



CAPHE PHAP-RM
7.8 CLEAN FUELS
2016

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7.8 Emissions controls for mobile sources: Clean fuels

7.8.1 What are clean fuels?

“Clean fuels” are fuel alternatives for cars, trucks, construction equipment, and other motorized vehicles and portable equipment (called mobile sources). Clean fuels produce less pollution than conventional fuels, such as gasoline and diesel. Some clean fuels can be substituted directly for conventional fuels, while others require special equipment or retrofits. Examples of clean fuels include ethanol, biodiesel, natural gas, biogas, electricity, propane, and hydrogen.¹

Clean fuels can reduce conventional and toxic pollutants, like particulate matter (PM_{2.5}) and sulfur dioxide (SO₂), or greenhouse gas pollutants, like carbon dioxide (CO₂) and methane (CH₄). Often, a clean fuel does both. The figure below shows the relative emissions of greenhouse gas pollutants as a carbon score. This score indicates the amount of emissions of greenhouse gas pollutants in comparison to conventional fuels. For example, biodiesel derived from waste grease, produces only about 18% as much greenhouse gas emissions as conventional gasoline or diesel.

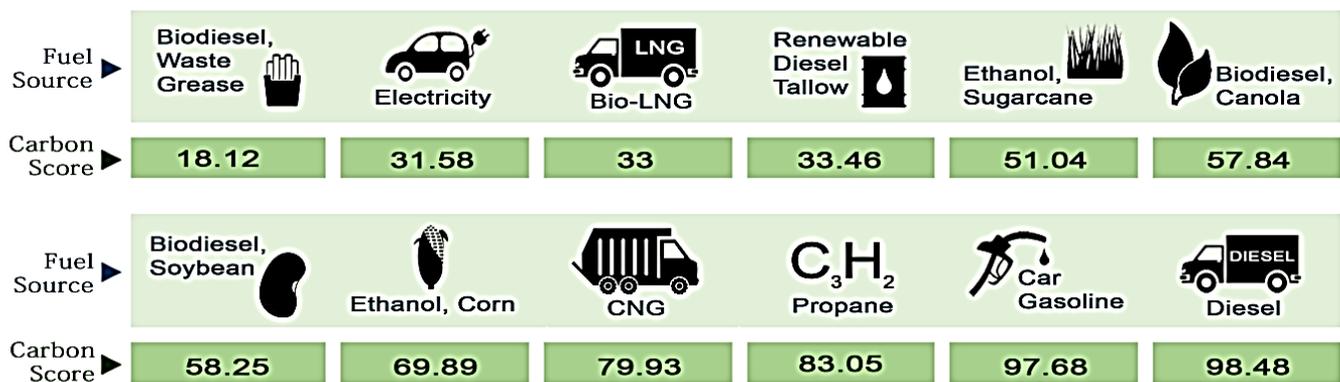


Figure 7.8-1. Fuel examples and carbon scores.²

7.8.2 What types of clean fuels can be used?

Several types of clean fuels are commonly used.

- Ultra low-sulfur diesel is a refined, cleaner diesel fuel with low sulfur content. The federal government is lowering the permissible amount of sulfur in fuels to 10 parts per million (required as the Tier 3

¹ ODEQ (Oregon Department of Environmental Quality). Oregon Clean Fuels Program: Clean Fuels 101. Available: <http://www.deq.state.or.us/aq/cleanFuel/qa.htm>. [accessed 15 February 2016].

² ODEQ (Oregon Department of Environmental Quality). Oregon Clean Fuels Program: Clean Fuels 101. Available: <http://www.deq.state.or.us/aq/cleanFuel/qa.htm>. [accessed 15 February 2016].

standard by January 2017). This will reduce emissions of SO₂ and PM_{2.5} from cars and trucks and other mobile sources.

- Biofuels are fuels of which a fraction is produced from one or more biomass sources (e.g. corn starch, agricultural crop residue, or recycled cooking grease). These include, for example, biodiesel blends like B30, which are a mix of 10% biodiesel and 70% petroleum-based diesel fuel. These, and many other, fuels also include additives that help to stabilize the mixture.³ These fuels reduce greenhouse gas pollutants like CO₂, and, to a smaller extent, conventional pollutants like PM_{2.5}.
- Compressed natural gas (CNG), liquefied natural gas (LNG) or propane can be used in many vehicles that are equipped with a special tank and fueling system. Both fuels are clean burning fuel alternatives.⁴ Some vehicles can run on CNG or propane alone (dedicated), natural gas or gasoline (bi-fueled), or natural gas with diesel fuel for ignition assistance (dual-fuel).

Other types of clean fuels have been introduced. While becoming more common, motor vehicles using these clean fuels currently represent a small fraction of those on the road:

- Electric vehicles, “plug-ins” and “plug-in hybrids” use a battery that must be charged to store the electrical energy that powers the motor.⁵ The EPA categorizes electric vehicles as “zero-emission” because the vehicle itself produces no exhaust or emissions. However, pollutants are emitted at coal, oil and natural gas power plants used to produce the electricity. Still, overall emissions of electric vehicles can be favorable compared to conventional vehicles. (Note that while hybrid vehicles include an electric motor, most are powered by conventional fuels, although in cases clean fuels can be used.⁶ Hybrids can obtain high fuel economy and low emissions with the power and range of conventional vehicles since less fuel is burned.)
- Fuel cell and hydrogen fuels may represent the future for clean fuels, especially since hydrogen can be produced by renewable energy sources and these are also “zero-emission” vehicles. Currently, Michigan, like most states, has very limited infrastructure for such vehicles.

³ EPA (Environmental Protection Agency). (2010). Green Remediation Best Management Practices: Clean Fuel & Emission Technologies for Site Cleanup. Available: <http://nepis.epa.gov/Exe/ZyPDF.cgi/P100891Y.PDF?Dockey=P100891Y.PDF>. [accessed 15 February 2016].

⁴ U.S. Department of Energy. (2014). Alternative Fuels Data Center: Natural Gas Vehicles. Available: http://www.afdc.energy.gov/vehicles/natural_gas.html. [accessed 17 February 2016].

⁵ U.S. Department of Energy. (2013). Alternative Fuels Data Center: All-Electric Vehicles. Available: http://www.afdc.energy.gov/vehicles/electric_basics_ev.html. [accessed 16 February 2016].

⁶ U.S. Department of Energy. (2013). Alternative Fuels Data Center: Hybrid Electric Vehicles. Available: http://www.afdc.energy.gov/vehicles/electric_basics_ev.html. [accessed 16 February 2016].

Clean Fuel & Emissions: Recommended Checklist
Operations and Maintenance
<ul style="list-style-type: none"> ✓ Implement an idle reduction plan ✓ Assure proper tune-ups of vehicles and equipment and maintenance of fuel storage tanks ✓ Establish routines for daily activities such as using biodegradable lubricants, closely managing petroleum-product waste materials, driving efficiently, and inflating tires properly ✓ Track fuel consumption and associated emission of GHG and air toxics and set reduction goals
Advanced Diesel Technologies
<ul style="list-style-type: none"> ✓ Rebuild engines to meet cleaner emission standards ✓ Repower vehicles with new engines or replace aged vehicles with new vehicles ✓ Retrofit existing equipment with aftertreatment devices
Alternative Fuels and Fuel Additives
<ul style="list-style-type: none"> ✓ Retrofit all existing nonroad equipment to use ULSD ✓ Use biodiesel produced from waste or agricultural products with reduced lifecycle GHG emissions ✓ Select fuel with additives that can further reduce air emissions
Alternative Vehicles
<ul style="list-style-type: none"> ✓ Replace conventional vehicles with electric fuel, hybrid, or compressed natural gas vehicles

Emissions from cars and trucks depend on a number of factors besides fuels, some of which are highlighted in the figure following.

Many other factors beyond fuels can affect emissions. Figure 2 shows additional measures that can help reduce emissions and reduce fuel use.

- For the vehicle, these include correct inflation and maintenance of tires, regular engine tune-ups, periodic replacement of filters in air and fuel systems, use of the recommended grade of motor oil, and repair/replacement of the engine, fuel and exhaust systems.⁷
- For the driver, avoiding rush hour period if possible, gradually accelerating, and combining short trips can save fuel and reduce emissions.
- For the city and state, fuel use can be reduced by using smoother pavement, optimal signaling, and other traffic control measures.
- Diesel engines can reduce emissions by rebuilding engines to meet cleaner emissions standards; replacing old engines or vehicles with cleaner ones; and/or retrofitting vehicles and equipment with particle traps and other equipment (Section 7.1).⁸

Figure 7.8-2. Clean Fuel and Emissions: Recommended Checklist.

7.8.3 How can we encourage the use of clean fuels?

Several policies encourage the use of clean fuels.

⁷ U.S. Department of Energy. (2013). Alternative Fuels Data Center: All-Electric Vehicles. Available: http://www.afdc.energy.gov/vehicles/electric_basics_ev.html. [accessed 16 February 2016]. And EPA (Environmental Protection Agency). (2010). Green Remediation Best Management Practices: Clean Fuel & Emission Technologies for Site Cleanup. Available: <http://nepis.epa.gov/Exe/ZyPDF.cgi/P100891Y.PDF?Dockey=P100891Y.PDF>. [accessed 15 February 2016].

⁸ EPA (Environmental Protection Agency). (2010). Green Remediation Best Management Practices: Clean Fuel & Emission Technologies for Site Cleanup. Available: <http://nepis.epa.gov/Exe/ZyPDF.cgi/P100891Y.PDF?Dockey=P100891Y.PDF>. [accessed 15 February 2016].

- The Renewable Fuel Standard program, administered by the US Environmental Protection Agency (EPA), mandates that renewable fuels be produced every year to replace or reduce the quantity of petroleum-based transportation fuel, heating oil or jet fuel.⁹ As a result, most gasoline sold has 10% ethanol, produced largely from corn. EPA is increasing this level to 15%.
- US EPA is further reducing the sulfur content in motor vehicles to 10 ppm. EPA already limits the level of benzene, a toxic air pollutant, in gasoline. Finally, a federal tax credit worth \$7500 is available to purchasers of electric vehicles (plug-ins, not hybrids).
- More aggressive approaches to introduce clean fuels have been taken elsewhere. Several US states have set clean fuel standards that require fuel producers and importers to introduce low carbon fuels (or buy carbon off-sets).¹⁰ Some companies have CNG fleets. Tax or incentive policies might be used to increase the sales and use of electric vehicles.
- Many transit buses use alternative fuels or hybrid technology. National statistics from 2011 show that 19% of transit buses use CNG, LNG or blends; 9% were hybrids, and 8% used biodiesel.¹¹
- A Michigan company has sold over 6300 propane-powered school buses nationally. In addition to lowering emissions, maintenance costs are reduced.¹²
- US EPA has school bus rebate programs that reduce emissions from diesel engines, which have been received by several Michigan school districts (Fairview Area, Hopkins, Reed City)¹³ EPA has additional clean-diesel grant programs, and the latest day to submit proposals was due April 26, 2016, which can be worth up to \$2.5 million.¹⁴

⁹ EPA (Environmental Protection Agency). (2015). Program Overview for Renewable Fuel Standard Program. Available: <http://www.epa.gov/renewable-fuel-standard-program/program-overview-renewable-fuel-standard-program>. [accessed 15 February 2016].

¹⁰ State of Washington Department of Ecology. (2015). Clean Fuel Standard: Preparing Washington for a Changing Climate. Available: <https://fortress.wa.gov/ecy/publications/publications/1501001.pdf>. [accessed 15 February 2016].

¹¹ APTA (American Public Transportation Association). (2016). More Than 35% of U.S. Public Transit Buses Use Alternative Fuels or Hybrid Technology. Available: http://www.apta.com/mediacenter/pressreleases/2013/Pages/130422_Earth-Day.aspx [accessed 16 March 2016].

¹² Roush, CleanTech. (2016). Available: <http://www.roushcleantech.com/> [accessed 16 March 2016].

¹³ EPA (Environmental Protection Agency). (2016). Clean Diesel. Available: <https://www.epa.gov/cleandiesel> [accessed 16 March 2016].

¹⁴ EPA (Environmental Protection Agency). (2016). Clean Diesel Funding Assistance Program. Available: https://www.epa.gov/sites/production/files/2016-02/documents/rfp-epa-oar-otaq-16-02_update.pdf [accessed 16 March 2016].

7.8.4 Why is this important?

The United States consumes 375 million gallons of gasoline each day. An additional 195 million gallons per day of diesel, jet and other fuels is used for trucks, air travel, rail and transit.¹⁵ Petroleum consumption by the transportation sector contributes significantly to air pollution, greenhouse gas emissions and climate change, which has emission and exposure impacts worth hundreds of billions of dollars per year.¹⁶ While modern vehicles incorporate many technologies to reduce emissions, motor vehicle-related emissions account for the largest share of PM_{2.5}, nitrogen oxides (NO and NO₂), and volatile organic compound (VOC) emissions in urban areas (see other chapters in this guide). Thus, the widespread use of gasoline and diesel fuels exposes people to harmful emissions daily.¹⁷

In Wayne County, about 68% (752 tons/year) of diesel exhaust emissions come from highway (on-road) traffic.¹⁸ About 30% of all greenhouse gas emissions in Detroit come from transportation-related sources and, of those, 98% come from passenger truck, car, and on-road freight.¹⁹

7.8.5 Implications for Health

7.8.5.1 Which pollutants are affected by the use of clean fuels?

Clean fuels can reduce emissions of several harmful pollutants emitted by gasoline and diesel-powered vehicles, including VOCs (e.g., benzene, toluene, xylenes, 1,3-butadiene, formaldehyde), PM_{2.5}, NO and NO₂, carbon monoxide (CO), and sulfur compounds. The lower VOC and NO emissions from clean fuels can help reduce the formation of ozone, a major air pollution problem in most urban areas.²⁰

¹⁵ EIA (U.S. Energy Information Administration). (2016). Oil: Crude and Petroleum Products Explained. Available: http://www.eia.gov/energyexplained/index.cfm?page=oil_home#tab3. [accessed 17 February 2016].

¹⁶ Sierra Club. (2010). Ending Our Dependence on Oil. Available: <https://americansecurityproject.org/wp-content/uploads/2010/10/Ending-our-Dependence-on-Oil.pdf>. [accessed 17 February 2016].

¹⁷ OEHHA (Office of Environmental Health Hazard Assessment). (2007). Fuels and Your Health: A Fact Sheet by Cal/EPA's Office of Environmental Health Hazard Assessment and the American Lung Association. Available: http://oehha.ca.gov/public_info/facts/fuelstoi.html. [accessed 17 February 2016].

¹⁸ CAPHE (Community Action to Promote Healthy Environments). (2016). Diesel Fact Sheet. Available: <http://caphedetroit.sph.umich.edu/project/diesel/>. [accessed 17 February 2016].

¹⁹ University of Michigan Center for Sustainable Systems. (2014). City of Detroit Greenhouse Gas Inventory: An Analysis of Citywide and Municipal Emissions for 2011 and 2012. Available: <http://skeodev.com/dekleine.pdf>. [accessed 17 February 2016].

²⁰ OEHHA (Office of Environmental Health Hazard Assessment). (2007). Fuels and Your Health: A Fact Sheet by Cal/EPA's Office of Environmental Health Hazard Assessment and the American Lung Association. Available: http://oehha.ca.gov/public_info/facts/fuelstoi.html. [accessed 17 February 2016].

7.8.5.2 What health effects can be mitigated?

The use of clean fuels would lead to improvements over time in respiratory diseases such as asthma; reduced lung diseases such as chronic obstructive pulmonary disease; fewer cases of cancer such as lung cancer; reduced irritation of the nose and throat; and reduced cases of headaches, dizziness, nausea, vomiting and confusion.²¹

7.8.6 What is happening in Detroit and Michigan?

Clean Cities - Detroit. The U.S. Department of Energy's Clean Cities program is a locally-based government and industry partnership aimed at expanding the use of alternatives to gasoline and diesel fuel. It combines local decision making with voluntary action by partners in a grassroots approach designed to build a sustainable alternative fuels market. More than 80 cities and regions have been designated as Clean Cities, including Detroit.²²

Metro Cars Detroit. As part of Detroit's Clean Cities program in 2010, Metro Cars partnered with the Clean Energy Coalition to purchase cars that operate on propane. The majority of Metro Cars fleet, approximately 300, is now operated on propane.²³

Green Fleets Program. The Clean Energy Coalition, an organization promoting the use of renewable energy, awarded \$5.4 million to DTE Energy (DTE) for the conversion of more than 170 gasoline-powered utility vehicles to run on CNG. The grant also paid for the construction of two CNG fueling stations and the refurbishment of 13 others across Michigan. This program will save about 250,000 gallons of petroleum each year, or an annual savings of \$450,000.²⁴

Michigan Clean Diesel Program. (For more information on Retrofitting, see [Section 7.1](#))

Several bus companies, municipalities and universities are using cleaner diesel fuels, including biodiesel blends in their vehicles.

7.8.7 What are the best practices that encourage cleaner fuels?

Clean fuel programs have been successfully used elsewhere, and many of these best practices could be used in Michigan.

- Require zero-emission vehicles. The California Air Resources Board approved the *Advanced Clean Cars Program* in 2012. By 2025, this will: increase the number of zero-emission vehicles sold in the state to

²¹ Community Action to Promote Healthy Environments, Health Effects of Air Pollutants Chart.

²² LARA (Department of Licensing and Regulatory Affairs). (2016). Clean Cities Program. Available: <http://www.michigan.gov/lara/0,4601,7-154-10401-42667--,00.html>. [accessed February 22 2016]. For more information on Clean Cities, see: <http://cec-mi.org/mobility/programs/detroit-clean-cities/>

²³ Clean Energy Coalition. Metro Cars Achieves Significant Fuel Savings After Converting Fleet to Propane. Available: <http://cec-mi.org/metro-cars-achieves-significant-fuel-savings-after-converting-fleet-to-propane/>. [accessed February 25 2016]

²⁴ Clean Energy Coalition. Clean Energy Coalition Powers Up Local Utility Fleet. Available: <http://cec-mi.org/clean-energy-coalition-powers-up-local-utility-fleet/> [accessed February 25 2016]

225,000 per year; reduce greenhouse gas emissions from new automobiles by 34%; and will reduce emissions of conventional pollutants by 75%.²⁵

- Expand awareness, education and training. *Wisconsin Clean Cities* oversees *Forwarding Wisconsin's Fuel Choice*, a two-year program designed to implement policy, barrier reduction, training, and educational initiatives to significantly expand the alternative fuels market in Wisconsin.²⁶
- Financial incentives. *Drive Clean Chicago*, funded by the Chicago Department of Transportation and federal Congestion Mitigation Air Quality program, is aimed at accelerating the adoption of alternative fuel vehicles in Chicago. In 2014, it launched the *Drive Clean Truck* initiative, which offers financial incentives to truck fleet owners to shift their diesel fleet to zero and low emission vehicles.²⁷ EPA grant programs were mentioned in the previous section.
- Retire old high-emission vehicles. The State of California's Cash for Clunkers program lowers emissions by taking older vehicles off the road. Since 2009, the program has offered a cash incentive to owners for retire older and more polluting cars. Such programs may not be cost-effectiveness.
- Required emissions testing. Many states require yearly or biennial emissions testing of cars and trucks, especially older vehicles. For example, California's *Smog Check Program* requires inspections of most gasoline-powered vehicles older than 6 years.²⁸ Michigan does not require emissions testing for cars and trucks,²⁹ however, it was required from 1994-1996 in Wayne, Oakland and Macomb Counties in order to comply with the federal ozone standards.^{30,31}

²⁵ California Air Resources Board. California's Advanced Clean Cars Program. Available: http://www.arb.ca.gov/msprog/consumer_info/advanced_clean_cars/consumer_acc.htm. [accessed February 23 2016].

²⁶ Wisconsin Clean Cities. (2016). Forwarding Wisconsin's Fuel Choice. Available: http://www.wicleancities.org/projects/projects_choice.php. accessed February 23 2016].

²⁷ Drive Clean Chicago. (2016). Our Programs. Available: <http://www.drivecleanchicago.com/OurPrograms.aspx#truck>. [accessed February 23 2016].

²⁸ California Department of Motor Vehicles. (2016). Smog Information. Available: <https://www.dmv.ca.gov/portal/dmv/detail/vr/smogfaq> [accessed February 25 2016].

²⁹ State Emissions Laws % Emissions Testing Locations. (2016). Available: <http://www.emissions.org/michigan-eco-friendly-driving-incentives/> [accessed February 25 2016].

³⁰ State of Michigan Natural Resources and Environmental Protection Act 451 Section 6507 (Excerpt). (1994). Available: [http://www.legislature.mi.gov/\(S\(xeeiki13ixcfuh5td5zwsjd\)\)/mileg.aspx?page=getObject&objectName=mcl-324-6507](http://www.legislature.mi.gov/(S(xeeiki13ixcfuh5td5zwsjd))/mileg.aspx?page=getObject&objectName=mcl-324-6507) [accessed February 25 2016], and EPA (Environmental Protection Agency) Green Book. (1994). Available: <http://www3.epa.gov/airquality/greenbook/frn/5937190.html> [accessed February 25 2016].

³¹ State of Michigan Natural Resources and Environmental Protection Act 451 Section 6506 (Excerpt). (1994). [http://www.legislature.mi.gov/\(S\(rmqkyb2xy0chibmx3a35udwh\)\)/mileg.aspx?page=getObject&objectName=mcl-324-6506](http://www.legislature.mi.gov/(S(rmqkyb2xy0chibmx3a35udwh))/mileg.aspx?page=getObject&objectName=mcl-324-6506) [accessed February 25 2016].

7.8.8 How many people could be affected in Detroit by clean fuels?

The number of people affected by clean fuel depends on how many cars, trucks, and other pollution-emitting vehicles use clean fuels and other strategies. Those who are likely to benefit the most include those who live, work, and spend time near major sources of pollution, such as major roadways and interstates, rail and shipping areas, freight terminals and some industrial sites. In addition, since some vehicle emissions are widely dispersed (including greenhouse gas emissions and the formation of ozone), everyone is affected, regardless of whether you live close to highways and industry.

Sites in Detroit where people are likely to be affected include:

- Ambassador Bridge and the future site of the Gordie Howe Bridge
- The new 186-acre Industrial Park, and logistics center, near the junction of I-75 and I-94 on Detroit's near east side³²
- Truck and rail transfer stations, for example the Container Port on West Fort Street
- Schools where buses are queuing
- Bus terminals
- People living or working near freeways, such as I-94, I-75, I-275, and I-96.
- People living or working on surface streets with considerable truck traffic, such as Fort Street and Michigan Avenue
- People living or working near construction sites and other locations where diesel vehicles or diesel engines operate, such as the new Hockeytown Arena.

7.8.9 Applicable Strategies for Detroit and/or Michigan:

Create laws and ordinances at State and local levels. Require that diesel trucks and buses use clean fuels and/or upgrade their fleets to clean fuel technologies.

Offer financial incentives. Implement incentive programs that promote alternative fuels, zero-emission vehicles, clean fuel technology, and related infrastructure. Programs could be particularly tailored to fleet owners, drivers, and bus companies, for replacing their high-polluting vehicles with cleaner technologies.

Require use of alternative fuels and fuel efficient/alternative vehicles in city contracts. Mandate that trucks and construction equipment doing business with the City of Detroit use alternative fuels and clean fuel technologies.

Require emissions testing at the state and/or county levels.

³² DEGC (Detroit Economic Growth Corporation). 2016. I-94 Industrial Park. Available: <http://www.degc.org/businesses/i-94-industrial-park> [accessed 3-17-16].

Encourage, incentivize or require electric charging stations and possibly parking for electric vehicles.

Provide education and assistance to firms, school districts, and governmental agencies to understand the benefits (health, environment and financial) of cleaner fuels and technologies.

Target and provide grant-writing assistance to apply for grants for cleaner fuels and vehicles. Government, industry and NGOs can apply to federal and state programs for this support.

Promote Michigan firms engaged in cleaner fuels and technologies and encourage their participation in policy and items above.