

**Connecticut Clean Diesel Plan
Diesel Technology Forum Table**

Glossary

Acronyms Terms & Definitions

Biodiesel: Biodiesel is a domestically produced, renewable fuel that can be manufactured from new and used vegetable oils and animal fats. Biodiesel is safe, biodegradable, and reduces air pollutants such as PM, CO, HC and air toxics. However, emissions of NO_x increase with the concentration of biodiesel in the fuel. Some biodiesel produces more NO_x than others, and some additives have shown promise in modifying the increases.

Blends of 20% biodiesel with 80% petroleum diesel (B20) can be used in unmodified diesel engines. Biodiesel can be used in its pure form (B100), but may require certain engine modifications to avoid maintenance and performance problems. Pure blends of biodiesel may not be suitable for cold climates. B20 reduces emissions of PM by about 10 percent. However, B20 also increases NO_x emissions by approximately 2%. The B20 blend costs about 15 to 30 cents per gallon more than regular diesel fuel. B100 reduces emissions of PM by roughly 40 percent and costs about 75 cents to \$1.50 more than regular diesel fuel. -EPA

Catalytic Converter: A catalytic converter consists of a metal housing filled with a hard material which is covered with a catalytic compound. The presence of the catalytic converter in the engine exhaust system breaks down the chemicals in the exhaust and reduces harmful pollutant emissions. -EPA

CCM Catalyzed Converter Muffler: Caterpillar's CCM is a diesel oxidation catalyst within a muffler assembly.

CCRT™ Catalyzed Continuously Regenerating Technology: CCRT is a Johnson Matthey DPF system incorporating DOC and passive DPF technologies.

CEM™ Catalytic Exhaust Muffler™: CEM™ is one of Johnson Matthey's diesel oxidation catalyst products.

Closed Crankcase Filtration System: A small but significant amount of exhaust gas leaks out from around the seals of the moving pistons in the engine and is conventionally vented to the atmosphere through the crankcase. These vapors, which contain PM, water and traces of oil, can make their way into passenger compartments of trucks and buses. Closed crankcase systems include condensation filters to remove the oil and

particulates, pressure regulators to protect the engine and ductwork to route the filtered gases back through the engine instead of to the atmosphere.

- CNG** **Compressed Natural Gas:** CNG is a mixture of hydrocarbons, mainly methane, and is produced either from gas wells or in conjunction with crude oil production. Vehicles powered by CNG perform just like vehicles powered by diesel fuel. CNG buses can reduce emissions of PM by about 70 to 90 percent if they meet Clean Fueled Fleet requirements or have catalysts. CNG engines that do not have catalysts may have higher formaldehyde, hydrocarbon, and ultra-fine PM emissions than Clean Diesel engines meeting EPA's 2007 emission standard for PM. The cost of CNG varies, but generally is comparable to the cost of regular diesel fuel. However, the cost of a new CNG vehicle can be much higher than a comparable diesel vehicle. Additionally, CNG buses require special refueling facilities as well as special maintenance facilities, both of which are expensive. -*EPA*
- CO** **Carbon Monoxide:** Carbon monoxide is a colorless, odorless and poisonous gas produced by the burning of fuels. Automobiles are the primary source of CO pollution. When CO enters the bloodstream, it reduces the delivery of oxygen to the body's organs and tissues. Health threats are most serious for those who suffer from cardiovascular disease, particularly those with angina or peripheral vascular disease. Exposure to elevated CO levels can cause impairment of visual perception, manual dexterity, learning ability and performance of complex tasks.
- 77% of the nationwide CO emissions are from transportation sources. The largest emissions contribution comes from highway motor vehicles. Thus, the focus of CO monitoring has been in urban areas where the main source of CO is motor vehicle exhaust. Other major CO sources are wood-burning stoves, incinerators and factories. -*EPA*
- CO₂** **Carbon Dioxide:** Carbon dioxide is a colorless, odorless gas which is a natural byproduct of the combustion of all types of fuels. It is also produced by respiration. It is a greenhouse gas, which can contribute to global warming.
- CRT[®]** **Continuously Regenerating Technology:** CRT[®] is Johnson Matthey's version of a passive DPF. (See DPF and Passive DPF.)
- CWMF** **Catalyzed Wire Mesh Filter:** A CWMF is a type of lightly catalyzed particulate filter designed to be used with a platinum-based, fuel borne catalyst to reduce particulates in diesel exhaust. (See *FBC*.)

DPM **Diesel Particulate Matter** (diesel PM) – That portion of the exhaust from a diesel fueled compression ignition engine that is collected via a particulate matter sampling method. Diesel PM consists of several constituents, including: an elemental carbon fraction, a soluble organic fraction and a sulfate fraction. The majority of diesel PM (i.e., 98%) is smaller than 10 microns in diameter.

DFX **DFX** (or Platinum Plus[®] DFX) is Clean Diesel Technologies' line of fuel borne catalysts. (See FBC.)

DOC **Diesel Oxidation Catalyst:** DOCs are devices that use a chemical process to break down pollutants in the exhaust stream into less harmful components. Diesel oxidation catalysts can reduce emissions of PM by 20 percent and HC by 50 percent and CO by approximately 40 percent. Oxidation catalysts cost about \$1,000 to \$2,000, can be installed on any diesel engine, and run on regular diesel fuel. Although installation time can vary, field experience suggests it takes about 1 to 3 hours to install an oxidation catalyst. (See Oxidation Catalyst, Catalytic Converter.) –*EPA*

DPF **Diesel Particulate Filter:** Diesel particulate filters are exhaust treatment devices that reduce diesel particulate matter through filtration. They can be installed on new and used buses, but must be used in conjunction with ULSD fuel. The combination of PM filters and ULSD can reduce emissions of PM, HC, and CO by 60 to 90 percent.

DPFs must be periodically “regenerated” to remove the collected particulate matter. DPFs can incorporate passive regeneration techniques, such as the catalyzed particulate filter, or they can incorporate active regeneration techniques, such as the electrically regenerated particulate filter. (See Passive DPF.) –*EPA & CARB*

DPX[™] **DPX[™]** is Engelhard's passive DPF system. (See DPF and Passive DPF.)

Emulsified Diesel Fuel: Emulsified diesel is a blended mixture of diesel fuel, water, and other additives that reduces emissions of PM as well as NO_x. Emulsified diesel can be used in any diesel engine, but the addition of water reduces the energy content of the fuel, so some reduction in power and fuel economy can be expected. Emulsified fuel will stay mixed for a fairly long time. However, if a vehicle sits dormant for months at a time the water can settle out of the fuel and possibly cause problems. Therefore school buses may want to phase out the use of the fuel towards the end of the school year and then reintroduce it in the fall. Case studies suggest that emulsified diesel can reduce emissions of smog-causing NO_x by about 10 - 20 percent and PM by about 50 - 60 percent. Emulsified diesel costs roughly 20 cents more per gallon than regular diesel fuel. –*EPA*

- ERG** **Exhaust Gas Recirculation:** EGR systems are designed to reduce NO_x emissions. Oxides of nitrogen are formed when the engine's combustion chamber gets too hot. EGR systems consist of a series of timed valves that carry exhaust gases back to the intake. Since these gases cannot burn again, they chemically slow down and cool the combustion process, decreasing the amount of NO_x produced.
- EGRT[®]** **Exhaust Gas Recirculation Technology** is a Johnson Matthey product that combines EGR and passive DPF technologies.
- FBC** **Fuel Borne Catalyst:** An FBC is a fuel additive containing one or more fuel-soluble metals that acts as a catalyst to lower the temperature at which regeneration occurs within a diesel particulate filter. *-CARB*
- HC** **Hydrocarbons:** An exhaust and evaporative pollutant of hydrogen and carbon atoms resulting from unburned fuel. HC contributes to the formation of ozone which is responsible for the choking, coughing, and stinging eyes associated with smog. Ozone damages lung tissue, aggravates respiratory disease, and makes people more susceptible to respiratory infections. Children are especially vulnerable to ozone's harmful effects, as are adults with existing disease. *-EPA*
- LSD** **Low Sulfur Diesel fuel:** Current EPA regulations specify that diesel test fuel contain 300 - 500 parts per million (ppm) sulfur for highway engines and 300 - 4000 ppm sulfur for nonroad engines. Significant reductions from these current sulfur levels are necessary in order for many retrofit technologies to provide meaningful, lasting emissions reductions. The manufacturers of these retrofit technologies will specify the maximum allowable sulfur level for effective operation of its products. In addition to enabling a wide array of emissions control technologies, the use of low sulfur alone reduces emissions of particulate matter.
- Sulfate, a major constituent of particulate matter, is produced as a byproduct of burning diesel fuel containing sulfur. Reducing the sulfur content of fuel in turn reduces sulfate byproducts of combustion and therefore particulate matter emissions. The retrofit program will verify particulate matter reductions from the use of low sulfur alone. For the purposes of the diesel retrofit program diesel fuel must contain less than 50 ppm sulfur to be considered a low sulfur fuel. *-EPA*
- NO_x** **Nitrogen Oxides:** Oxides of nitrogen are a family of reactive gaseous compounds that contribute to air pollution in both urban and rural environments. NO_x emissions are produced during the combustion of fuels at high temperatures. The primary sources of atmospheric NO_x include highway sources (such as light-duty and heavy-duty vehicles), nonroad

sources (such as construction and agricultural equipment, and locomotives) and stationary sources (such as power plants and industrial boilers). NO_x can irritate the lungs, cause bronchitis and pneumonia, and lower resistance to respiratory infections. Nitrogen oxides are an important precursor both to ozone and acid rain, and may affect both terrestrial and aquatic ecosystems. -EPA

Oxidation Catalyst: A type of catalyst (catalytic converter) which chemically converts HC and CO to water vapor and carbon dioxide. (See Catalytic Converter.) -EPA

Particulate ReactorTM: ESW's Particulate ReactorTM is an oxidizing catalytic emission reduction system (see *oxidation catalyst*) which also incinerates carbon PM in diesel engine exhaust. ESW indicates that the unique converter substrate design forces carbon particles to relentlessly collide with the catalyzed fabric structure while making their way through these passages. Within the reactor sufficient temperatures are created to incinerate carbonaceous particulate matter. -ESW

Particulate Trap: An aftertreatment device which filters or traps diesel particulate matter from engine exhaust until the trap becomes loaded to the point that a regeneration cycle is implemented to burn off the trapped particulate matter. DPFs are specialized particulate traps. -EPA

PM **Particulate Matter:** Particulate matter includes dust, dirt, soot, smoke and liquid droplets directly emitted into the air by sources such as factories, power plants, cars, engines, construction activity, fires and natural windblown dust. Particles formed in the atmosphere by condensation or by the photochemical transformation of emitted gases are also considered particulate matter. -EPA

Passive DPF: A passive DPF is a continuously regenerating DPF that contains a catalyzed substrate, which allows the filter to be regenerated at lower operating temperatures than those required for burning off the soot on a non-catalyzed filter.

SCR **Selective Catalytic Reduction:** SCR is a technology designed to reduce NO_x emissions by injecting a catalyst, usually ammonia, into the hot exhaust stream to convert NO_x into nitrogen and CO₂. The system consists of the pump/injector components plus sensors to insure adequately high temperature for the catalyst to work and to protect against engine damage.

SO₂ **Sulfur Dioxide:** Sulfur dioxide belongs to the family of sulfur oxide gases (SO_x). SO_x gases are byproducts of the combustion of fuels that contain sulfur. SO₂ dissolves in water vapor to form acid, and interacts with other

gases and particles in the air to form sulfates and other products that can be harmful to people and their environment. -*EPA*

ULSD

Ultra Low Sulfur Diesel: ULSD is diesel fuel that contains less than 15 parts per million sulfur. ULSD will be available nationwide in June 2006, but currently is available in certain parts of the country. The primary purpose of ULSD is to enable or improve the performance of aftertreatment technologies such as a PM filter. The quantity of emissions reductions from the use of ULSD alone will vary depending on the application, level of sulfur reduction, and other fuel characteristics of the replacement fuel (e.g., cetane number, aromatics, PNA). Some case studies suggest that the use of ULSD alone can reduce emissions of PM between 5 and 9 percent. While ULSD-only emission reductions for PM are relatively modest on a per-vehicle basis compared to aftertreatment retrofit, the emission reductions can be significant if an entire fleet is fueled with ULSD. The price differential between ULSD and regular diesel fuel varies by location but ranges between 8 and 20 cents per gallon. In 2006, when ULSD is available nationwide, the cost differential will be much less. -*EPA*

ULSF

Ultra Low Sulfur Fuel (see ULSD)