600-$4,000 installation: 1-3 hours
Diesel Particulate Filter (DPF) Active or Passive	85-95		85-95	50-90	material: $8,000-$50,000 installation: 6-8 hours
Partial Diesel Particulate Filter (pDPF) Partial or Flow-through	up to 60		40-75	10-60	material: $4,000-$6,000 installation: 6-8 hours
Selective Catalytic Reduction (SCR) *		up to 75			$10,000-$20,000 Urea $.80/gal
Closed Crankcase Ventilation (CCV) *	varies				
Exhaust Gas Recirculation (EGR) *		25-40			
Lean NOx Catalyst (LNC) *		5-40			$6,500-$10,000

* May be combined with DOC or DPF systems to reduce PM, HC and CO emissions.

For a detailed matrix that includes specific retrofits and the best practices and alternatives related to those retrofits as well as information on the environmental, social and economic impacts of different retrofit technologies, go here: Insert Best Practices from 150512.EPP Exhaust Aftertreatment Retrofits Matrix.xlsx

Here is a snapshot of what you'll find at this link:

Retrofits	Best Practices	Alternatives *
	Installation / Maintenance & Operation	Combination of More than One Retrofits
Source:		
Diesel Oxidation Catalyst (DOC)	• **Fuel:** DOCs perform best with Ultra Low Sulfur Diesel fuel (ULSD), and some DOCs are verified for use with Low Sulfur Diesel (LSD). [B] • If properly installed and maintained, DOCs should remain effective for the life of the vehicle, generally 5-10 years or 10,000+ hours of operation. [B] • Regular engine maintenance is essential to DOC performance. [B] • DOC is likely to be heavier than a muffler, it is likely that special mounting is necessary. [B] • **Installation, Maintenance, and Opportunities Fact Sheet:** www.epa.gov/cleandiesel/documents/420f10030.pdf • Periodic inspection and tightening of mounting hardware. • Maintain vehicles and monitor fuel and lubrication oil consumption. A bad fuel injector or increased oil consumption may be masked by a DOC. • The DOC may be damaged by excessive fuel or oil consumption or a poorly maintained engine.	• DOCs have also been verified in combination with crankcase ventilation systems for additional emissions reduction. [B]

Diesel Particulate Filter (DPF) Active or Passive	• DPFs work best on engines built after 1995 [A] • **Installation/Mnte Fact Sheet:** http://www.epa.gov/cleandiesel/documents/420f10028.pdf • Require periodic maintenance to clean out non-combustible materials, such as ash. [A]	• DPFs can be coupled with closed crankcase ventilation, selective catalytic reduction or lean NOx catalyst technologies for additional emission reductions. [A]
Partial Diesel Particulate Filter (pDPF) Partial or Flow-through	• **Installation Fact Sheet:** http://www.epa.gov/cleandiesel/documents/420f10028.pdf • **Mnte/Ops. Fact Sheet:** http://www.epa.gov/cleandiesel/documents/420f10028.pdf	
Selective Catalytic Reduction (SCR)	Uses diesel exhaust fluid to reduce nitrogen oxide emissions. Most 2010 and newer engines rely on this technology and as a result DEF is widely available.	• SCR systems are commonly used in conjunction with a DOC and/or DPF for comprehensive reductions of NOx and PM.
Closed Crankcase Ventilation (CCV)	• CCV systems incorporate filter elements that must be periodically replaced [A] • CCV system maintenance requirements must be reviewed for each manufacturer's product and potentially for each configuration [A]	• Emissions will be further reduced if the CCV is paired with a DOC or DPF.

Maintenance

Fuel use can be reduced and worker comfort, safety and productivity improved with regular maintenance of excavators, loaders, pavers, rollers, haul trucks and other vehicles and equipment.

Proper maintenance consists of regular tune-ups of vehicles and equipment and checking and replacement of worn or damaged parts. Daily maintenance is also a priority, such as a truck walk-around and greasing of equipment prior to the shift start and prior to starting the diesel motor.[8]

Preventative Maintenance Best Management Practices

- Replace air and fuel filters regularly (more frequently in dusty construction settings)
- Inspect air hoses and clamps for leaks, cracks, and chafing damage
- Consider switching to synthetic lubricants
- Measure tire pressure at least once per week
- Check axle alignment regularly and adjust as needed
- Monitor fuel quality

The Illinois Department of Transportation (IDOT) purchasing policy for construction contracts requires retrofits for diesel-fueled equipment (Tier 1 and earlier) to reduce emissions - "The reduction of emissions of particulate matter (PM) for off-road equipment shall be accomplished by installing retrofit emission control devices. The retrofit emission control devices shall achieve a minimum PM emission reduction of 50 percent."

[8] "Reducing Greenhouse Gas Emissions in the BC Road Building and Maintenance Industry", beginning on page 16: http://www.th.gov.bc.ca/publications/eng_publications/geotech/3348_Roadbuilding_BP-V13-232ppi.pdf

Anti-idling requirements and training

Reduced idling decreases fuel consumption and the associated costs and GHG emissions. Adoption of an anti-idling policy through employee training or monitoring is an effective method to reduce emissions.

Education and incentives play an important role in changing behavior by informing the driver or operator about the adverse impacts of unnecessary idling on emissions, fuel consumption, engine wear, and potential health risks, as well as by encouraging desired behaviors. Companies may institute an idle reduction policy that includes training for their drivers on vehicle operation procedures to improve efficiency.

Computer programs may be used to monitor the amount of time that vehicles spend idling. For example, Alabama Department of Transportation (ALDOT) has placed GPS tracking systems on two-thirds of the equipment and vehicles in its fleet. It uses these systems to monitor idle time and equipment usage. In addition to helping ALDOT enforce its anti-idling policy, these systems allow ALDOT to compare the operating costs of equipment to industry standards and to identify opportunities for cost savings. The GPS systems are part of a package of green fleet initiatives that save ALDOT $6.6 million per year. The State of Oregon has also utilized computer programs to reduce idling. As of 2010, the Oregon Department of Transportation (ODOT) had placed anti-idling hardware on 81 of the 3,000-plus vehicles in its fleet. ODOT installs this hardware on all new three-quarter ton, one-ton, five-yard, and ten-yard trucks and has a policy of installing anti-idling hardware on all vehicles whenever it is feasible.

Anti-idling policies

Anti-idling policies restrict the amount of time that a vehicle can idle its main engine.

- In the State of California, unnecessary idling of California's Department of Transportation (Caltrans) fleet vehicles and equipment was forbidden by Deputy Directive 96, issued in 2008. Idling is only allowable while in traffic, during vehicle maintenance, while providing power to equipment, and when idling is necessary to prevent emergency situations.[9]
- The City of Portland maintains an idle reduction policy for its city fleet vehicles (http://www.portlandonline.com/auditor/index.cfm?c=51471&a=272453) and requires vendors in loading areas to comply with a similar idle reduction approach.
- The City of Seattle's Purchasing Department includes a general vehicle anti-idling requirement in all City contracts, requiring the City vendors and contractors to adopt anti-idling practices to reduce greenhouse gas emissions (http://www.seattle.gov/city-purchasing-and-contracting/city-purchasing/green-purchasing/green-purchasing-guidance).

A comprehensive list of idling regulations across the country is kept up to date by the American Transportation Research Institute (http://www.atri-online.org/research/idling/ATRI_Idling_Compendium.pdf).

Driver/Operator Training

Educating drivers and operators about the impacts and adverse effects of long-duration idling can help change their behavior. "Eco-driving" programs that instruct employees on a number of techniques to conserve fuel when driving, including turning off a vehicle instead of letting it idle, are another useful emissions-reduction tool. [10]Many software packages exist to help fleets plan their routes more efficiently.

Natural Resources Canada offers a program called "Fleet Smart" that offers information, training and tools to improve driver and operator handling of heavy duty trucks with the goal to reduce fuel consumption, see http://www.nrcan.gc.ca/energy/efficiency/transportation/commercial-vehicles/fleetsmart/16930.

The Oregon Department of Environmental Quality (Oregon DEQ) issued a report in 2010 on recommendations for improving truck efficiency and reducing idling: http://www.deq.state.or.us/aq/committees/docs/truck/improveEfficiencyReport.pdf. Before adopting regulations, the report recommended an adequate phase-in period for both the truck efficiency and idling measures before beginning compliance efforts to allow truck operators, carriers and shippers to incorporate these requirements into their business plans. Implementation of the recommended strategies can result in a relatively quick return on investment.

Idle Reduction Equipment

Idle reduction and operational strategies reduce emissions by maximizing efficient use of equipment and limiting the amount of time an engine needs to operate.

There are five categories of technology-based idling reduction alternatives:[11]

- ***Automatic Shut-Down/Start-Up Systems***
  - Electronic diesel engines can be programmed to shut down after a preset time period. This requires changes to the engine control module that automatically controls the engine starting and stopping on a set time interval, ambient temperature and state of battery charge.
- ***Battery Powered/Engine-Off Systems***
  - A system that captures energy produced by the engines alternator and stores it in independent battery storage. When the engine is off, the energy can be useful for: powering A/C and heat systems, and keeping the truck engine warm.
- ***Diesel Fired Heaters***
  - Diesel-fired heaters are small, lightweight heating devices that burn diesel fuel from the vehicle tank or from a separate tank.
- ***Auxiliary Power Units***
  - Auxiliary power systems (APUs) are essentially small generator sets (5-10 hp) which produce greater amounts of stand-alone heat and power.
- ***External Electrification Systems***
  - External electrification refers to a technology that provides the truck driver with climate control and other needs from an external 120 VAC power supply.

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[10] *Caltrans Activities to Address Climate Change*. California Department of Transportation. April 2013.

[11] http://www.th.gov.bc.ca/publications/eng_publications/geotech/3348_Roadbuilding_BP-V13-232ppi.pdf or http://www.epa.gov/smartway/forpartners/technology.htm#tabs-4

For additional details, go here: http://www.epa.gov/smartway/forpartners/technology.htm#tabs-4

Text box:

Reducing climate impacts and protecting human health: School bus idle reduction programs are a win-win.

- **Minnesota:** In 2002, the state adopted legislation (https://www.revisor.mn.gov/statutes/?id=123B.885) to protect the health and safety of children from harmful diesel bus emissions. This law calls for schools to reduce the unnecessary idling of school buses in front of schools, and reroute bus parking zones away from air-intake vents (or if necessary, relocate the air-intake vents).
- **Oregon:** An economic stimulus funded project in 2010 with the Klamath County School District, which covers the largest geographic area in Oregon, funded diesel particle filters and diesel oxidation catalysts on 37 buses. Average low temperatures are below 40° F for 8 months of the year. This led to extensive idling in the mornings to warm the engines. Direct fired engine heaters were installed to reduce idling time and improve the operating efficiency of the newly installed exhaust controls. About 1.5 tons of PM is reduced and more than 9,000 gallons of fuel saved annually. While the project cost $317,652 to complete, fuel savings and avoided health costs amounted to a return of $294,600 in the first year alone.

Alternative Fuels

Most construction equipment and large delivery vehicles are fueled by diesel. Although diesel is significantly more efficient than regular gasoline (i.e., more miles per gallon), its combined gaseous and particulate emissions can override those mileage benefits. Some alternative fuels used to replace standard diesel fuel may reduce the environmental and human health impacts associated with construction projects and the delivery of goods. However, it is important to consider the tradeoffs that may be associated with each alternative before making a switch. The GHG impacts of alternative fuels vary widely. Some fuels have minimal GHG emissions benefits compared to gasoline or diesel, while others lead to substantial reductions. Even for a given alternative fuel, GHG reductions can vary widely depending on how the fuel is produced. For more information, see the California Air Resources Board's Carbon Intensity Lookup table for fuels that replace gasoline - http://www.arb.ca.gov/fuels/lcfs/lu_tables_11282012.pdf).

The list below includes some general information on typical diesel fuel alternatives (note that not all alternatives are appropriate for construction equipment). For more information, link here: (150512.EPP Fuels Matrix.xlsx)

Biodiesel (B20)

- Biodiesel is an alternative fuel made by reacting animal or vegetable fats with alcohol. Biodiesel refers to the pure fuel before blending with diesel fuel. (80% petroleum diesel, 20% biodiesel blend).

Biodiesel (B99-B100)

- B100 is 100% biodiesel and not blended with petroleum diesel.

Compressed Natural Gas (CNG)

- CNG is a readily available alternative to gasoline that's made by compressing natural gas to less than 1% of its volume at standard atmospheric pressure. Consisting mostly of methane, CNG is odorless, colorless and tasteless.

Liquefied Natural Gas (LNG)

- Natural gas is converted into LNG, by a process called liquefaction, into a clear, colorless liquid.

Propane

- Liquefied petroleum gas (LPG) - A gas normally compressed and stored as a liquid.

Hybrid-Electric

- Powered by both gasoline and a battery that recharges as the vehicle brakes.

Electric

- All-electric vehicles (EVs) use a battery to store the electrical energy that powers the motor.

Ethanol (E85)

- Pure alcohol that is typically blended with gasoline to produce a cleaner-burning fuel.

For more information, go to this link: 150512.EPP Fuels Matrix.xlsx

Case studies

- Clean Diesel Retrofits on the East County Courthouse (Multnomah County, Oregon)
  - An innovative partnership between Multnomah County, the City of Portland, and private contractors provided funds to retrofit construction equipment with clean diesel technology. Using these machines to build the East County Courthouse resulted in cost savings and benefits to public health and health equity.
- Adopting Clean Fuels and Technologies on School Buses: Pollution and Health Impacts in Children – abstract
  - A change to ultralow- sulfur fuel reduced a marker for inflammation in children's lungs by 16 percent for all children riding the bus and by 20-31 percent for asthmatics. Researchers followed 275 elementary children on school buses before and after cleaner fuels and technologies were used on the buses. On average, children in the districts missed an average of 3.1 school days over a nine month period. When riding a bus that used ULSD, there was an 8 percent lower risk of being absent. For those riding a bus with a diesel oxidation catalyst there was a 6 percent reduction in absenteeism. The researchers extrapolated a 14 million day

reduction in absenteeism nationally if all buses were fitted with similar pollution controls.

- The Manufacturers of Emission Controls Association's (MECA's) published a compilation of case studies of construction projects that required the use of diesel particle filters and other exhaust controls on construction equipment. For details, see case studies at this link: http://www.meca.org/galleries/files/Construction_retrofit_case_studies_July_2009.pdf.

Purchasing resources

Government agencies can advance important public health goals by capitalizing on their participation with private contractors through clean diesel equipment and vehicle contract specifications. Contract specifications can make clean diesel an everyday part of your upcoming public works projects, and even deliveries of goods directly to your agency. Clean diesel construction specifications should be a meaningful element of a comprehensive program

There is much to learn from the many organizations that have required diesel emission control technology and anti-idling in their construction contract specifications.

According to the Northeast Diesel Collaborative, the most important elements to consider when adopting clean diesel construction specifications are to:

- Communicate and educate your contractors early on and throughout the project
- Develop clear contract specifications
- Establish viable inspection and reporting provisions to ensure accountability

In addition, the Northeast Diesel Collaborative has prepared a very comprehensive guide to achieve success with clean diesel specifications called "*Best Practices for Clean Diesel Construction - Successful Implementation of Equipment Specifications to Minimize Diesel Pollution*" (http://northeastdiesel.org/pdf/BestPractices4CleanDieselConstructionAug2012.pdf). This outlines elements of success including writing clear specification, ensuring organizational support and planning for success. Roles and responsibilities of key personnel are also laid out clearly and supported by checklists.

Here is a brief synopsis of that planning checklist, and other sources:

Acquisition and Procurement Planning Checklist

- **Needs assessment**
  - Identify and consider demand reduction opportunities
  - Identify and consider possibilities of sharing

- **Information gathering/market survey of verified technologies**
  - EPA verified technologies
  - CARB verified technologies
  - VERT™[12] technologies
- **Outreach to requisitioning agency**
- **Evaluation Criteria Considerations**
  - Consider the ability and willingness of vendors to go beyond what is statutorily required and how this can be rewarded, e.g.,
    - Use of alternative fuels
    - Use of emerging technologies that reduce emissions
  - Solicit vendors to suggest ways to continually reduce emissions and reward those who do
- **Contractual Requirements – Specific clauses**
  - What's statutorily required (locally), e.g.
    - Retrofits
    - Use of ULSD
  - Include requirements for idling reduction practices
  - Include requirements for reporting post award
  - Include penalties for failure to comply
  - Include incentives to outperform targets for emissions and fuel
- **Post award follow up**
- Obtain report of equipment used on project and emission reduction and other practices implemented
- Oversight to ensure vendor compliance with cleaner diesel clauses

Contract Specifications:

Diesel Emission Reduction Requirements

The following organizations have developed contract language pertaining to diesel emission reductions. Further details are available at this link/Excel spreadsheet and includes the following:

- Guidance Language, Contract Language, Ordinance/Regulation Language
  1. Diesel Emission Control Technology
  2. Idling Requirements
  3. Exemptions
  4. Penalties for Non-Compliance
  5. Reporting

[12] A UK-based association dedicated to the promotion of best available technology for emission control

6. Costs of Retrofits
7. Mitigation Plans to Address Sensitive Population
8. Other Requirements
9. For More Information

- **Northeast Diesel Collaborative**
    - The Northeast Diesel Collaborative published the Best Practices for Clean Diesel Construction: Successful Implementation for Equipment Specification to Minimize Diesel Pollution, a comprehensive guide that provides recommendations for successful implementation of specifications to minimize diesel pollution and exposure during construction in 2012. In addition, the NEDC developed a Model Contract Specifications Template in 2010. http://northeastdiesel.org/pdf/BestPractices4CleanDieselConstructionAug2012.pdf
- **US Green Building Council** (USGBC) LEED Green Construction Credit
    - The Council created a clean construction pilot credit that can be used for LEED (Twenty four projects in 12 states and 3 countries outside the U.S. are using this protocol to date.). This credit provides a framework for projects to develop and implement a plan to reduce particulate matter (PM) emissions from non-road diesel engines, equipment and vehicles used during construction projects. http://www.usgbc.org/credits/sspc75
- **Clean Diesel Clearinghouse** - This tool, which can be customized to individual construction specification protocols, allows contractors to input their vehicles and equipment used on a given project and to discover the exhaust controls that are available while also allowing a project officer to quickly determine compliance with their own construction specifications. www.cleandieselclearinghouse.org
- **Columbia University** - Developed stringent contract specification to limit diesel emissions on construction sites in 2011. http://manhattanville.columbia.edu/construction
- **State of Massachusetts Department of Transportation** - Developed a diesel retrofit specification in 2005 that has been included in all Highway Division contracts advertised for bid. As of 2014, the retrofit specification requirements also extend to all State Revolving Fund projects. http://www.mhd.state.ma.us/default.asp?pgid=content/publications_diesel_spec&sid=about
- **New Jersey Executive Order 60** – Signed in 2011, this directive requires that construction equipment meet the Tier 4 emissions standard. http://www.nj.gov/dep/stopthesoot/eoi.htm
- **City of Philadelphia –** Pursuant to Executive Order 1-07, construction contractors must minimize idling and use retrofits or vehicles meeting the Tier 4 emissions standard.
    - http://www.phila.gov/health/pdfs/CleanDieselFactSheet71213.pdf ; http://www.phila.gov/health/pdfs/Diesel_engine_emissions_controls_71013.pdf
- **University of Pittsburgh Medical Center** - implemented a contract specification that requires all new and used construction equipment to meet Tier 4 emissions standard. http://dieselcleanup.org/downloads/Clean%20Construction%20Policy%20-%20University%20of%20Pittsburgh%20Medical%20Center%20-%20April%202011.pdf
- **California Air Resources Board –** In 2007, CARB passed the Off-Road regulation to reduce emissions of oxides of nitrogen (NOx) and particulate matter (PM) from off-road diesel vehicles operating within California. The Off-Road regulation imposes, among other requirements, limits on idling,

requires a written idling policy, restricts the adding of older vehicles into fleets starting on January 1, 2014; and requires fleets to reduce their emissions by retiring, replacing, or repowering older engines, or installing Verified Diesel Emission Control Strategies, VDECS (i.e., exhaust retrofits). http://www.arb.ca.gov/msprog/ordiesel/faq/overview_fact_sheet_dec_2010-final.pdf

- **City of Chicago** – Passed in 2011, Chicago's Clean Diesel Construction ordinance bans pre-Tier 1 vehicles from City of Chicago construction sites, unless such vehicles use particulate filters. The ordinance also applies a scoring system to contractors' vehicles based on engine model year, use of a diesel emission control retrofit device, fuel type, and other factors. Chicago applies minimum clean fleet scores to its construction contractors; the minimum score established for 2014 increases in 2017 and again in 2020. http://www.cityofchicago.org/city/en/progs/env/clean-diesel.html
- **New York City** - Local Law 77 (December 2003) mandates the use of ultra-low sulfur diesel fuel and best available technology (BAT) by non-road construction equipment on all city construction contracts. http://www.nyc.gov/html/dep/pdf/local_law_77.pdf
- **Cook County's** Green Construction Ordinance – Adopted in 2009, contractors must install Level 3 verified PM retrofits (minimum 85% reduction in diesel PM) on any on-road or off-road engines used in publicly funded projects or insure that the engine out emissions for PM are equal to or less than 0.01 g/bhp-hr.
  http://www.suffredin.org/legislativelibrary/Legislation.asp?LegislationID=475&Library=cook
- **Los Angeles County Metropolitan Transportation Authority** (LACMTA) Green Construction Policy - http://media.metro.net/projects_studies/sustainability/images/Green_Construction_Policy.pdf
    - The Los Angeles County Metropolitan Transportation Authority (LACMTA) will only use greener, less polluting construction equipment and vehicles; and implement best practices to meet or exceed air quality emission standards in all construction projects performed on LACMTA properties and rights-of-way.

Other Resources

- EPA Diesel Emissions Quantifier - The DEQ is an interactive tool that evaluates clean diesel projects and options for medium-and heavy-heavy duty diesel vehicles by estimating emission reductions, cost effectiveness, and health benefits. This quantifier was developed for users with little or no modeling experience.
- State of Illinois – Executive Order 09-11 (2009):
    - Only to the extent permissible under any applicable Federal or State law or regulation, all State-funded road construction contracts for areas that are in non-attainment with the federal 8-hour ozone standard or the particulate matter (PM) 2.5 standard for air quality are required to use clean construction practices. These include, where feasible: idling limitations, use of ultra-low sulfur diesel, erosion control, dust control, and on all off-road vehicles the installation of a verified diesel emission control device that achieves a particulate matter emission reduction of 50 percent or more from uncontrolled engine emission levels.

  https://www.illinois.gov/Government/ExecOrders/Documents/2009/execorder2009-11.pdf

- 2015_04_16-List of Resources for Reducing Diesel Emissions.docx
    - Clean Diesel Clearinghouse - http://cleandieselclearinghouse.org/index.php

- EPA Sector Report on Reducing GHG Emissions from the Construction Sector (2009) - http://archive.epa.gov/sectors/web/pdf/construction-sector-report.pdf
- State of Massachusetts Department of the Environment
  - Reducing Air Emissions from Diesel Construction Engines - http://www.mass.gov/eea/agencies/massdep/water/wastewater/reducing-air-emissions-from-diesel-construction-engines.html
  - Diesel Engine Retrofits in the Construction Industry: A How To Guide (2008) - http://www.mass.gov/eea/docs/dep/air/diesel/conretro.pdf
- NYC Local Law 77 implementation report published in 2004: http://www.nyc.gov/html/ddc/downloads/pdf/lowsulfur.pdf
- EPA resources:
  - EPA's Mobile Sources - http://www.epa.gov/otaq/standards/basicinfo.htm
  - Non-road Diesel Engine, Vehicle and Equipment Information can be found at: http://www.epa.gov/otaq/nonroad-diesel.htm
  - Clean diesel fuel program information can be found at: http://www.epa.gov/otaq/fuels/dieselfuels/index.htm
  - EPA Fact Sheet -- Diesel Exhaust in the US - http://www.epa.gov/cleandiesel/documents/420f03022.pdf
- Emissions Standards for Nonroad Diesel Engines: https://www.dieselnet.com/standards/us/nonroad.php
- Non-Road Diesel Emission Reduction Study (2003, Washington Department of Ecology) http://www.ecy.wa.gov/programs/air/cars/diesel_exhaust_information.htm
- Clean Air Task Force, http://www.catf.us/
- California Air Resources Board - http://www.arb.ca.gov/msprog/msprog.htm
- Association of Equipment Manufacturers (AEM's) implementation of EPA's nonroad diesel regulation: https://www.aem.org/SRT/Regulatory/Tier4/
- Puget Sound Clean Air Agency - http://www.pscleanair.org/priorities/transportation/dieselsolutions/Pages/off-road.aspx
- Article about the Flexibility Provisions in 2014 amendments to EPA's nonroad diesel engine regulation - https://www.whdlaw.com/ArticleDetail.aspx?ID=1988
- The West Coast Collaborative - http://www.westcoastcollaborative.org/

- Anti-idling language
  - City of Seattle); http://www.seattle.gov/city-purchasing-and-contracting/city-purchasing/green-purchasing/green-purchasing-guidance
  - City of Portland - http://www.portlandonline.com/auditor/index.cfm?c=51471&a=272453
- The Carbon Dioxide-Equivalent Benefits of Reducing Black Carbon Emissions from U.S. Class 8 Trucks Using Diesel Particulate Filters: A Preliminary Analysis (Clean Air Center, 2009)
- Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) tool: https://greet.es.anl.gov/afleet_tool
- Fleet Footprint Calculator, https://greet.es.anl.gov/fleet_footprint_calculator This tool is based on GREET. It provides well to wheel outputs in carbon dioxide equivalent emissions

and barrels of petroleum for off-road as well as on-road vehicles and equipment. The calculator is in an EXCEL spreadsheet format and documentation is available in a User Guide.

- FleetSmart, Natural Resources of Canada - information, training and tools to improve driver and operator handling of heavy duty trucks with the goal to reduce fuel consumption http://www.nrcan.gc.ca/energy/efficiency/transportation/commercial-vehicles/fleetsmart/16930

Scenario of Construction Sector-wide GHG Emissions Reductions		
Activity	Assumption	Metric tons CO2e annually
Reduce Equipment Idling	10% reduction from all off-road diesel heavy equipment	830,000
Improve Maintenance & Driver Training	Combined practices to increase fuel economy by 3% for heavy equipment	130,000
Increase Fuel Switching to Biodiesel (B20)	Replace 10% of diesel use with B20	1,400,000
Improve Electricity Conservation	Combined practices to reduce total electricity use by 10%	3,100,000
Total Scenario Emissions Reductions		5,460,000
Source: EPA: Potential for Reducing Greenhouse Gas Emissions in the Construction Sector *http://archive.epa.gov/sectors/web/pdf/construction-sector-report.pdf*		