Federal Control of Air Emissions From New Heavy-Duty Road Vehicles

by Arnold W. Reitze Jr.

Arnold W. Reitze Jr. is Professor of Law, S.J. Quinney College of Law, University of Utah; J.B. and Maurice Shapiro Professor Emeritus of Environmental Law, The George Washington University; and author of three books on air pollution published by ELI.

Summary

Heavy-duty road vehicles are subject to a regulatory program administered primarily by the federal government, a program that evolved out of concerns about increasing smog in California in the 1960s. Among the applicable regulations today are Clean Air Act mobile source provisions, Tier 2 standards, and the proposed Tier 3 standards. The mobile source program has existed for one-half century, but regulation of heavy-duty vehicles developed much later than the program for light-duty vehicles. More recently, the federal government has begun implementing a program to control greenhouse gas emissions from heavy-duty vehicles.

Heavy-duty diesel vehicles are major contributors to the atmospheric concentrations of nitrogen oxides (NO_x) and particulate matter (PM) and are modest contributors of the other conventional air pollutants. Heavy-duty vehicles are also responsible for toxic emissions that are known or suspected human or animal carcinogens, or have serious noncancer health effects. Heavy-duty diesel powered highway vehicles in 2005 emitted 1.8% of the nation's carbon monoxide (CO), 44.0% of the NO_x, 3.9% of the volatile organic compounds (VOCs), 50.3% of the coarse PM (PM_{10}), and 61.7% of the fine PM ($PM_{2.5}$) from highway vehicles.[1] Heavy-duty gasoline-powered highway vehicles in 2005 were responsible for emissions of 4.1% of the nation's CO, 5.9% of the NO_x, 4.2% of the VOCs, 4.4% of the PM_{10}, and 4.7% of the $PM_{2.5}$.[2] Thus, heavy-duty vehicles (HDVs), particularly those powered by diesel engines, are a significant portion of the emissions from highway vehicles.[3] Conventional air pollutants emitted from mobile sources can be minimized through (1) control of the combustion process, (2) using clean fuel, and (3) installing air pollution control devices. Transportation sources in 2011 contributed nearly one-third of the carbon dioxide (CO_2) emitted in the United States, which is the chemical responsible for about 84% of U.S. greenhouse gas (GHG) emissions.[4] In 2012, the U.S. emissions were 17.5% of the world's CO_2 emissions.[5] Nearly one-quarter of the CO_2 emitted by the U.S. highway transportation sector in 2011 was from buses and medium-duty and heavy-duty trucks (HDTs).[6]

Highway vehicles are subject to a regulatory program administered primarily by the federal government. The mobile source program has existed for one-half century, but regulation of HDVs developed much later than the program applicable to light-duty vehicles (LDVs). More recently, the federal government has begun implementing a program to control GHG emissions from HDVs.

I. Introduction to the Pre-1970 Legal Controls on Mobile Source Air Pollution

Control of motor vehicle emissions prior to 1970 was driven by the legal requirements imposed on new vehicles

1. Stacy C. Davis et al., Transportation Energy Data Book: Edition 32, 12-4, tbl. 12.3; 12-6, tbl. 12.5; 12-8, tbl. 12.7; 12-10, tbl. 12.9; & 12-12, tbl. 12.11 (U.S. Dept. of Energy, July 2013) [ORNL-5198].
2. *Id.*
3. In 2012, highway vehicles were responsible for the release of 38.3% of the nation's CO, 34.7% of the NO_x, 12.6% of the VOCs, 0.3% of the sulfur dioxide (SO_2), 2.9% of the $PM_{2.5}$, and 1.3% of the PM_{10}. Davis et al., *supra* note 1, at 12-2, tbl. 12.1.
4. Davis et al., *supra* note 1, at 11-5, tbl. 11.4; 11-4, tbl.11.3.
5. Davis et al., *supra* note 1, at 11-2, tbl. 11.1.
6. *Id.* at 11-8, tbl. 11.7.

by the state of California. During the 1940s, photochemical smog or haze first appeared in Los Angeles, and by the late 1940s, the automobile was beginning to be suspected as the source of what was to become known as smog.[7] In 1960, the California Motor Vehicle Control Act created a Motor Vehicle Pollution Control Board (MVPCB) within California's Department of Health.[8] By the mid-1960s, the MVPCB became the subject of increasing criticism for its close ties to the industry. Moreover, the entry of the federal government into the air pollution field made the creation of a state agency with broader authority a rational development.[9] This resulted in the abolition of the MVPCB in August 1967 and its replacement with the California Air Resources Board (CARB). The 1967 Mulford-Carroll Act, S.B. 490, gave CARB comprehensive authority over both stationary and mobile air pollution sources.[10] Over the years, CARB became the recognized authority on the regulation of motor vehicle emissions and became the most important influence in developing a federal program.[11]

The first federal air pollution legislation was the 1955 Air Pollution Control Act, which provided for limited research efforts, but contained no regulatory measures.[12] In 1960, the U.S. Congress authorized the Surgeon General of the Public Health Service to make a study and report on the human health effects of motor vehicle exhaust.[13] Amendments to the 1955 Act in 1963 renamed the Act the Clean Air Act (CAA). It provided for a conference process to deal with interstate air pollution,[14] but it also directed the Secretary of Health, Education, and Welfare (HEW) to encourage the development of motor vehicle emission controls by the automotive and fuel industries, and it created a technical committee to work with industry.[15]

Congress first authorized automotive emissions controls in the Motor Vehicle Air Pollution Control Act of 1965.[16] The Act prohibited the distribution in commerce of new motor vehicles and new motor vehicle engines unless they conformed to federal regulations.[17] After regulations were promulgated, a manufacturer had to obtain a certification from the Secretary of HEW that the vehicle or engine conformed to the regulations.[18]

In 1966, HEW imposed the first federal regulatory emission standards to model year (MY) 1968 and thereafter vehicles.[19] Gasoline powered vehicle's crankcase emissions were to be reduced to zero, tailpipe emissions of hydrocarbon (HC) were to be reduced by 72%, and CO emissions were to be reduced by 56% using MY 1963 emissions as the baseline; however, commercial vehicles were not regulated.[20]

In June 1968, HEW tightened exhaust standards for MY 1970 and later vehicles and for the first time imposed evaporative standards beginning with MY 1971 vehicles.[21] Subpart D applied to heavy-duty gasoline engines and imposed a standard of 275 parts per million (ppm) for HC and 1.5% CO by volume.[22] Subpart E imposed an opacity limit on diesel exhaust from heavy-duty engines, but imposed no other restrictions on the vehicles exhaust.[23] HDVs were defined as those greater than 6,000 pounds (lbs.) gross vehicle weight rating (GVWR).[24]

The Air Quality Act of 1967 expanded motor vehicle research, provided for federal registration of fuel additives, established a grant program for state motor vehicle inspection programs, and increased the authority of the Secretary of HEW to regulate new motor vehicle emissions.[25] The 1967 Act also preempted new vehicle emissions controls, although California was eligible for a waiver so that it could set more stringent standards.[26] From 1968 until the creation of the U.S. Environmental Protection Agency (EPA) in 1970, the National Air Pollution Control Administration within HEW implemented the CAA.[27]

7. James E. Krier & Edmund Ursin, Pollution & Policy 52 (1977). *See also* Harold W. Kennedy & Martin E. Weekes, *Control of Automobile Emissions—California's Experience and the Federal Legislation*, 33 Law & Contemp. Probs. 297 (1968).
8. Krier & Ursin, *supra* note 7, at 136.
9. *Id.* at 178.
10. *The History of the California Environmental Protection Agency*, *available at* http://www.calepa.ca.gov/about/history01/arb.htm (last visited Jan. 22, 2014).
11. *See generally* California Environmental Protection Agency Air Resources Board, http://www.arb.ca.gov/homepage.htm (last visited Jan. 22, 2014).
12. Pub. L. No. 84-159, later 42 U.S.C. §§7401-7671q, ELR Stat. CAA §§101-618.
13. Act of June 8, 1960, Pub. L. No. 86-493, 74 Stat. 162 (current version at CAA §103, 42 U.S.C. §7503).
14. *See generally* Arnold W. Reitze Jr., *The Legislative History of U.S. Air Pollution Control*, 36 Hous. L. Rev. 679 (1999).
15. Pub. L. No. 88-206, §6, 77 Stat. 392 (Dec. 17, 1963).
16. Pub. L. No. 89-272, 79 Stat. 992 (Oct. 20, 1965).
17. *Id.* at CAA §203.
18. *Id.* at CAA §206.
19. Dept. of Health. Education, and Welfare, *Control of Air Pollution From New Motor Vehicles and New Motor Vehicle Engines*, 31 Fed. Reg. 5170 (Mar. 30, 1966).
20. *Id.*
21. Dept. of Health. Education, and Welfare, *Control of Air Pollution From New Motor Vehicles and New Motor Vehicle Engines, Standards for Exhaust Emissions, Fuel Evaporative Emissions, and Smoke Emissions, Applicable to 1970 and Later Vehicles and Engines*, 33 Fed. Reg. 8303 (June 4, 1968).
22. 33 Fed. Reg. at 8306.
23. *Id.*
24. GVWR is the maximum operating weight of the vehicle as specified by the manufacturer.
25. Pub. L. No. 90-148, §§104, 201 (CAA §§104, 210, 209, 208), 81 Stat. 488, 62 Stat. 791, 80 Stat. 731 (Nov. 21, 1967).
26. *Id.* at §201 (CAA §208); *see also* City of Chicago v. General Motors Corp., 467 F.2d 1262, 1264, 2 ELR 20636 (7th Cir. 1972) (holding that the Air Quality Act of 1967 "explicitly provided for preemption"); *see* David P. Currie, *Motor Vehicle Air Pollution: State Authority and Federal Preemption*, 68 Mich. L. Rev. 1083, 1090 (1970).
27. Records of the Environmental Protection Agency (EPA), *available at* http://www.archives.gov/research/ (Document 412.1) (last visited Jan. 22, 2014).

II. The CAA Amendments of 1970

The CAA Amendments of 1970 shaped the basic structure of the CAA that has controlled air pollution for more than 40 years.[28] This law, which the CAA Amendments of 1977[29] and 1990[30] strengthened, provided a dual strategy to improve air quality through (1) a federal program in Subchapter II, administered by EPA, to promulgate and enforce emissions standards applicable to new motor vehicles, and to regulate fuels and fuel additives,[31] and (2) a joint federal and state program, in Subchapter I, to primarily control stationary sources.[32] The federal/state program, however, also regulates in-use motor vehicles, which begins after motor vehicles are sold to the ultimate purchasers.[33]

The CAA's §202(a) provides EPA with general authority to prescribe vehicle standards, subject to any specific limitations elsewhere in the Act. Section 206(d) authorizes EPA to establish methods and procedures for testing whether a motor vehicle or motor vehicle engine conforms to §202 requirements. Section 202,[34] which regulates emission standards for new motor vehicles or new motor vehicle engines, also affects the CAA's Subchapter 1 state implementation plan (SIP) process that is used to achieve compliance with atmospheric air quality standards, because federal motor vehicle standards will determine the overall emissions from the transportation sector.[35]

Under the 1970 CAA Amendments, motor vehicle emissions were to be controlled primarily through improved technology mandated by the federal government's standards for new vehicles (except for California).[36] The 1970 CAA Amendments authorized the Administrator of EPA to promulgate regulations for any class of new motor vehicles or new motor vehicle engines.[37] EPA has the authority and responsibility to establish programs to provide for a 90% reduction of light-duty MY 1975 HC and CO emissions using MY 1970 vehicles as the baseline.[38] By MY 1976, NO_x reductions of 90% from LDVs were required based on MY 1971 vehicle emissions.[39] To achieve these goals, EPA established federal emission standards of 0.41 grams per mile (gpm) for HC; 3.4 gpm for CO; and 0.4 gpm for NO_x,[40] but the requirements were later relaxed by EPA.[41] It should be noted that LDVs have chemical-specific emission standards for each model year regardless of the vehicles size, but HDV standards allow emissions to increase with engine size.

For heavy-duty spark ignition engines, a HC standard of 275 ppm and a CO standard of 1.50% was imposed for MYs 1970-1973. For MYs 1974-1978, a NO_x standard of 16 grams per brake horsepower hour (g/bhp-hr) was added, and the CO standard changed to 40 g/bhp-hr.[42] For MYs 1974-1978, heavy-duty diesel engines (HDEs) and urban buses, EPA imposed a combined non-methane hydrocarbon (NMHC) and NO_x standard of 16 g/bhp-hr and CO standard of 40 g/bhp-hr.[43]

III. The 1977 CAA Amendments

The 1977 CAA Amendments added additional mobile source air pollution control requirements and changed some of the requirements in Subchapter II that were previously authorized.[44] Section 202(a)(3) requires standards applicable to emissions of HCs, NO_x, CO, and PM from HDVs to be based on the greatest degree of emission reduction available for the model year to which such standards apply, giving appropriate consideration to cost, energy, and safety.[45] The Amendments postponed until MY 1980 the more stringent CO and HC standards[46] and relaxed the light-duty vehicle NO_x emission standard from .4 to 1.0 gpm for MY 1981 and thereafter.[47] States with nonattainment areas could, with EPA approval, adopt the more stringent California standards.[48] The Amendments required inspection and maintenance (I/M) programs in areas that are nonattainment for CO or ozone (O_3).[49] They also added warranty and tampering provisions.[50]

EPA regulations for heavy-duty spark ignition engines became more stringent over time. HC was 1.5 g/bhp-hr for MYs 1974-1984; 1.9 g/bhp-hr from 1985-1986; and dropped to 1.1 g/bhp-hr for vehicles less than 14,000 lbs. GVWR in MY 1987, and for vehicles over 14,000 lbs. GVWR, the standard was 1.9 g/bhp-hr. These standards remained unchanged from MY 1998 through MY 2007.[51] The NO_x standard was 16 g/bhp-hr from MYs 1974-1978 and then was reduced to 10 g/bhp-hr through

28. Pub. L. No. 91-604, 84 Stat. 1676; *see generally* David P. Currie, *The Mobile Source Provisions of the Clean Air Act*, 46 U. Chi. L. Rev. 27 (1981).
29. Pub. L. No. 95-95, 91 Stat. 712 (1977).
30. Pub. L. No. 101-549, 104 Stat. 2468 (1990).
31. 42 U.S.C. §§7521-7574.
32. 42 U.S.C. §§7401-7515. Stationary sources include "any building, structure, facility, or installation which emits or may emit any air pollutant." CAA §111(a)(3), 42 U.S.C. §7411(a)(3).
33. CAA §216(3), (4), (5), 42 U.S.C. §7550(3), (4), (5).
34. 42 U.S.C. §7521.
35. CAA §110, 42 U.S.C. §7410.
36. Pub. L. No. 91-604, §§6, 116, 202, 84 Stat. 1689, (codified as amended at CAA §202).
37. 1970 CAA §202(a)(1).
38. 1970 CAA §202(b)(1)(A).
39. 1970 CAA §202(b)(1)(B).
40. Frank Grad et al., The Automobile and the Regulation of Its Impact on the Environment 340 (1975).
41. An application for a suspension was denied May 12, 1972, which was reversed by the U.S. Court of Appeals for the District of Columbia (D.C.) Circuit in *International Harvester v. Ruckelshaus*, 478 F.2d 615, 3 ELR 20133 (D.C. Cir. 1973). EPA granted a one-year postponement. Pub. L. No. 91-604 (1973). Congress granted another postponement until 1977 (1978 for NO_x) in the Energy Supply and Environmental Coordination Act. Pub. L. No. 93-319 (1974). In 1975, EPA granted another postponement. *See* In re Applications for Suspension of 1975 Motor Vehicle Exhaust Emission Standards (Mar. 5, 1975).
42. Davis et al., *supra* note 1, at 12-18, tbl. 12.15.
43. Davis et al., *supra* note 1, at 12-16, tbl. 12.14.
44. Pub. L. No. 95-95 (Aug. 7, 1977).
45. 42 U.S.C. §7521(a)(3).
46. CAA §202(b)(1)(A), 42 U.S.C. §7521(b)(1)(A).
47. CAA §202(b)(1)(B), 42 U.S.C. §7521(b)(1)(B).
48. CAA §177, 42 U.S.C. §7507.
49. CAA §§182(c)(3), 187(a)(6), 42 U.S.C. §§7511a(c)(3), 7512a(a)(6).
50. CAA §203(a)(3), (4), 42 U.S.C. §7522(a)(3), (4).
51. Davis et al., *supra* note 1, at 12-18, tbl. 12.15.

MY 2007. The NO_x + NMHC standard was 10.6 from MYs 1985-1987 and then was reduced to 6.0 g/bhp-hr for MYs 1988-1990. The CO standard was 25 g/bhp-hr for MYs 1979-1984; 37.1 g/bhp-hr in MYs 1985-1986; it then dropped to 14.4 g/bhp-hr for vehicles equal to or less than 14,000 lbs. GVWR, but remained 37.1 g/bhp-hr for heavier vehicles from MYs 1987-2007.[52]

For HDEs and urban buses, the HC standard was 1.5 g/bhp-hr for MYs 1979-1984 and 1.3 g/bhp-hr from 1985-2006. The NO_x + NMHC standard was 10.0 from MYs 1979-2003. The NO_x standard was 10.7 g/bhp-hr from MYs 1985-1989, 6.0 g/bhp-hr for MY 1990, and dropped to 5.0 g/bhp-hr for MYs 1991-1997. The CO standard was 15.5 g/bhp-hr for MYs 1985-2007. Diesel vehicles also were required to meet a 0.6 g/bhp-hr PM standard for MYs 1988-1990.[53]

IV. The 1990 CAA Mobile Source Control Provisions

The 1990 CAA Amendments to Subchapter II revised and tripled the size of the mobile source provisions found in the 1970 CAA.[54] The most significant new provisions impose more stringent controls on motor vehicles and motor vehicle engines (CAA §202(g)); emissions from light-duty trucks (LDTs) over 6,000 lbs. GVWR of MY 1996 and thereafter have one set of requirements regardless of whether they are gasoline-fueled or diesel-fueled (CAA's §202(h))[55]; new requirements for gasoline and diesel fuel to reduce air pollution emissions (CAA §211); a program to encourage the development of "clean-fuel" vehicles (CAA §§241-250); and new requirements applicable to nonroad mobile sources and trains (CAA §213(a)(2) &(5)). Section 202(j)(4) provides EPA with the authority to regulate CO emissions from heavy-duty vehicles when operated at cold temperatures.[56] Section 202(k) requires the Administrator to promulgate standards applicable to evaporative emissions of HCs.[57]

The primary mandate of CAA Subchapter II is to the control emissions from new motor vehicles and new motor vehicle engines. Federal motor vehicle requirements are primarily performance-oriented. The decision concerning how to meet the standards is left to the manufacturers. The major federal emissions standards are found in CAA §202,[58] however, §209(b) allows California to continue to impose its own program.[59] CAA §177, added in 1977, allows states to adopt the more stringent California motor vehicle emission standards.[60] States were slow to utilize §177, but after enactment of the 1990 Amendments, interest in using this provision increased because of the need for additional VOC emission reductions in ozone nonattainment areas.[61] The 1990 Amendments also limited emissions during cold temperature operation, and imposed new requirements concerning the control of evaporative losses, including losses during refueling. Section 202(d) imposes emission standards on vehicles and engines for their useful life, which were extended for post-1990 vehicles to 10 years or 100,000 miles, whichever first occurs.

The pre-1990 standards were called "Tier 0" standards.[62] EPA implemented the 1990 CAA Amendments through its Phase I standards that were phased in during MYs 1994 through 1998.[63] The statute uses the term "Phase," but EPA in its regulations uses the term "Tier." Vehicles are required to meet the standards imposed by the 1990 CAA Amendments for 10 years or 100,000 miles (10/100,000), whichever occurs first, rather than the prior five year or 50,000-mile (5/50,000) requirement.[64] However, §202(g) allows emissions to increase after five years or 50,000 miles. LDVs and LDTs up to 6,000 GVWR produced in MY 1994 and thereafter must meet specified standards for five years or 50,000 miles for NMHC, CO, and NO_x.[65] There also were standards for NMHC, CO, and NO_x that were applicable to LDVs up to 3,750 lbs. loaded vehicle weight (LVW) for the new 10-year or 100,000-mile (10/100,000) useful life standard.[66] LDTs over 3,750 lbs. LVW, but less than 6,000 lbs. GVWR, had less stringent emissions requirements. A PM standard applied to MY 1995 and thereafter LDTs.[67] Standards also were established for LDTs over 6,000 lbs. GVWR.[68] Light-duty diesels of less than 3,750 lbs. LVW had Tier 1 standards for NO_x and PM.[69]

By 1999, EPA was to determine the need, cost, and feasibility of Tier 2 standards for 2004 and later model year gasoline and diesel-fueled LDV and LDT of 3,750 lbs. LVW or less.[70] EPA sent its Final Tier 2 Study to Congress in 1998, which concluded that a need existed for further emission reductions, and more stringent emission standards were technologically feasible and cost effective.[71] Two issues identified for consideration in the upcoming rulemaking were: (1) the disparity in emission standards for cars and light trucks; and (2) the disparity in emission standards for gasoline vehicles and diesel vehicles.

52. *Id.*
53. Davis et al., *supra* note 1, at 12-16, tbl. 12.14.
54. Craig N. Oren, *The Clean Air Act Amendments of 1990: A Bridge to the Future*, 21 Envtl. L. 1817, 1919 (1991); Henry A. Waxman, *An Overview of the Clean Air Act*, 21 Envtl. L. 1721, 1768-72 (1991).
55. CAA §202(h), tbl. H, 42 U.S.C. §7521(h), tbl. H.
56. 42 U.S.C. §7521(j)(4).
57. 42 U.S.C. §7521(k).
58. 42 U.S.C. §7521.
59. 42 U.S.C. §7543(b).
60. 42 U.S.C. §7507.
61. Arnold W. Reitze Jr., *Air Quality Protection Using State Implementation Plans—Thirty-Seven Years of Increasing Complexity*, XV Vill. Envtl. L.J. 209, 244 (2004).
62. 40 C.F.R. §86.094-8.
63. U.S. EPA, *Control of Air Pollution From New Motor Vehicles and New Motor Vehicle Engines: Gaseous and Particulate Emission Regulations for 1994 and Later Model Year Light-Duty Vehicles and Light-Duty Trucks*, 56 Fed. Reg. 25724 (June 5, 1991).
64. CAA §202(d), 42 U.S.C. §7521(d).
65. CAA §202(g)(1), 42 U.S.C. §7521(g)(1).
66. *Id.*
67. CAA §202(g)(2), 42 U.S.C. §7521(g)(2); 40 C.F.R. §86.094-9, tbl. A94-11.
68. CAA §202(h), 42 U.S.C. §7521(h).
69. 40 C.F.R. §86.094-9, tbls. A94-9 & -12.
70. CAA §202(i)(3)(A), 42 U.S.C. §7521(i)(3)(A).
71. U.S. EPA, Office of Air and Radiation, *EPA's Program for Leaner Vehicles and Cleaner Gasoline* (July 31, 1998).

A. Tier 2 Standards

EPA's Tier 2 standards of February 10, 2000, apply to gasoline- and diesel-fueled light-duty passenger cars, LDTs, and medium-duty passenger vehicles (MDPVs) (large sport-utility vehicles (SUVs) and passenger vehicles) with the requirements being phased in from 2004 to 2010.[72] The standards were amended in 2000 and 2002.[73] The standards are based on California's 1998 Low Emission Vehicle (LEV) II program that requires passenger cars and LDTs to meet the same stringent standards by 2009. Tier 2 standards are codified at 40 C.F.R. Part 86, Subpart S. They include limitations on CO, formaldehyde (HCHO), NO_x, PM, and nonmethane organic gases (NMOG). Manufacturers are required to produce passenger vehicles that are 77-95% cleaner than the vehicles subject to Tier 1 requirements.[74] The heaviest LDTs are required to reduce emissions in 2004 by more than 60% from the pre-1994 standards.[75]

Under Tier 2, emission standards apply to all vehicles based on weight class categories. Motor vehicle weights are based on several definitions. Curb weight is the actual weight of the vehicle with all standard equipment and fuel at nominal tank capacity.[76] LVW is curb weight plus 300 lbs.[77] GVWR is the manufacturer's maximum design loaded weight.[78] Adjusted loaded vehicle is the numerical average of the curb weight added to the GVWR.[79] Categories of light LDVs and LDTs include: LDT1 (3,750 lbs. or less LVW); LDT2 & 3 (>3,750 LVW-5,750 lbs. adjusted LVW); LDT4 (> 5,750 lbs. adjusted LVW); and MDPVs weighing between 8,500 and 10,000 lbs. GVWR or that meet other requirements.[80] LDT 3 and 4 are considered LDTs. HDVs are defined as those weighing more than 8,500 lbs. GVWR or more than 6,000 lbs. curb weight or having a frontal area in excess of 45 square feet.[81] HDVs are subject to different regulations that also were promulgated in 2000 and are discussed later in this Article.[82]

Manufacturers of a particular vehicle need to comply with one of the various mixes of pollutant limits called certification bins. A bin is a set of emission standards measured by reference to the Federal Test Procedure (FTP).[83] A bin is equivalent to a horizontal row of FTP standards found in Tables S04-1 and S04-2.[84] There are 50,000-mile requirements and 120,000-mile requirements.[85] The Tier 2 standards allowed manufacturers of vehicles under 6,000 lbs. to phase in compliance with fleet average requirements, with the entire fleet sold by each manufacturer having to meet Tier 2 standards in 2007 and thereafter.[86] Because emissions control technology improved after 1990 and because low-sulfur fuel was required by CAA §211, EPA used §202(a) and (b) as the authority for imposing more stringent requirements than provided in CAA §202(i).[87] The high-efficiency emission control technologies for NO_x and PM required by the Tier 2 standards for light-duty diesel vehicles led to mandated low-sulfur highway diesel fuel beginning October 1, 1993.[88] The sulfur reduction program is discussed later in this Article.

Beginning with MY 1994, LDTs with a GVWR of 3,751-5,750 lbs. have almost the same standards for diesel- and gasoline-fueled vehicles.[89] The Tier 2 requirements apply to vehicles fueled with gasoline, diesel, methanol, ethanol, natural gas, or liquefied petroleum gas and expand the vehicles regulated to include minivans and SUVs.[90] For LDTs over 6,000 lbs. GVWR, the CAA imposes emissions limits for NMHC, CO, and NO_x.[91] Tier 2 emission standards are more complex with requirements based on bin categories.[92] Tier 2 also requires a 50% reduction in the three-day diurnal plus hot soak evaporative standard for passenger and LDTs.[93] All heavy LDTs and MDPVs must meet Tier 2 standards by MY 2009.[94]

Under Subchapter II, mobile sources are subject to the enforcement provisions in §203 and to the provisions concerning the acquisition of records or information found in §208.[95] Section 203(a)(3) was amended in 1990 to strengthen the prohibitions on tampering. Section 205 increased maximum civil penalties from $10,000 to $25,000 per violation and allows EPA to assess administrative penalties against vehicle manufacturers and fuel suppliers.[96] Administrative penalties may be appealed in federal district courts.[97] The enforcement provision of CAA §§205 and 113(c)(l) do not provide criminal penalties for violations of the mobile source requirements.[98]

72. U.S. EPA, *Control of Air Pollution From New Motor Vehicles: Tier 2 Motor Vehicle Emission Standards and Gasoline Sulfur Control Requirements*, 65 Fed. Reg. 6698 (Feb. 10, 2000).
73. U.S. EPA, *Control of Emissions of Air Pollution From 2004 and Later Model Year Heavy Duty Highway Engines and Vehicles; Revision of Light-Duty On-Board Diagnostics Requirements*, 65 Fed. Reg. 59896 (Oct. 6, 2000); *Control of Air Pollution From New Motor Vehicles; Amendments to the Tier 2 Motor Vehicle Emission Regulations*, 67 Fed. Reg. 72821 (Dec. 6, 2002).
74. U.S. EPA, *EPA's Program for Cleaner Vehicles and Cleaner Gasoline* (Dec. 1999) [EPA420-F-99-051].
75. *Id.*
76. *See, e.g.*, 40 C.F.R. §86.1803-01.
77. *Id.*
78. *Id.*
79. *Id.*
80. 40 C.F.R. §86.1803-01. *See also* David M. Bearden, *EPA's Tier 2 Emission Standards for New Motor Vehicles: A Fact Sheet* (CRS Report for Congress 1, June 12, 2000).
81. 40 C.F.R. §86.1803-01.
82. U.S. EPA, *Control of Emissions of Air Pollution From 2004 and Later Model Year Heavy Duty Highway Engines and Vehicles; Revision of Light-Duty On-Board Diagnostics Requirements*, 65 Fed. Reg. 59896 (Oct. 6, 2000).
83. 40 C.F.R. §86.1803-01.
84. 40 C.F.R. §86.1811-04.
85. *Id.* tbls. SO4-1 & SO4-2.
86. 40 C.F.R. §86.1811-04, tbl. S04-7.
87. 42 U.S.C. §7521(a), (b), & (i).
88. CAA §211(i), 42 U.S.C. §7545(i).
89. CAA §202(g), tbl. G, 42 U.S.C. §7521(g), tbl. G.
90. 40 C.F.R. §86.1811-04(a).
91. CAA §202(h), tbl. H, 42 U.S.C. §7521(h), tbl. H.
92. 40 C.F.R. §86.1811-04, tbl. S04-1.A bin is a subcategory of vehicles based on a group of vehicles selected by the manufacturer that meet regulatory distribution requirements for allocating vehicles among bin categories. *See* 40 C.F.R. §86.1803-01.
93. 40 C.F.R. §86.1811-01(d).
94. 40 C.F.R. §86.1811-04(k), tbl. S04-8.
95. 42 U.S.C. §§7522 & 7542.
96. 42 U.S.C. §7524.
97. CAA §205(c)(5), 42 U.S.C. §7524(c)(5).
98. 42 U.S.C. §7413(c)(1).

Therefore, criminal enforcement of Subchapter II violations must be brought using nonenvironmental criminal statutes or by using the falsification prohibitions found in §113(c)(2).[99]

B. *Proposed Tier 3 Standards*

On May 21, 2013, EPA promulgated proposed Tier 3 motor vehicle emissions and fuel standards, which it expected to finalize in February 2014.[100] The proposed standards would impose more stringent vehicle emissions standards and mandate the reduction of the sulfur content of gasoline beginning in 2017. Tier 3 continues the Tier 2 approach of integrating the regulation of vehicle emissions and fuels.[101] The proposed Tier 3 standards would reduce both tailpipe and evaporative emissions from passenger cars, LDTs, MDPVs, and some HDVs through the regulation of NMOG, NO_x, and PM, as well as imposing more stringent evaporative emissions standards.[102] The proposed standards would apply to all LDVs and LDTs below 8,500 lbs. GVWR, and MDPVs (8,500 to 10,000 lbs. GVWR) as well as HDVs up to 14,000 lbs. GVWR.[103] As with Tier 2 regulations, manufacturers are free to choose to certify vehicles to any of several "bins" of emission standards, so long as the sales-weighted average of the NMOG + NO_x values from the selected bins meet the fleet average standard for that model year.[104] Emission limits for the combined NMOG and NO_x are based on a weighted fleet average standard that requires approximately an 81% reduction from the MY 2013 fleet average.[105]

The Tier 3 proposal is coordinated with California's LEV III program and the federal program to reduce GHG emissions for MYs 2017-2025 vehicles,[106] but for vehicles over 6,000 lbs. GVWR, the standards apply beginning in MY 2018.[107] Tier 3 standards are consistent with California's 2012 LEV III requirements, which allows automakers to sell the same vehicles in all 50 states.[108] Fifteen states have adopted the LEV III program under §177 of the CAA as of 2013.[109] Vehicles in §177 states are required to meet the more stringent tailpipe emission standards and evaporative emission standards found in the California law, but with the Tier 3 requirements proposing federal standards almost identical to California standards, §177's option should be diminished in importance.

A new PM standard requires a 70% reduction in per-vehicle emissions.[110] It applies to each vehicle (i.e., not as a fleet average).[111] For LDV, LDT, and MDPVs, the PM standards drops from the existing 10 milligrams per mile (mg/mi) to 3 mg/mi for all model years.[112] They are based on the FTP, for all model years, with a phasein beginning in MY 2017 for vehicles at or below 6,000 lbs. GVWR and in MY 2018 for vehicles above 6,000 lbs. GVWR.[113] Most current light-duty vehicles already meet this standard, thus the proposed standard is designed to bring all LDVs to the PM emission level being demonstrated by most LDVs today.[114] The proposed program includes a PM standard of 6 mg/mi for in-use vehicles during the phasein period, based on the FTP.[115] For vehicles at or below 6,000 lbs. GVWR, at least 20% of a company's U.S. sales must meet the standards in MY 2017 and 100% must comply by MY 2021.[116]

In addition to the proposed FTP standards, which are based on highway and suburban simulated driving, EPA is proposing NMOG + NO_x and PM standards based on a Supplemental Federal Test Procedure (SFTP) (and specifically the US06 component of the test).[117] EPA designed the proposed US06 PM standards to evaluate emissions under relatively extreme driving conditions that arise from high-speed, high-load driving conditions (e.g., rapid acceleration).[118] This can result in the creation of a temporary rich air/fuel mixture to protect exhaust components from thermal damage. A rich fuel mixture can increase emissions of NMOG + NO_x and PM, primarily due to the incomplete combustion that occurs under rich conditions and the diminished effectiveness of the catalyst.[119] The proposed Tier 3 program includes certification PM standards evaluated over the SFTP (specifically the US06 component of the SFTP procedure, which generates values typically higher than the PM emitted over the FTP due to the increased load on the vehicle. The SFTP procedure calls for meeting a level of 10 mg/mi for lighter vehicles at or below 6,000 lbs. GVWR and 20 mg/mi for heavier vehicles.[120] The requirements must be met during the vehicle's useful life, which is being extended from 120,000 miles

99. 42 U.S.C. §7413(c)(2).
100. U.S. EPA, *Control of Air Pollution From New Motor Vehicles: Tier 3 Motor Vehicle Emission Standards and Fuel Standards*, 78 Fed. Reg. 29816 (May 21, 2013). *See* Chris Knight, *EPA "Tier III" Opponents Renew Criticisms Over Fuel Rule's Costs, Benefits*, 24 Clean Air Rep. (Inside EPA) 22:33 (Oct. 24, 2013).
101. *Id.*
102. 78 Fed. Reg. at 29851.
103. *Id.*
104. 78 Fed. Reg. at 29852.
105. 78 Fed. Reg. at 29816, 29852.
106. Tier 3 proposed rule, 78 Fed. Reg. 29821, 29851. GHG emissions are discussed later in this Article. The GHG regulation is found at 77 Fed. Reg. 62643 (Oct. 15, 2012).
107. 78 Fed. Reg. 29821.
108. 78 Fed. Reg. at 29820, 29821, tbl. I-1. There are, however, some differences in the California and the federal programs, but they are not major differences. *See* 78 Fed. Reg. at 29851. In December 2012, EPA approved a waiver of CAA preemption for the CARB's LEV III program with compliance beginning in 2015. 78 Fed. Reg. at 29820.
109. These states include Connecticut, Delaware, Georgia, Maine, Maryland, Massachusetts, New Jersey, New Mexico, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, Vermont, and Washington. *See* http://transportpolicy.net (last visited Jan. 22, 2014).
110. Tier 3 proposed rule, 78 Fed. Reg. at 29819.
111. 78 Fed. Reg. at 29821.
112. *Id.*
113. *Id.*
114. *Id.* at 29852, 29854.
115. *Id.* at 29822.
116. Tier 3 proposed rule, 78 Fed. Reg. at 29855.
117. 78 Fed. Reg. at 29856.
118. *Id.*
119. *Id.*
120. 78 Fed. Reg. at 29824, 29857.

to 150,000 miles.[121] The proposed vehicle emissions standards are applicable regardless of the type of fuel used by a vehicle.[122] As with the FTP PM standard, a separate in-use US06 PM standard during the percent phasein period is proposed.[123] For MY 2025 vehicles, the SFTP NMOG + NO_x standard would reach its fully phased-in fleet average level of 50 mg/mi.[124]

The proposed standards apply to LDVs, or passenger cars, LDTs (LDT1s, LDT2s, LDT3s, and LDT4s), and MDPVs.[125] HDVs up to 14,000 lbs. GVWR were not included in Tier 2, but are regulated by the HD vehicle rule of 2001.[126] The combined NMOG + NO_x emissions standard for LDVs and trucks below 8,500 lbs. and MDPVs to 10,000 lbs. GVWR will go from the existing 160 mg/mi to 30 mg/mi by 2025.[127]

The NMOG + NO_x standards will be fleet-average standards, meaning that a manufacturer is required to certify each of its vehicles to a per-vehicle "bin" standard and sales-weight these values to calculate its fleet-average NMOG + NO_x emissions for each model year.[128] The standards for LDVs in MY 2017 representing a 46% reduction from Tier 2 requirements and become increasingly stringent with an 81% reduction required in MY 2025.[129] There are two separate sets of declining fleet-average standards. LDVs and small light trucks (LDT1s) are in one group, and heavier light trucks (LDT2s, LDT3s, LDT4s) and MDPVs are in a second group, and both are subject to a 30 mg/mi standard in MY 2025 and later.[130]

The evaporative emission standard will be based on new test procedures and represents about a 50% reduction from current standards.[131] It applies to all LDV and on-road heavy-duty gasoline-fueled vehicles (HDGVs).[132] In addition, LDVs, MDPVs, and some HDVs will have leak tests and restrictions on leaks in the fuel and evaporation control systems.[133] Moreover, EPA plans to adopt and incorporate the CARB's onboard diagnostic system (OBD) requirements, effective for MY 2017, for all but the heavier fraction of the HDV class.[134]

The proposed Tier 3 standards include both emission limits for HDVs and restrictions on the sulfur content of gasoline.

121. 78 Fed. Reg. at 29868.
122. Tier 3 proposed rule, 78 Fed. Reg. 29869.
123. 78 Fed. Reg. at 29821, 29852.
124. 78 Fed. Reg. at 29856.
125. 78 Fed. Reg. at 29820.
126. Tier 3 proposed rule, 78 Fed. Reg. at 29820. *See also infra* Part VI.
127. 78 Fed. Reg. at 29821.
128. 78 Fed. Reg. at 29853.
129. 78 Fed. Reg. at 29821, 29852.
130. 78 Fed. Reg. at 29852.
131. 78 Fed. Reg. at 29884.
132. Tier 3 proposed rule, 78 Fed. Reg. at 29883.
133. 78 Fed. Reg. at 29894.
134. 78 Fed. Reg. at 29824.

V. Federal Heavy-Duty Highway Vehicle Emission Controls

The CAA requires standards to be promulgated by EPA for classes of new motor vehicles or new motor vehicle engines.[135] EPA's Administrator is directed to set standards for HC, CO, NO_x, and PM from HDVs that reflect "the greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available for the model year to which the standards apply, giving appropriate consideration to cost, energy, and safety factors associated with the application of such technology."[136] Regulations apply beginning no sooner than the model year commencing four years after a revised standard is promulgated and will apply for at least three model years.[137]

For many years, HDVs had to meet less-stringent standards than were imposed on LDVs, but the 1990 CAA Amendments aimed to reduce the disparity. The 1990 Act provides for the revision of HDVs or engine regulations promulgated prior to the 1990 CAA Amendments.[138] The 1990 Act provides for the regulation of NO_x from heavy-duty gasoline-and diesel-fueled trucks to not exceed 4.0 g/bhp-hr beginning with MY 1998,[139] but the Administrator may regulate any air pollutant, which in his/her judgment may reasonably be anticipated to endanger public health or welfare.[140]

A. *Diesel Vehicles*

Diesel regulations potentially have the most significant effect on atmospheric air quality deterioration caused by medium- and HDTs because in 2011, diesels consumed 88.4% of the fuel used by this source category.[141] Large Class 7 and 8 diesel trucks in 2011 consumed 98.96% of the fuel used by this segment of the transportation system.[142] Diesels engines have gained acceptance for use in motor vehicles due to their fuel efficiency that is approximately 30% better than gasoline engines having similar performance characteristics and their durability.[143] However, CAA requirements are an important factor in determining whether diesel-powered vehicles can be profitably marketed. While California has been the leader in establishing emission standards for LDVs, EPA usually has led California in establishing standards for both on-road and off-road diesel engines.[144]

135. CAA §202(a)(3)(A), 42 U.S.C. §7521(a)(3)(A).
136. *Id.*
137. CAA §202(a)(3)(C), 42 U.S.C. §7521(a)(3)(C).
138. CAA §202(a)(3)(B), 42 U.S.C. §7521(a)(3)(B).
139. CAA §202(a)(3)(B)(ii), 42 U.S.C. §7521(a)(3)(B)(ii).
140. CAA §202(a)(3)(A) & (a)(1).
141. Davis et al., *supra* note 1, at A-12, tbl. A.6.
142. *Id.* at 2-7, tbl. 2.5 (calculated from the data).
143. Ted Hollman & Wanda Lauderdale, Air Pollution Control Division, Colorado Department of Health, Diesel Emissions: Their Formation, Impacts, and Recommendations for Control 1 (1983).
144. National Research Council, State and Federal Standards for Mobile Source Emissions (executive summary 3) (2006).

1. Environmental Effects

EPA evaluated the health effects of heavy-duty vehicle emissions in the preamble to its 2001 regulations[145] and in its proposed Tier 3 regulations in 2013.[146] The Agency found that NO_x and VOC emissions from HDVs contribute a substantial percentage of the precursors or direct components of ambient ozone concentrations, which can cause acute respiratory problems, aggravate asthma, decrease lung function, and cause pulmonary inflammation.[147]

PM is a liquid or solid that includes chemically and physically diverse substances. Particles equal to or less than 10 microns but more than 2.5 microns in diameter are considered PM_{10}. Particles having a diameter less than 2.5 microns are known as $PM_{2.5}$. The health and environmental effects of PM are related to the size of the particles, with fine particles being considered more dangerous.[148]

PM, sulfur and nitrogen compounds, and aldehydes emissions are known or considered likely to be carcinogens. Human epidemiological evidence links diesel exhaust to an increased risk of lung cancer as well as noncancer health effects.[149] In 2012, the World Health Organization classified diesel engine exhaust as "carcinogenic to humans."[150] Health effects associated with ambient PM include premature mortality, aggravation of respiratory and cardiovascular disease, aggravated asthma, acute respiratory symptoms, chronic bronchitis, and decreased lung function.[151] The spectrum of adverse health effects is greater for $PM_{2.5}$.[152] Health effects associated with short-term exposures to ambient $PM_{2.5}$ include mortality, cardiovascular effects, respiratory effects, and numerous other maladies.[153]

PM emissions also have an adverse impact on the environment. Sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) and their gas phase oxidation products can dissolve in water droplets and further oxidize to form sulfuric and nitric acid, which react with ammonia to form sulfates and nitrates, both of which are important components of ambient PM.[154] PM emissions are also associated with reduced crop yields and forest productivity, visibility reductions, and eutrophication of water bodies.[155]

HDVs account for substantial portions of the country's air pollution from particulates and ozone. According to EPA, in 2005, HDVs accounted for 49.9% of highway vehicle NO_x emissions (44.0% from diesels) and 54.7% of the highway vehicle PM_{10} emissions (50.3% from diesels).[156] The pollution contribution by HDVs is higher in some urban areas.[157] Major cities that fail to meet ozone air quality standards that are heavily impacted by NO_x emissions from HDVs include the following: Atlanta, the District of Columbia, Hartford, Los Angeles, Sacramento, and San Diego. In these urban areas, HDVs contribute 22-33% of the total NO_x inventories.[158]

NO_x emissions also contribute to the formation of $PM_{2.5}$, particularly in the western United States.[159] In Atlanta, Cincinnati, Detroit, Hartford, Los Angeles, San Diego, and Santa Fe, the estimated highway HDV contribution to mobile source PM_{10} in 2007 was 25-38%; the national percent contribution by mobile sources was estimated to be about 20%.[160]

PM is directly emitted from combustion sources and is formed secondarily from gaseous precursors such as SO_2, nitrogen oxides, or organic compounds.[161] Fine particles are generally composed of sulfate, nitrate, chloride and ammonium compounds, organic and elemental carbon, and metals.[162] Diesel PM contains small quantities of mutagenic and carcinogenic compounds and several toxic trace metals of potential toxicological significance including chromium, manganese, mercury, and nickel.[163] In addition, small amounts of dioxins have been measured in diesel exhaust.[164]

Nationally, highway vehicles contribute only 2.9% of the $PM_{2.5}$ emissions.[165] But the contribution to $PM_{2.5}$ by HDVs varies by regions of the country, and is a significant source of these emissions in some urban areas.[166] However, data from newer engines indicates that PM emissions differ in quantity and composition than the emissions from older engines.[167] Sulfate typically makes up over one-half the fine particles found in the eastern United States. Organic carbon also accounts for a large portion of $PM_{2.5}$, with a slightly higher fraction in the West. Diesel engine emissions of elemental carbon make up about 5-6% of particle mass. Nitrates play a relatively small role in the production of fine particles, but ammonium nitrate, formed from NO_x and ammonia emissions, is a significant component of $PM_{2.5}$ in California.[168] Diesel PM consists of three primary constituents: unburned carbon particles (soot); the soluble organic fraction (SOF), which consists of unburned HCs that have condensed into liquid droplets or have condensed onto unburned carbon particles; and sulfates, which result from sulfur in the engine's exhaust.[169]

---

145. U.S. EPA, *Control of Air Pollution From New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements*, 66 Fed. Reg. 5002 (Jan. 18, 2001).
146. Tier 3 proposed rule, 78 Fed. Reg. at 29828.
147. Diesel Rule, 66 Fed. Reg. at 5007, 5012; 78 Fed. Reg. at 29828.
148. 66 Fed. Reg. at 5017.
149. 66 Fed. Reg. at 5007, 5020.
150. *Limited Data Complicate EPA Risk Assessment of Diesel Exhaust Exposures*, 23 Clean Air Rep. (Inside EPA) 13:22 (June 21, 2012).
151. Diesel Rule, 66 Fed. Reg. at 5002, 5006.
152. *Id.* at 5020.
153. Tier 3 proposed rule, 78 Fed. Reg. at 29894.
154. 78 Fed. Reg. at 29831.
155. 66 Fed. Reg. at 5025.
156. Davis et al., *supra* note 1, at 12-6, tbl. 12.5 & 12-10, tbl. 12.9.
157. Diesel Rule, 66 Fed. Reg. at 5011.
158. 66 Fed. Reg. at 5028.
159. *Id.*
160. *Id.*
161. 66 Fed. Reg. at 5017.
162. Tier 3 proposed rule, 78 Fed. Reg. at 29830.
163. Diesel Rule, 66 Fed. Reg. at 5017.
164. *Id.*
165. Davis et al., *supra* note 1, at 12-11, tbl. 12.10.
166. Diesel Rule, 66 Fed. Reg. at 5018.
167. Anthony Lacey & Bobby McMahon, *HEI Study Spurs Call to Differentiate Health Risks of "New" Diesel Exhaust*, 23 Clean Air Rep. (Inside EPA) 9:35 (Apr. 26, 2012).
168. Diesel Rule, 66 Fed. Reg. at 5018.
169. 66 Fed. Reg. at 5047.

2. Diesel Technology

Diesel fuel and gasoline are significantly different. Gasoline engines use spark plugs to ignite the fuel and air mixture.[170] Diesel engines inject fuel into air heated by compressing the air in the engine's cylinder.[171] Refineries therefore produce gasoline that resists spontaneous combustion, but diesel fuel's resistance to spontaneous combustion is lower than gasoline.[172] Diesels use compression ratios that may exceed 20:1, but 13:1 to 18:1 is more common; gasoline automobiles use compression ratios of about 8.5 to 1.[173] The high compression ratios and excess air used in diesels result in high NO_x emissions, but the excess air results in low CO emissions compared with gasoline engines.[174] Total HC emissions from diesels are comparable to those from gasoline vehicles, but diesel engines generally produce more of the types of HC emissions associated with cancer.[175] However, diesel engines have high HC emissions if the combustion temperature is too low to produce complete combustion, if the fuel is delivered late from the injector, or if the vehicle is under a heavy load.[176] In addition, the stratified mixture of fuel and air found in diesel combustion chambers results in fuel-rich zones that lead to the formation of PM commonly called soot.[177]

Diesel engines are approximately 33% more fuel-efficient than comparable gasoline engines, in part because of their higher compression ratios.[178] In addition, diesel fuel has more energy by volume than gasoline, thus diesel engines begin with a 15% advantage over gasoline engines.[179] Diesel engines are more efficient during low-power operation. When operating in urban areas under light loads, a diesel engine can achieve up to twice the miles per gallon (mpg) of a gasoline-powered vehicle.[180] But the trade off is that diesel engines must be designed to cope with higher NO_x and particulate emissions, cold-start problems, and noise, vibration, and odor problems greater than those associated with conventional engines.[181]

170. Edward F. Obert, Internal Combustion Engines and Air Pollution 2-5 (3d ed. 1973).
171. U.S. Dept. of Energy, *Maximizing Potential of Diesel and Gasoline for a Cleaner, More Efficient Engine*, http://energy.gov/articles/maximizing-potential-diesel-and-gasoline-cleaner-more-efficient-engine (last visited Jan. 30, 2014).
172. *See* The Engineering ToolBox, *Fuels and Chemicals-Autoignition Temperatures*, http://www.emgomeeringtoolbox.com/fuels-ignition-temperatures-d_171.html (last visited Jan. 30, 2014). The spontaneous combustibility of diesel fuel is measured by its "cetane number" while gasoline's "octane number" indicates the fuel's resistance to such spontaneous combustion. Hollman & Lauderdale, *supra* note 143, at 1.
173. Cummins Engine Co., Answers to Questions About Diesel 5 (1974).
174. Report of the Technology Panel of the Diesel Impacts Study Committee, National Research Council, Diesel Technology 33, 40 (1982).
175. Natural Resources Defense Council, *Exhausted by Diesel*, Ch. 2 Human Health Impacts, http://www.nrdc.org/air/transportation/ebd/chap2.asp (last visited Jan. 30, 2014).
176. Diesel Technology, *supra* note 174, at 34.
177. Hollman & Lauderdale, *supra* note 143, at 1-2.
178. Diesel Technology, *supra* note 174, at 40.
179. Diesel Technology, *id.* at 2.
180. Diesel Technology, *id*.
181. Diesel Technology, *id.* at 36.

3. NMHC Control

For emission control purposes, the CAA is generally focused on NMHCs, which are also expressed as NMOG to account for oxygenates such as ethanol. The portion of HCs that is methane plays a minimal role in the production of ozone in the atmosphere. Gasoline vehicles rely on catalytic converters to reduce levels of NMOG and NO_x, CO, and most air toxics in their exhaust.[182] The majority of the NMOG emitted from a gasoline engine is generated during cold start, before the catalyst is fully operational.[183]

Vapors from the fuel tank and fuel system of gasoline vehicles can be released as evaporative emissions, which are primarily the lighter and more volatile HC compounds in the gasoline.[184] Evaporative emission controls on current vehicles usually consist of a canister filled with activated charcoal and connected by hoses to the fuel system. Vapors are directed to the canister, which collects the vapors on the carbon and stores them until the system is purged when the vehicle is operating by drawing them out of the canister and sending the vapors to the engine to be combusted, which restores the capacity of the canister.[185] HC emissions occur when the system is compromised because the carbon canister is overwhelmed due to the engine not operating for a time in excess of the canister's storage capability, or vapors permeate or leak from components.[186] Effective controls involve proper material selection for fuel system components, careful design of the components, and on-board diagnostics to check the system for failure.[187]

4. NO_x Control

To reduce NO_x emissions from diesel engines requires technology that can deal with the relatively high emissions of NO_x compared to gasoline engines due to diesel's lean-burn operation at high-combustion temperatures.[188] To reduce these emissions, EPA promulgated its 2001 regulatory requirements that require new technology to be deployed by MY 2007.[189] The NO_x diesel standard of 4.0 g/bhp-hr applicable in MYs 1998-2003 became a more stringent combined NO_x + NMHC standard for MYs 2004-2006 and became a 0.2 g/bhp-hr limit for NO_x in MY 2007.[190] This required engine modifications as well as improved treatment of exhaust gas. Controlling NO_x emissions is a challenge for diesel engines because the three-way catalyst used in LDVs is ineffective in controlling diesel emissions, which led to the development of the NO_x adsorber as the primary NO_x control technology used to provide reduction in NO_x emissions from diesel

182. Tier 3 proposed rule, 78 Fed. Reg. at 29841.
183. 78 Fed. Reg. at 29842.
184. 78 Fed. Reg. at 29841.
185. *Id.*
186. *Id.*
187. *Id.*
188. Diesel Rule, *supra* note 145, 66 Fed. Reg. at 5049.
189. Diesel Rule, *supra* note 145, at 5049.
190. Davis et al., *supra* note 1, at 12-16, tbl. 12.14.

engines.[191] NO_x adsorbers have the ability to control NO_x under the oxygen-rich (fuel-lean) conditions found in diesel operation.[192] However, to obtain optimal performance from this technology requires engine exhaust temperatures and exhaust air-to-fuel ratios to be matched to the design parameters of the adsorbers.[193]

NO_x adsorber operation is adversely impacted by sulfur in the fuel even at low levels.[194] NO_x adsorber operational deterioration can be reversed through a periodic "desulfation" event, which also increases the fuel consumption.[195] However, NO_x adsorbers are likely to have a very favorable NO_x-to-fuel-economy trade off when compared to other NO_x controls such as cooled exhaust gas recirculation and retarded ignition timing that has been used to meet less-stringent NO_x standards.[196]

The use of Selective Catalytic Reduction (SCR) technology is another way to reduce NO_x. The SCR system uses a urea solution to produce ammonia and CO_2. A SCR catalyst then uses the ammonia to reduce NO_x to N_2 and water.[197] Catalysts containing precious metals (platinum) can be used to improve low-temperature NO_x reduction performance and to oxidize any ammonia that may pass through the SCR.[198] This enables SCR systems to achieve NO_x reductions at the relatively low temperatures found in diesel exhaust, but this technology is also sensitive to sulfur in the diesel fuel, which inhibits low-temperature performance and results in higher particulate emissions.[199] SCR systems require vehicles to carry a supply of urea, which means that the infrastructure for delivering urea at the diesel fuel pump need to be developed if this technology is to be widely used. Moreover, because urea depletion does not normally affect vehicle operation, there will be an incentive not to refill the urea tank, which could compromise the effectiveness of SCR. These obstacles limit the viability of SCR as an NO_x control strategy to meet the NO_x standard.[200]

5. PM Control

Diesel PM consists of unburned carbon particles or soot (the largest portion of the total PM), the SOF (unburned HCs that have condensed into liquid droplets or have condensed onto unburned carbon particles), and sulfates (from sulfur in fuel and oil).[201] PM also is emitted from brake and tire wear and from crankcase emissions.[202] Exhaust emission-control devices to control harmful diesel PM include the diesel oxidation catalyst (DOC), and diesel particulate filters (PM traps). DOCs effectively control only 10-30% of the total PM that are SOFs.[203]

A small fraction of the sulfur in diesel fuel is emitted directly into the atmosphere as sulfate, while some of the sulfur in the fuel is transformed in the atmosphere into sulfate particles (indirect sulfate).[204] Reducing sulfur in the fuel decreases the amount of direct sulfate and indirect sulfate PM emitted from HDEs.[205]

A more effective approach is to place a particulate trap in the exhaust system of a diesel vehicle that captures particulates in a filter and periodically burns them, releasing CO_2, in a process called regeneration.[206] EPA requires particle traps or trap-oxidizers to meet the adjustment, cleaning, repair, or replacement requirements specified for various heavy- and LDVs.[207] The basic uncatalyzed trap is only moderately effective at controlling SOF particulates and cannot meet the 2001 diesel rule's PM standard.[208] These traps have been supplanted by catalyzed PM traps that can control more than 90% of the diesel PM if the diesel fuel's sulfur level is at or below 15 ppm.[209]

The passively regenerating diesel particulate filter technologies generate NO_2, through the oxidation of the nitrogen monoxide (NO), created in the engine combustion process, across a platinum catalyst.[210] NO_2 oxidizes carbon captured by the PM trap's filtering media under the exhaust temperature range of normal operating conditions. This prevents plugging and failure of the PM trap. Sulfur contamination of the catalyst reduces NO_2 production that leads to the PM trapped in the diesel particulate filter increasing, which can create excessive exhaust backpressure, low engine power, and even catastrophic failure of the diesel particulate filter itself.[211] An increase in exhaust backpressure can result in a vehicle having poor acceleration and engine stalls that strand the vehicle due to "trap plugging." Trap plugging also has the potential to cause engine damage. Moreover, if the exhaust backpressure gets high enough to open the exhaust valves prematurely, the exhaust valves can then strike the piston causing catastrophic engine failure.[212]

Effective controls on PM exhaust emissions have developed for HDEs, and they have been successfully applied to light-duty diesel engines.[213] New research however demonstrates that the level of PM from gasoline light-duty vehicles is more significant than had been previously thought. PM emissions of most current-technology gasoline vehicles are fairly low, well below the Tier 2 PM standards. EPA's Tier 3 proposal calls for a new FTP PM to ensure that all new vehicles would perform at a level representing

191. Diesel rule, 66 Fed. Reg. at 5049.
192. 66 Fed. Reg. at 5049.
193. 66 Fed. Reg. at 5052.
194. 66 Fed. Reg. at 5053, 5059.
195. 66 Fed. Reg. at 5057.
196. 66 Fed. Reg. at 5062.
197. Diesel Rule, 66 Fed. Reg. at 5053.
198. *Id.*
199. *Id.*
200. *Id.*
201. 66 Fed. Reg. at 5047.
202. 66 Fed. Reg. at 5031.
203. Diesel Rule, 66 Fed. Reg. at 5047.
204. 66 Fed. Reg. at 5031.
205. *Id.*
206. Diesel Rule, 66 Fed. Reg. at 5051.
207. 40 C.F.R. §86.004-25(b).
208. Diesel Rule, 66 Fed. Reg. at 5047.
209. 66 Fed. Reg. at 5047.
210. 66 Fed. Reg. at 5057.
211. *Id.*
212. *Id.*
213. Tier 3 proposed rule, 78 Fed. Reg. at 29855.

what is already being achieved by available emission control technologies.[214] The proposed FTP PM standard can be achieved with improvements to the fuel controls during the cold start without the need for new technology or hardware. The PM standard level EPA is proposing would ensure that future PM performance is consistent with current well-performing Tier 2 vehicles.[215]

6. Control of Toxic Air Pollutants

EPA reports that about 30 individual epidemiologic studies show, on average, exposure to diesel exhaust results in lung cancer risks being increased by 33-47%, which makes diesel exhaust a mixture of pollutants that collectively poses one of the greatest relative cancer risks when compared with the other individual pollutants assessed.[216] Mobile sources were responsible for 43% of outdoor toxic emissions and over 50% of the cancer risk and noncancer hazard associated with primary emissions in 2005.[217] EPA identifies benzene as a known human carcinogen by all routes of exposure, and highway mobile sources account for 70% of the ambient exposure.[218] Benzene is the largest contributor to cancer risk of all 133 pollutants quantitatively assessed in EPA's 1999 National-Scale Air Toxics Assessment (NATA).[219] Mobile sources were responsible for 74% of the noncancer (respiratory) risk from outdoor air toxics according to EPA's 1999 NATA study.[220] The majority of this risk was from acrolein, and HCHO.[221] Heavy-duty vehicle emissions contain other substances that are known or suspected human or animal carcinogens, or have serious noncancer health effects.[222] These include 1,3-butadiene, naphthalene, acetaldehyde, acrolein, and dioxin.[223] Adverse noncancer health effects including blood disorders, such as preleukemia and aplastic anemia, are associated with low-dose, long-term exposure to benzene.[224] HCHO is considered to be an important cancer risk of the 80 pollutants assessed in 2005,[225] based on nasal tumors in animal bioassays.[226] Acetaldehyde is classified as a probable human carcinogen.[227] Acrolein is extremely acrid and when inhaled, it is an intense irritant to the respiratory tract and a serious eye irritant.[228] 1,3-Butadine is a human carcinogen when inhaled.[229] Polycyclic organic matter (POM) defines a broad class of compounds that includes the polycyclic aromatic HC compounds (PAHs). POM compounds are formed from diesel combustion, and cancer is the major concern from exposure.[230] EPA has classified seven PAHs (benzo[a]pyrene, benz[a]anthracene, chrysene, benzo[b] fluoranthene, benzo[k]fluoranthene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene) as Group B2, probable human carcinogens.[231]

Naphthalene emissions are found in gasoline and diesel exhaust, and "acute (short-term) exposure of humans to naphthalene by inhalation, ingestion, or dermal contact is associated with hemolytic anemia and damage to the liver and the nervous system."[232] Some compounds, such as HCHO and acetaldehyde, are also formed in a secondary process when other mobile source pollutants undergo chemical reactions in the atmosphere.[233]

The regulatory program to control criteria pollutants, especially ozone (through VOC and NO_x restrictions) and PM_{10}, has been assisted by important reductions in diesel PM and gaseous air toxics based on CAA §202(a) (on-highway engine requirements), §211 (the fuel requirements), and §213 (nonroad engine requirements).[234] CAA §202(l)(2) directs EPA to consider additional controls to reduce emissions of hazardous air pollutants from motor vehicles and their fuels.[235] Standards are to reflect the greatest degree of emission reduction achievable through the application of available technology, taking into account existing standards, costs, noise, energy, safety factors, and lead time.[236] At a minimum, the regulations shall apply to emissions of benzene and HCHO.[237] Section 202(a)(1) of the CAA directs EPA to set standards for new motor vehicles or new motor vehicle engines that in EPA's judgment causes or contributes to air pollution, which may reasonably be anticipated to endanger public health or welfare.[238] EPA's regulation of mobile source toxics is based on these provisions in §202.[239]

A mobile source air toxics (MSATs) final rule based on CAA §202(l) was promulgated March 29, 2001.[240] Twenty-one MSATs, including diesel exhaust, are identified that are considered by the Agency to pose potential adverse human health risks. But EPA did not set more stringent standards than the technology-forcing standards found in the rule in its Tier 2 rulemaking.[241] EPA's MSAT rule committed the Agency to additional rulemaking that would evaluate the need for and feasibility of additional

214. *Id.*
215. *Id.* at 29856.
216. Diesel Rule, 66 Fed. Reg. at 5022. *See also* American Lung Association, *A Penny for Prevention: The Case for Cleaner Gasoline and Vehicle Standards* 12 (Apr. 2013).
217. Tier 3 proposed rule, 78 Fed. Reg. at 29837.
218. *Id. See also* U.S. EPA, *Control of Hazardous Air Pollutants From Mobile Sources*, 72 Fed. Reg. 8428 (Feb. 26, 2007).
219. 72 Fed. Reg. at 8434.
220. 72 Fed. Reg. at 8433.
221. *Id.*
222. Tier 3 proposed rule, 78 Fed. Reg. at 29835.
223. Diesel Rule, 66 Fed. Reg. at 5024.
224. *Id.*; 78 Fed. Reg. at 29832.
225. Tier 3 proposed rule, 78 Fed. Reg. at 29837.
226. 78 Fed. Reg. at 29834.
227. *Id.*
228. 78 Fed. Reg. at 29835.
229. *Id.*
230. *Id.*
231. Tier 3 proposed rule, 78 Fed. Reg. at 29836.
232. *Id.*
233. Hazardous Rule, 72 Fed. Reg. at 8433.
234. Diesel Rule, 66 Fed. Reg. at 5009.
235. 42 U.S.C. §7521(l)(2).
236. *Id.*
237. *Id.*
238. 42 U.S.C. §7521(a)(1).
239. Hazardous Rule, 72 Fed. Reg. at 8432.
240. U.S. EPA, *Control of Emissions of Hazardous Air Pollutants From Mobile Sources*, 66 Fed. Reg. 17230 (Mar. 29, 2001).
241. *Id.* The Tier 2 rule is found at 65 Fed. Reg. 6698 (Feb. 10, 2000).

controls.[242] Almost six years later, EPA's Mobile Source Air Toxics Rule was promulgated February 26, 2007.[243]

The rule finalized standards for exhaust HC emissions from passenger vehicles during cold temperature operation; evaporative HC emissions from passenger vehicles; the benzene content of gasoline; and HC emissions from portable fuel containers that would reduce evaporation, permeation, and spillage from these containers.[244] The benzene content of gasoline is limited to an annual refinery average of 0.62% by volume, beginning in 2011, with a maximum average standard for refineries of 1.3% by volume beginning on July 1, 2012.[245] These controls reduced emissions of benzene and other MSATs from passenger vehicles as well as particulate emissions.[246] Vehicles at or below 6,000 lbs. GVWR are subject to a sales-weighted fleet average NMHC level of 0.3 grams/mile. Vehicles between 6,000 and 8,500 lbs. GVWR and MDPVs are subject to a sales-weighted fleet average NMHC level of 0.5 gpm. For lighter vehicles, the standard would phase in between 2010 and 2013. For heavier vehicles, the new standards will phase in between 2012 and 2015.[247] The rule also establishes nominally more stringent evaporative emission standards for all LDVs, LDTs, and MDPVs.[248] However, other than the reduction in the benzene content of gasoline, which would be applicable to the fuel used in HDGVs, the regulation does not have much applicability to HDVs.

B. Heavy-Duty Vehicle Emissions Control

The federal government controls heavy-duty vehicle emissions, including those from diesel engines, as part of the Federal Motor Vehicle Emission Control Program authorized by CAA §202(a)(3).[249] Emission limits are set for HDTs, heavy-duty gasoline-fueled engines, and HDEs in §202(a)-(i).[250] HDEs, rather than the entire vehicle, must be certified as meeting emission standards because the manufacturers of the HDEs often are not the manufacturer of HDVs.[251] Emission standards are based on g/bhp-hr, a measurement of pollution per unit of work, rather than in gpm, which is the approach used for LDVs.[252] HDVs are defined as those manufactured primarily for use on the public roads that have a maximum design loaded weight (GVWR) in excess of 6,000 lbs.[253] Some vehicles that exceed 6,000 lbs. GVWR are regulated as LDVs.[254] If GVWR is over 6,000 lbs., the HDV regulations promulgated under §202(a)(3)(A) apply, but LDT over 6,000 lbs. GVWR must meet the requirements of §202(h).[255]

HDVs and HDEs must meet standards based on "the greatest degree of emission reduction achievable through the application of technology the Administrator believes to be available for the model year to which such standards apply, giving appropriate consideration to cost, energy, and safety factors associated with the application of such technology."[256] CAA §202(a)(3)(B) allows EPA to revise its standards after considering new air quality information.[257]

Federal authorization to regulate emissions from HDVs or HDEs began with the Motor Vehicle Air Pollution Control Act of 1965.[258] However, little regulation occurred, even after the passage of the CAA in 1970, which led Congress to more specifically require HDVs/HDEs to be regulated in the CAA Amendments of 1977, in amended CAA §202(a). Standards governing emissions of PM and NO_x from diesels were promulgated in 1981 and were upheld in *NRDC v. EPA*.[259] Particulate standards were imposed by CAA §202(h), Table H, on MY 1995 and later LDTs of more than 6,000 lbs.[260]

The CAA authorizes EPA in CAA §202(a)(3)(A)(i) to promulgate regulations limiting NO_x and NMHC emissions from classes or categories of HDVs or engines.[261] Section 202(a)(3)(A)(ii) allows EPA to establish regulatory categories of HDVs and HDEs. EPA responded by regulating three categories of HDEs: light, medium, and heavy beginning with MY 1990.[262]

CAA §206(a)(3) requires EPA to issue a certificate of conformity for HDEs for vehicles or engines that meet the standards of CAA §202. A certificate of conformity is required before a vehicle may be introduced into commerce.[263] Violating this requirement subjects the violator to an action to restrain the violation and to civil penalties.[264] Vehicles that exceed the §202(a) emission standard, however, may be sold after the payment of a nonconformance penalty.[265] Regulations dealing with nonconformance penalties are found in 40 C.F.R. Part 86. Subpart L. EPA also issued rules requiring emission standards to be met under more stringent testing conditions beginning in 2007.[266] These requirements are codified, as amended, in 40 C.F.R. Part 86, Subpart N.

242. U.S. EPA, *Control of Emissions of Hazardous Air Pollutants From Mobile Sources*, 66 Fed. Reg. 17230 (Mar. 29, 2001).
243. U.S. EPA, *Control of Hazardous Air Pollutants From Mobile Sources*, 72 Fed. Reg. 8428 (Feb. 26, 2007).
244. 72 Fed. Reg. at 8428.
245. *Id.*
246. *Id.*
247. Hazardous Rule, 72 Fed. Reg. at 8431.
248. *Id.*
249. 42 U.S.C. §7521(a)(3).
250. 42 U.S.C. §7521(a)-(i).
251. CAA §202(a)(3)(B), 42 U.S.C. §7521(a)(3)(B).
252. Brake horsepower (bhp) = torque x rpm. Torque is measured in pound feet. Torque is measured over the dynamometer schedule of 40 C.F.R. Part 86, Appendix I(f)(1), (2) & (3). It is integrated over time and is used to calculate emissions as specified at 40 C.F.R. §86.004-11.
253. CAA §202(b)(3)(C), 42 U.S.C. §7521(b)(3)(C).
254. CAA §202(h), (j), 42 U.S.C. §7521(h), (j).
255. However, see *NRDC v. Thomas*, 805 F.2d 410, 438, 17 ELR 20269 (D.C. Cir. 1986) (declining to apply different standards for LDTs that are HDVs than is applicable to other HDVs).
256. CAA §202(a)(3)(A), 42 U.S.C. §7521(a)(3)(A).
257. 42 U.S.C. §7521(a)(3)(B).
258. Pub. L. No. 89-272, §202(a), 79 Stat. 992, 992-93 (codified as amended at CAA §202(a)(1)).
259. 655 F.2d 318 (D.C. Cir. 1981). Emission standards for 2004 and later model year heavy-duty diesels are found at 40 C.F.R. §86.004-11.
260. 42 U.S.C. §7521(h), tbl. H.
261. 42 U.S.C. §7521(a)(3)(A).
262. 40 C.F.R. §86.090-2.
263. CAA §203(a)(1), 42 U.S.C. §7522(a)(1).
264. CAA §§204, 205, 42 U.S.C. §§7523, 7524.
265. CAA §206(g), 42 U.S.C. §7525.
266. 65 Fed. Reg. 59896 (Oct. 6, 2000).

Diesel engines are subject to particulate emission limits that are not imposed on gasoline-fueled vehicles. The particulate standard for MY 2007 and later heavy-duty diesel trucks is 0.01 g/bhp-hr.[267] Pursuant to the 1990 CAA Amendments, particulate standards, as well as the other standards, were subject to the extension of vehicles' useful life that makes the standards more stringent. For HDEs the useful life is eight years or 290,000 miles, whichever occurs first.[268] The 1990 Amendments also impose smoke emission limitations on HDEs. As an example, for MY 2007 and later engines, the Act institutes an opacity limit for smoke.[269] Smoke measurement techniques are found at 40 C.F.R. Part 86, Subpart I.

EPA promulgated combined emission standards October 21, 1997, for highway heavy-duty engines that require reduction in NO_x plus NMHC emissions in MY 2004 and later vehicles.[270] On October 6, 2000, EPA promulgated its Phase 1 emissions reduction for heavy-duty engines.[271] For MYs 2004 to 2006 HDEs, the combined standard is 2.4 g/bhp-hr for NO_x and NMHC.[272] CO limits are 15.5 g/bhp-hr. Particulate standards are 0.1 g/bhp-hr for diesel engines other than those used in urban buses—the urban bus particulate standard is 0.05 g/bhp-hr.[273]

A more stringent rule applicable to heavy-duty engines was promulgated by EPA in its Highway Diesel Rule of January 18, 2001, which regulates the vehicle and its fuel as a single system.[274] The Phase 2 program imposes the following standards on 2007 and later diesel heavy-duty engines and vehicles. The NO_x standard is 0.20 g/bhp-hr, and the NMHC standard is 0.14 g/bhp-hr. A combined NO_x and NMHC standard of 2.4 g/bhp-hr and a PM emissions standard of 0.01g/bhp-hr is imposed.[275] The NO_x standards provide for a 78% reduction and a 60% reduction from the standards for MY for 2005, 8,500-10,000-pound and 10,000-14,000-pound vehicles, respectively.[276] The MY 2005 standards are equivalent to the California LEV-I NO_x standards, and the Phase 2 NO_x standards are consistent with the CARB LEV-II NO_x standards for LEVs.[277] The NO_x standard is slightly higher for the 10,000 to 14,000-pound vehicles because their weight results in using more fuel per mile than vehicles tested at lighter payloads; therefore, they tend to emit slightly more grams of pollutant per mile than lighter vehicles.[278] The NMHC standards represent a 30% reduction from the 2005 standards for 8,500-10,000 and 10,000-14,000-pound vehicles and also are consistent with California's NMOG standards, although the NMHC standard for 10,000-14,000-pound vehicles is higher than for 8,500-10,000-pound vehicles to account for their weight.[279] The PM standard is 80% lower than the California standard for diesel vehicles. The PM standard is a new standard for federal HDVs and is consistent with the light-duty Tier 2 bins 7 and 8 level of 0.02 g/mi.[280]

The Phase 2 regulation requires the sulfur content of diesel fuel to be reduced by 97%.[281] The sulfur reduction requirement also helps to achieve the emissions reductions mandated for light-duty diesels pursuant to the Tier 2 regulations.[282] The rule also includes more stringent standards for heavy-duty gasoline-fueled vehicles.[283] The rule also makes the FTP more stringent by imposing provisions to ensure effective in-use emission control.[284] Manufacturers of heavy-duty diesel engines were required to meet the Supplemental Emission Test and the Not-to-Exceed (NTE) standards, beginning in MY 2007, in addition to meeting the standards based on the preexisting FTP.[285]

The regulations make the regulation of crankcase emissions more stringent and change the preexisting rule by counting crankcase emissions against a vehicle's emission limit.[286] Heavy-duty diesel engine manufacturers are expected to control crankcase emissions through the use of closed crankcase filtration systems or by routing unfiltered blow-by gases directly into the exhaust system upstream of the emission control equipment, unless manufacturers can show adequate control can be achieved without "closing" the crankcase.[287]

Evaporative emissions have been controlled by EPA's regulations since 1993.[288] Vehicles usually use a canister holding charcoal that collects evaporative losses over several days of non-driving. EPA's requirements include diurnal testing based on heating and cooling the ambient air in the SHED and other tests to ensure compliance.[289] The Phase 2 program provides more stringent evaporative emissions standards for heavy-duty engines and vehicles of "1.4 and 1.75 grams per test for the 3-day diurnal and supplemental 2-day diurnal tests, respectively" for 8,500 to 14,000-pound vehicles and 1.9 and 2.3 grams per test for vehicles

267. 40 C.F.R. §86.007-11(a)(1)(iv).
268. 40 C.F.R. §86.090-2.
269. 40 C.F.R. §86.007-11(b)(1)(iv).
270. 62 Fed. Reg. 54693 (Oct. 21, 1997), as amended at 65 Fed. Reg. 6848 (Feb. 10, 2000); 65 Fed. Reg. 59945 (Oct. 6, 2000) (codified at 40 C.F.R. §86.004-11).
271. 65 Fed. Reg. 59896 (Oct. 6, 2000).
272. 40 C.F.R. §86.004-11.
273. 40 C.F.R. §86.004-11(a)(ii).
274. U.S. EPA, *Control of Air Pollution From New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements*, 66 Fed. Reg. 5002 (Jan. 18, 2001).
275. 40 C.F.R. §86.007-11.
276. Diesel Rule, 66 Fed. Reg. at 5042.
277. *Id.*
278. *Id.*
279. *Id.*
280. *Id.*
281. *Id.*
282. Tier 2 Regulations, 65 Fed. Reg. 6698 (Feb. 10, 2000).
283. Diesel Rule, 66 Fed. Reg. at 5005.
284. 66 Fed. Reg. at 5038.
285. 66 Fed. Reg. at 5036.
286. 40 C.F.R. §86.007-11(c).
287. Diesel Rule, 66 Fed. Reg. at 5054. Closed crankcase filtration systems separate oil and PM from the blow-by gases through single or dual-stage filtration approaches, routing the blow-by gases into the engine's intake manifold and returning the filtered oil to the oil sump. *Id.*
288. 58 Fed. Reg. 16002 (Mar. 24, 1993).
289. *Id.* SHED is the *Federal Register* acronym for sealed housing for evaporative determination, which is an enclosure in which the evaporative emissions are captured before measurement. Details concerning the evaporative emissions testing procedures can be found at 78 Fed. Reg. at 29895.

over 14,000 lbs.[290] These standards will apply to heavy-duty gasoline-fueled vehicles and engines, and methanol-fueled HDVs and engines, but they do not apply to diesel-fueled vehicles.[291] The Highway Diesel Rule also is limited in its applicability to medium-duty vehicles (MDVs), both diesel- and gasoline-fueled, that are regulated by the Tier 2 program, discussed earlier in this Article. It does apply to MDVs between 10,000 and 14,000 lbs. or that otherwise do not meet the MDV definition.[292]

These standards represent more than a 50% reduction from the MY 2005 standards.[293] The standards for 8,500 to 14,000-pound vehicles are consistent with the Tier 2 standards for MDPVs, which have essentially identical evaporative emission control systems as HDVs in the 8,500 to 10,000-pound weight range.[294] The same standards apply to 10,000 to 14,000-pound HDVs because the evaporative emission control system design is essentially the same.[295] For the over 14,000-pound HDVs, because of their slightly larger fuel tanks and because non-fuel emissions are higher in larger vehicles, the evaporative emission standards are slightly higher.[296] The MY 2007 and thereafter standards for the three-day diurnal test are 3 and 4 grams/test for the 8,500 to 14,000 and the over 14,000-pound categories, respectively.[297] The Highway Diesel Rule does not apply to nonroad vehicles, which are regulated by the Nonroad Diesel Rule of 2004.[298]

The Phase 2 rule was the subject of litigation in the U.S. Court of Appeals for the District of Columbia (D.C.) Circuit by engine manufacturers, automobile makers, and fuel refiners.[299] The court examined EPA's actions in adopting technology-forcing regulations and upheld the Agency's rule as not being arbitrary.[300] In addition, the Phase 2 rule requirement that the sulfur content of fuel be capped at 15 ppm also was upheld as being necessary to protect the required NO_x control technology.[301]

The National Petroleum & Refiners Association contended that EPA inappropriately overlooked the use of SCR technology. But, the court upheld EPA's determination that SCR is not viable. SCR systems require urea to be added at 3-6 gallons for every 100 gallons of fuel used. Since a failure to replenish the urea causes emissions to rise but does not affect performance, there is not much reason for truckers to add it. Moreover, there is only a limited distribution system for urea.[302]

290. Diesel Rule, 66 Fed. Reg. at 5006.
291. 66 Fed. Reg. at 5044.
292. Diesel Rule, 66 Fed. Reg. at 5041, 5044.
293. 66 Fed. Reg. at 5044.
294. *Id.*
295. *Id.*
296. *Id.*
297. Davis et al., *supra* note 1, Heavy-Duty Highway Compression-Ignition and Spark-Ignition Engines-Evaporative Emission Standards, 12-20, tbl. 12.16.
298. U.S. EPA, *Control of Emissions of Air Pollution From Nonroad Diesel Engines and Fuel*, 69 Fed. Reg. 38958 (June 29, 2004).
299. Nat. Pet. & Ref. Assn v. EPA, 287 F.3d 1130, 1135, 32 ELR 20644 (D.C. Cir. 2002).
300. *Id.* at 1141.
301. *Id.* at 1143-45.
302. *Id.* at 1145.

C. *Proposed Tier 3 Requirements*

The proposed Tier 3 requirements as discussed earlier are primarily directed at the control of LDVs, but contain provisions that apply to HDVs in the Class 2b (8,501-10,000 lb.) and Class 3 (10,001-14,000 lb.) categories that are typically full-size pickup trucks and work vans and are about half diesel- and half gasoline-fueled.[303] HDVs also include motor vehicles at or below 8,500 lbs. GVWR that have a vehicle curb weight of more than 6,000 lbs. or a basic vehicle frontal area in excess of 45 square feet, and these vehicles would be regulated as Class 2b vehicles.[304] MDPVs are classified as HDVs under the CAA, but are regulated by the light-duty program under both the current Tier 2 program and the proposed Tier 3 program.[305]

The key elements of the proposed Tier 3 program "include a combined NMOG + NO_x declining fleet average standard beginning in 2018 and reaching the final, fully phased-in level in 2022, creation of a bin structure for standards, new stringent PM standards phasing in on a separate schedule, and changes to the test fuel used to evaluate gasoline- and ethanol-fueled vehicles."[306] EPA believes the current HDV certification requirement to test at the adjusted loaded vehicle weight (ALVW), equal to vehicle curb weight plus one-half the payload weight, is more appropriate for heavy-duty work trucks and vans than the LDT requirement to test at curb weight plus 300 lbs. The HDV Tier 3 proposal is coordinated with California's LEV III program to allow manufacturers to comply nationwide by marketing a single vehicle fleet.[307]

The proposed rule includes heavy-duty tailpipe emissions reductions of about 60% from the MY 2009 requirements for the combined fleet average of NMOG + NO_x and a per-vehicle PM standard.[308] The NMOG + NO_x standard is to decline to 178mg/mi for the large Class 2b vehicles and to 247 mg/mi for Class 3 vehicles by 2022.[309] PM standards proposed for Class 2b vehicles are 8 mg/mi and 10 mg/mi for Class 3 vehicles.[310] In addition, standards are proposed that vary for different vehicle classes based on emissions from a modified SFTP that is intended to ensure vehicles have robust emissions control over real-world driving patterns that are not effectively evaluated by the FTP drive cycle.[311]

Emission standards for HDVs are based on a combined NMOG and NO_x fleet average. Diesel produces low NMHC emissions (NMOG is not reported for diesels), but have high NO_x emissions; gasoline vehicles have opposite performance. The combined standard allows manufactur-

303. Tier 3 proposed rule, 78 Fed. Reg. at 29821, 29873-74.
304. 78 Fed. Reg. at 29874. *See also* 40 C.F.R. §1803-01.
305. 78 Fed. Reg. at 29874.
306. *Id.*
307. *Id.*
308. *Id.*
309. Class 2b vehicles are 8,501-10,000 lbs. GVWR. Class 3 vehicles are 10,001-14,000 lbs. GVWR. 78 Fed. Reg. at 29823. Standards are found at 78 Fed. Reg. 29823, tbl. I-4.
310. Tier 3 proposed rule, 78 Fed. Reg. 29823, 29876.
311. 78 Fed. Reg. at 29856, 29858.

ers to balance the trade offs needed to meet the standard.[312] The feasibility of the Tier 3 proposed 30 mg/mi NMOG + NO_x fleet average standard depends on the effectiveness of emissions control from exhaust catalyst systems that will require gasoline at 10 ppm sulfur or lower to properly function.[313] Larger vehicles are expected to have difficulty achieving cold-start NMOG emissions control, so it will be important for these vehicles to control NO_x emissions to near-zero levels. This would allow vehicles to meet the combined NMOG + NO_x emissions standards for the full useful life.[314] Achieving the proposed Tier 3 emission standards will require careful control of the exhaust chemistry and exhaust temperatures to ensure high catalyst efficiency. The impact of sulfur on oxygen storage components in the catalyst makes this a challenge, even with 10 ppm gasoline sulfur levels.[315]

Tier 3 requirements also deal with evaporative losses from gasoline-fueled vehicles because manufacturers have developed more effective technologies to manage canister loading and purging and to reduce permeation emissions. EPA is proposing relatively minor changes to the test procedures for demonstrating compliance with the proposed Tier 3 evaporative emission standards.[316] Evaporative emission standards imposed by Tier 3 regulations, however, represent about a 50% reduction from current standards, but diesel vehicles are not contributing to this reduction.[317] EPA is proposing to include HDGVs, beginning in MY 2018, within the Tier 3 evaporative emissions program, which includes the proposed hot soak plus diurnal and canister bleed test emission standards that would apply to these HDGVs.[318] There will also be new leak-detection tests that mandate that the cumulative diameter of any leaks in the fuel/evaporative system not exceed 0.02 inches, but this requirement will not apply to HDGVs above 14,000 lbs. GVWR.[319] Furthermore, EPA is proposing that HDGVs equal to or less than 14,000 lbs. GVWR be required to meet the refueling emission standard by MY 2018. Refueling emission standards in 40 C.F.R. §86.1816-05 would apply to Class 3 HDGVs as well, beginning in MY 2018, because the fuel and evaporative control systems on these vehicles are similar to those on their slightly lighter weight Class 2b vehicles.[320]

Under existing law, the HDV regulatory useful life during which emissions standards apply is 120,000 miles or 11 years, whichever first occurs.[321] Tier 3 proposes to extend the useful life to 150,000 miles or 15 years, whichever first occurs.[322] The extended useful life will be phased in over MYs 2018-2022, and is expected to apply to about 50% of the vehicles in 2018, and reach 100% by 2022.[323]

VI. Regulation of Sulfur in Fuel

CAA §211(c)(1) allows fuels to be regulated if emission products of the fuel either: "cause or contribute to air pollution . . . that may reasonably may be anticipated to endanger public health or welfare," or "will impair to a significant degree the performance of any emission control device or system which is in general use, or which the Administrator finds has been developed to a point where in a reasonable time it will be in general use were such a regulation to be promulgated."[324]

A. Sulfur in Gasoline

Sulfur is a natural constituent of petroleum that is found in gasoline and diesel fuel.[325] Sulfur in gasoline became a significant issue for EPA in the late 1990s, when catalytic converters used to control pollutants in motor vehicle exhaust, including NMOG and NO_x, as well as PM (the volatile HC fraction), CO, and most air toxics, were inhibited in performance by sulfur in gasoline.[326] "(T)hree-way catalytic exhaust systems utilize platinum group metals (PGM), metal oxides and other active materials to oxidize organic compounds and carbon monoxide from vehicle exhaust gases."[327] Sulfur from gasoline is oxidized during combustion, and then chemically binds (chemisorb) with, or reacts with, active sites and coating materials in the catalytic converter, which inhibits catalytic reactions.[328] Degradation in catalyst performance due to gasoline sulfur would reduce or eliminate the margin necessary to ensure in-use compliance with the proposed Tier 3 emissions standards.[329]

EPA promulgated regulations to control the sulfur content of gasoline on February 10, 2000, as part of the Tier 2 motor vehicle emissions standard.[330] The Tier 2 rulemaking required refiners to reduce sulfur levels in gasoline by approximately 90%, to an average of 30 ppm by 2006, with an 80 ppm per gallon cap.[331] On June 12, 2002, EPA published amendments to the sulfur standards, but did not change the sulfur limits.[332] The gasoline sulfur regulations are codified at 40 C.F.R. Part 80, Subpart H. However, even with the 30 ppm limit, sulfur content degrades

312. 78 Fed. Reg. at 29881.
313. 78 Fed. Reg. at 29947.
314. *Id.*
315. *Id.*
316. Tier 3 proposed rule, 78 Fed. Reg. at 29896. The procedures are found at 59 Fed. Reg. 16262 (Apr. 6, 1994).
317. 78 Fed. Reg. at 29824.
318. *Id.* The proposed evaporative emission standards for the various vehicle classes are found at 78 Fed. Reg. 29824, tbl. I-5.
319. 78 Fed. Reg. at 29824.
320. *Id.*
321. 40 C.F.R. §86.1805-4.
322. Tier 3 proposed rule, 78 Fed. Reg. at 29882.
323. *Id.*
324. 42 U.S.C. §7511(c)(1).
325. Tier 3 proposed rule, 78 Fed. Reg. at 29920.
326. 78 Fed. Reg. at 29819.
327. 78 Fed. Reg. at 29862.
328. 78 Fed. Reg. at 29863.
329. 78 Fed. Reg. 29867.
330. U.S. EPA, *Control of Air Pollution From New Motor Vehicles: Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirement*; Final Rule, 65 Fed. Reg. 6698 (Feb. 10, 2000) (codified primarily at 40 C.F.R. pt. 80, Subpart H).
331. 78 Fed. Reg. at 29820. *See also* 40 C.F.R. §80.195. The regulations include provisions for trading sulfur credits to increase the flexibility of the program. 40 C.F.R. §§80.271-.315.
332. U.S. EPA, *Control Air Pollution From New Motor Vehicles; Amendment to the Tier 2/Gasoline Sulfur Regulations*, 67 Fed. Reg. 40181 (June 12, 2002).

the emission performance of vehicles and inhibits further reductions in vehicle emissions control technology performance. Thus, to achieve the proposed Tier 3 tailpipe emissions standards, EPA is proposing to reduce gasoline sulfur content from a 30 ppm annual average to 10 ppm by January 1, 2017.[333] EPA believes a 10 ppm average sulfur level will enable compliance with these proposed Tier 3 NO_x/NMOG tailpipe exhaust standards, but further reductions will cause sulfur control costs to quickly escalate.[334] The petroleum industry opposes the sulfur standard, but the standard is supported by the auto industry, engine manufacturers, state regulators, public health organizations, and environmental organizations.[335] While opposition to the 10 ppm sulfur limit is led by the American Petroleum Institute, not all refiners believe the cost of compliance will impose major production costs.[336]

Certifying vehicles based on a useful life of 150,000 miles or 15 years, compared to the current 120,000 miles or 10 or 11 years as applicable, adds to manufacturers' compliance challenge for Tier 3 emissions standards, which makes it important to assure catalytic converters are not contaminated.[337]

Current gasoline requirements include the prohibition on blending gasoline with denatured fuel ethanol (DFE) that has a sulfur content greater than 30 ppm. If the proposed Tier 3 10 ppm refinery average sulfur standard is finalized, manufacturers of DFE for use by oxygenate blenders will also be required to meet a 10 ppm sulfur cap.[338]

Tier 3 standards will facilitate an immediate emission reduction from all gasoline-fueled vehicles, old and new, at the time the sulfur controls are implemented.[339] Emission reductions would increase over time as newer vehicles become a larger percentage of the fleet.[340] Tier 3 sulfur and tailpipe regulations are expected to reduce nitrous oxide (N_2O) and methane (CH_4) emissions, which are potent GHG emissions.[341] These reductions would be offset by CO_2 emissions associated with the energy used to remove sulfur within a refinery. EPA estimated a maximum increase of up to 4.6 million metric tons of CO_{2e} in 2017 for all U.S. refineries complying with the lower sulfur standards if the proposed sulfur standards are fully phased in, with the actual increase expected to be considerably lower because refineries do not operate at their permit capacity.[342] In 2017, EPA projects that "the range of potential decrease in CH_4 and N_2O emissions overlaps with the range of projected increase in CO_2 from refinery processes, suggesting that a net increase or decrease in GHG emissions cannot be quantified with certainty."[343]

B. *Sulfur in Diesel Fuel*

Sulfur in diesel fuel is the source of most diesel particulate emissions.[344] Moreover, sulfur plugs the catalyzed diesel particulate trap (trap-oxidizer) used to control diesel particulates.[345] Pursuant to the statute, EPA in 1990 set quality standards that provided emissions benefits by limiting the amount of sulfur and aromatics in highway diesel fuel beginning in 1993.[346] The regulations subsequently were amended in 1994, 1997, 1998, and 2001.[347]

EPA published the Federal Ultra Low Sulfur Highway Diesel Final Rule on January 18, 2001, as part of the heavy-duty vehicle rule.[348] It capped sulfur levels at 15 ppm, which is a 97% reduction from prior levels. Industry organizations challenged the rule, arguing, in part, that EPA lacked the authority to promulgate the rule. States and local governments supported the rule and urged EPA to promulgate standards for nonroad engines as well. The D.C. Circuit in *National Petrochemical & Refiners Ass'n v. EPA*[349] held that the rule requiring diesel engine manufacturers to substantially reduce PM and NO_x emissions over a seven-year period, and requiring diesel engine fuel to have no more than 15 ppm of sulfur, was not arbitrary or capricious. The diesel engine rule is found in 98 pages of the *Code of Federal Regulations*, but most of the complex rule deals with the process of phasing in the more restrictive sulfur limits and technical explanations of implementation requirements.[350]

EPA's 2001 rule specifies that, beginning June 1, 2006, refiners are to produce highway diesel fuel that meets a maximum sulfur standard of 15 ppm, which is a 97% reduction in the sulfur content of diesel fuel.[351] All 2007 and later model year diesel-fueled vehicles must be refueled with low-sulfur diesel fuel.[352] EPA's sulfur standard is based on its assessment of the impact of sulfur on advanced exhaust emission control technologies, and the feasibility of low-sulfur fuel production and distribution. Exhaust emission control devices, particularly the catalytic converter, have been used in gasoline-fueled automobiles for over 35 years, but have had only limited application in diesel vehicles.[353] Reducing the sulfur content of diesel fuel allows use of high-efficiency catalytic exhaust emission control

333. Tier 3 proposed rule, 78 Fed. Reg. at 29825.
334. 78 Fed. Reg. at 29821.
335. Michael Bologna, *Oil Industry Accuses EPA of Flawed Process in Implementing Gasoline, Vehicle Standards*, 44 Env't Rep. (BNA) 1293 (May 3, 2013).
336. John Siciliano & Chris Knight, *Refiners Split Over API's Claims of Major Costs From EPA "Tier III" Fuel Rule*, 24 Clean Air Rep. (Inside EPA) 10:11 (May 9, 2013).
337. Tier 3 proposed rule, 78 Fed. Reg. at 29868, 29947.
338. 78 Fed. Reg. at 29936.
339. 78 Fed. Reg. at 29826.
340. Tier 3 proposed rule, 78 Fed. Reg. at 29826.
341. 78 Fed. Reg. at 29845.
342. *Id.*
343. *Id.*
344. Diesel Rule, 66 Fed. Reg. at 5031.
345. 66 Fed. Reg. at 5046, 5047, 5057.
346. U.S. EPA, *Regulation of Fuels and Fuel Additives: Fuel Quality Regulations for Highway Diesel Fuel Sold in 1993 and Later Calendar Years*, 55 Fed. Reg. 34120 (Aug. 21, 1990). These standards were reviewed in a final rulemaking at 65 Fed. Reg. 59896 (Oct. 6, 2000).
347. 59 Fed. Reg. 35858 (July 14, 1994); 63 Fed. Reg. 49465 (Sept. 16, 1998); 65 Fed. Reg. 59896 (Oct. 6, 2000); 66 Fed. Reg. 5135 (Jan. 18, 2001).
348. Diesel Rule, *supra* note 145 (codified at 40 C.F.R. pt. 80, subpt. I).
349. 287 F.3d 1130 (D.C. Cir. 2002).
350. 40 C.F.R. §§80.00 to 80.620.
351. Diesel Rule, 66 Fed. Reg. 5002 (Jan. 18, 2001).
352. 66 Fed. Reg. at 5002.
353. 66 Fed. Reg. at 5007.

devices in a vehicle's exhaust system.[354] The benefits also include reduced sulfate PM and sulfur oxides emissions.[355]

Motor vehicle diesel fuel must comply with the sulfur regulation until it leaves the pump. The regulations impose liability on refiners, importers, distributors, resellers, carriers, and retailer or wholesale purchaser-consumers if they sell or use motor vehicle diesel fuel that does not meet applicable standards.[356] Parent corporations are liable for violations committed by a subsidiary.[357] The CAA does not apply these prohibitions to individuals. To avoid liability, a party must "show that the violation was caused by actions of someone other than that party's employees or agents."[358] Responsibility for compliance is placed at all levels in the distribution chain, including the imposition of vicarious liability on upstream parties for downstream violations over which they can exercise control. Diesel fuel that does not meet the sulfur standards may be marketed for uses other than in motor vehicles if the fuel was dyed as prescribed in federal regulations.[359]

On June 29, 2004, EPA expanded regulation of sulfur used in diesel engines to reach the previously unregulated category of fuel used in nonroad diesel equipment with the Clean Air Nonroad Diesel Rule.[360] The rule regulates emissions from off-road diesel engine and requires reductions in the sulfur content of nonroad diesel fuels from 3,000 ppm to 500 ppm by 2007 and from 500 ppm to 15 ppm by 2010.[361] In addition, the rule instituted regulation of marine and locomotive diesels by placing the same sulfur reductions as on off-road diesel, but with the date of the 500 ppm to 15 ppm step delayed until 2012.[362]

EPA's diesel rules preempt state regulation pursuant to CAA §211(c)(4)(A),[363] except California, as explained in §211(c)(4)(B).[364] In states other than California, §211(c)(4)(A)(ii) provides an exception to preemption for state prohibitions or controls if they are identical to those adopted by EPA. Alternatively, states may seek EPA's approval of an SIP revision containing fuel control measures, as described in §211(c)(4)(C) if state control or prohibition "is necessary to achieve the national primary or secondary ambient air quality standard which the plan implements." When EPA adopted the highway diesel fuel sulfur standard of 500 ppm pursuant to our authority under §211(c)(1) of the CAA in 1990, states were preempted from also doing so under the provisions of §211(c)(4)(A). The 15 ppm highway diesel fuel sulfur standard modifies the existing standard, and EPA's position is that the 2001 rule continues the explicit preemption under §211(c)(4)(A). States other than California with highway diesel fuel sulfur control programs not approved in their SIPs are preempted under §211(c)(4)(A) and will therefore need to obtain a waiver from EPA for state fuel sulfur control measures, unless the state control or prohibition is identical to the federal rule.[365] The Tier 3 proposed rule will have little effect on diesel fuel because it already is required to meet a 15 ppm sulfur cap. For this reason, EPA believes no further action is needed to enable diesel fuel vehicles to meet the proposed emissions standards.[366]

VII. Controlling GHG Emissions From HDVs

In 2011, the transportation sector was responsible for 27.6% of the U.S. GHG emissions and 31.7% of the CO_2 emissions, making transportation the end-use sector releasing the most CO_2.[367] CO_2 differs from conventional pollutants because the conversion of carbon in fuel to CO_2 provides much of the heat used to power modern societies.[368] HCs in fuel react with air during combustion to produce CO_2, water vapor, and heat.[369] The hot gases created by combustion are converted to mechanical energy by the engine and delivered to the wheels of a motor vehicle.[370] If the combustion process is not chemically perfect, conventional regulated pollutants such as HC, NMHC, CO, and PM are also produced. But CO_2 is the inherent byproduct of the thermodynamic process and cannot be prevented from being emitted from mobile sources because no cost-effective control technology is available now or in the foreseeable future. Therefore, if CO_2 is to be controlled from mobile sources, people must drive fewer miles, use more fuel-efficient vehicles, or use fuels that produce less CO_2 emissions.[371] Reducing CO_2 emissions is both an engineering problem and a political/social problem.

The consumption of transportation is usually expressed in terms of vehicle miles traveled (VMT). Total vehicle miles increased from 2,144,362 miles in 1990 to 2,957,192 miles in 2011, which is a 37.90% increase.[372] In 1990, trucks and buses were responsible for 33.9% of the VMT, and in 2011, they were responsible for 46.6% of the VMT.[373] From 1990 to 2011, U.S. CO_2 emissions increased by 10.74%, but during those years, CO_2 emissions from transportation sources remained relatively constant at about one-third of the nation's CO_2 emissions.[374] From 1990 to

354. 66 Fed. Reg. at 5007, 5009.
355. 66 Fed. Reg. at 5008.
356. 40 C.F.R. §80.612.
357. 40 C.F.R. §80.612(a)(4).
358. 40 C.F.R. §80.613.
359. 40 C.F.R. §§80.29(b), 80.520.
360. U.S. EPA, *Control of Emissions of Air Pollution From Nonroad Diesel Engines and Fuel*, 69 Fed. Reg. 38958 (June 29, 2004).
361. 40 C.F.R. §§80.501 & .510(c).
362. 40 C.F.R. §80.510(c).
363. 42 U.S.C. §7511(c)(4)(A).
364. Diesel Rule, 66 Fed. Reg. at 5085.
365. *Id.*
366. Tier 3 proposed rule, 78 Fed. Reg. at 29826.
367. Davis et al., *supra* note 1, at 11-5, tbl. 11.4.
368. The Babcock & Wilcox Co., Steam: Its Generation and Use 4-1 (1960). One pound of carbon combines with oxygen to release 14,100 British thermal units. *Id.*
369. *See generally* Edward F. Obert , Internal Combustion Engines and Air Pollution 1-19 (1973).
370. *Id.*
371. *See generally* American Association of State Highway and Transportation Officials, *Primer on Transportation and Climate Change* 23-40 (Apr. 2008); Congress of the United States Office of Technology Assessment, Improving Automobile Fuel Economy (1991).
372. Davis et al., *supra* note 1, at 3-11, tbl. 3.7.
373. *Id.* calculated from the data.
374. *Id.* at 11-6, tbl. 11.5.

2011, medium- and HDTs and buses increased their CO_2 emissions by 70.1%.[375]

A. Corporate Average Fuel Economy Standards

In 1975, Congress enacted the Energy and Policy Conservation Act (EPCA) in response to the oil embargo of 1973-1974.[376] Among its provisions were Corporate Average Fuel Economy (CAFÉ) standards that impose a minimum level of average fuel economy applicable to manufacturers of LDVs for a given model year.[377] Passenger vehicles are subject to statutory fuel economy standards, while non-passenger vehicles must meet standards set by the U.S. Department of Transportation's (DOT's) National Highway Traffic Safety Administration (NHTSA). NHTSA first established light-duty truck standards for MY 1979 for vehicles up to 6,000 lbs. GVWR, which was increased to 8,500 lbs. GVWR for MY 1980.[378] Light-duty truck CAFÉ requirements are defined to include many SUVs, vans, and pickup trucks.[379]

On April 6, 2006, DOT imposed new fuel economy standards for sport-utility vehicles, pickup trucks, vans, and minivans beginning with MY 2008.[380] The rule was projected to result in fuel economy for these vehicles of approximately 29.6 mpg in MY 2012, based on the combined CAFÉ standard of 25.0 mpg.[381]

The 2006 DOT standards attempt to balance emissions reductions with safety concerns by considering the product of a vehicle's width (distance between tires) and its wheelbase (the distance from the front to the rear axles).[382] This results in a separate fuel economy standard for each vehicle, and the manufacturer must meet a fleet average based on the weighted distribution of its production volumes.[383] The 2006 rule also expands the applicability of CAFÉ standards to include MDPVs (i.e., larger passenger vans and SUVs with a GVWR of 8,500 to 10,000 lbs.) in MY 2011, which DOT estimated would bring an additional 240,000 vehicles into the CAFÉ program.[384]

On Dec. 19, 2007, the Energy Independence and Security Act (EISA) of 2007 was signed into law.[385] It was applicable beginning with MY 2011 vehicles and requires more stringent CAFÉ standards for passenger vehicles based on regulations issued by the Secretary of Transportation.[386] Commercial medium- and heavy-duty highway vehicles as well as work trucks having a GVWR of 8,500 to 10,000 lbs. were to have new standards based on the maximum feasible improvement as determined by the Secretary.[387]

B. EPA's and NHTSA's Joint CO_2 Regulations

In 2007, the U.S. Supreme Court, in *Massachusetts v. EPA*,[388] the most important environmental case of the decade, held that motor vehicle emissions of GHGs were pollutants based on the definition found in the CAA.[389] To regulate motor vehicle emissions, three additional requirements had to be met: (1) a GHG must endanger public health or welfare; (2) appropriate cost-effective control technology must exist; and (3) adequate time to comply must be provided.[390] EPA made its endangerment finding on December 15, 2009, in a final rule saying GHG emissions from new motor vehicles contribute to air pollution, and air pollution may reasonably be anticipated to endanger public health and welfare.[391] This allowed EPA's light-duty vehicle CO_2 standard to be finalized.

EPA and NHTSA promulgated a joint light-duty vehicle rule on May 7, 2010, aimed at reducing CO_2 from the MYs 2012-2016 vehicles through mandated fuel efficiency requirements.[392] This regulation made CO_2 a regulated pollutant under the CAA, which triggers the applicability of many provisions of the CAA that apply to stationary sources, On June 26, 2012, the D.C. Circuit upheld EPA's endangerment finding and its GHG vehicle regulations.[393] On December 20, 2012, the D.C. Circuit rejected a petition for a rehearing en banc.[394] On January 25, 2013, EPA denied a petition to reconsider its GHG regulations.[395] Petitions for certiorari were then filed, which resulted in the D. C. Circuit delaying action on several lawsuits over

375. *Id.* at 11-8, tbl. 11.7.
376. Pub. L. No. 94-163, 89 Stat. 871, 901-16 (1975).
377. 49 U.S.C. §32901(a)(6) (1994).
378. National Highway Traffic Safety Administration, *Average Fuel Economy Standards for Light Trucks Model Years 2008-2011*, 71 Fed. Reg. 17566, 17571 (Apr. 6, 2006) (codified at 49 C.F.R. pts. 523, 533, and 537).
379. *See* 49 C.F.R. §533.5(a), (g) & (h) (2009).
380. 71 Fed. Reg. at 17566, 17624 (Apr. 6, 2006).
381. Davis et al., *supra* note 1, at 4-23, tbl. 4.22.
382. 71 Fed. Reg. at 17566.
383. *Id.* at 17576.
384. *Id.* at 17570. A definition of MDPV is found in EPA's Tier 2 regulations at Tier 2 Light-Duty Vehicle and Light-Duty Truck Emission Standards and Gasoline Sulfur Control Requirements, 65 Fed. Reg. 6698 (Feb. 10, 2000) (codified at 40 C.F.R. pts. 80, 85, & 86).
385. Pub. L. No. 110-140. *See generally* CRS Report for Congress, *Energy Independence and Security Act of 2007: A Summary of Major Provisions* (Dec. 21, 2007) [RL34294].
386. Pub. L. No. 110-140, §102(b)(2)(B), 121 Stat. 1498-1501 (2007). 49 U.S.C. §32902(f).
387. 49 U.S.C. §32902(k).
388. Massachusetts v. EPA, 549 U.S. 497, 532, 37 ELR 20075 (2007).
389. CAA §302(g), 42 U.S.C. §7602(g) (2006).
390. CAA §202(a)(1)-(2), 42 U.S.C. §7521(a)(1)-(2) (2006).
391. U.S. EPA, Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66496 (Dec. 15, 2009).
392. Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, 75 Fed. Reg. 25324 (May 7, 2010) (to be codified at 40 C.F.R. pts. 85, 86 & 600, and 49 C.F.R. pts. 531, 533 & 536-38). *See generally* Arnold W. Reitze Jr., *Controlling Greenhouse Gases From Highway Vehicles*, 31 Utah Envtl. L. Rev. 309 (2011). The development of the rule is discussed in Jody Freeman, *The Obama Administration's National Auto Policy: Lessons From the "Car Deal,"* 35 Harv. Envtl. L. Rev. 343 (2011).
393. Coalition for Responsible Regulation, Inc. v. EPA, 684 F.3d 102, 42 ELR 20141 (D.C. Cir. June 26, 2012).
394. Coalition for Responsible Regulation, Inc. v. EPA, 2012 WL 6621785, 2012 WL 6681996, 42 ELR 20260 (D.C. Cir. Dec. 20, 2012). *See also* Dawn Reeves, *Dissents in GHG Ruling Decision May Help Bid for Supreme Court Review*, 29 Envtl. Pol'y. Alert 26:30 (Dec. 26, 2012); Andrew Childers, *States Ask Supreme Court to Narrow Applicability of 2007 Climate Change Ruling*, 44 Env't Rep. (BNA) 1213 (Apr. 26, 2013).
395. 78 Fed. Reg. 5347 (Jan. 25, 2013).

EPA's GHG rules.[396] On October 15, 2013, the Supreme Court granted certiorari in the case now named *Utility Air Regulatory Group v. EPA*[397] for the limited issue of whether the regulation of GHG emissions from vehicles necessarily triggered the need for a permit program for stationary source GHG emissions. The case is scheduled for oral argument on February 24, 2014, but because of the limited issue being argued, the court is not likely to review the issue of the applicability of the CAA to mobile source GHG emissions.

Vehicles covered by the 2010 GHG rule are responsible for almost 60% of the transportation-related GHG emissions.[398] The rule is projected to reduce GHGs from the U.S. light-duty fleet by approximately 21% by 2030 from what would occur without this rule.[399] The rule creates a 50-state standard that California and other states that have worked to create more stringent motor vehicle fuel efficiency standards accepted.[400] This resulted in the automobile industry dropping lawsuits opposing the California standards, which have been adopted by 13 other states.[401]

EPA's MY 2012 through MY 2016 regulations are based on its CAA §202 authority; NHTSA's standards are based on its authority under 49 U.S.C. §32902. EPA's standards require LDVs to meet an estimated combined average emissions level of 250 g/mi in MY 2016, which is equivalent to a combined average fuel economy of 35.5 mpg, if the standard is met solely through fuel economy improvements.[402] NHTSA's standards would require a combined average light-duty vehicle fuel economy that becomes increasingly stringent from MY 2012 until it reaches 34.1 mpg in MY 2016.[403] The reason for the small difference in the standards is due to the differences in the statutes under which the two agencies operate. This resulted in slightly higher fuel efficiency requirements under EPA's regulation because EPA expects manufacturers to obtain CO_2 credits for reductions in emissions of GHGs due to improvements in air conditioner systems. Such credits are not available under the laws that are applicable to NHTSA.[404] NHTSA's CAFÉ standards for passenger cars are projected to increase from 33.3 to 37.8 mpg over five years, and LDTs will go from 25.4 to 28.8 mpg, which is an average annual increase in fuel efficiency of 4.3% relative to MY 2011 standards.[405]

On October 15, 2012, EPA and NHTSA promulgated regulations for MYs 2017-2025 LDVs.[406] The rule calls for a combined passenger car and light truck fuel efficiency of 35.1 mpg for 2017, which will increase to 48.7 mpg in 2025.[407] Passenger cars are expected to average 55.3 mpg in 2025.[408] A few petroleum and other industry groups have filed lawsuits challenging the rule, but the automotive manufacturers are supporting the rule.[409]

C. *Heavy-Duty Truck Standards*

On May 21, 2010, President Barack Obama directed NHTSA and EPA to initiate rulemaking to reduce GHG emissions from on-road, HDVs.[410] EPA and NHTSA responded on November 30, 2010, with the promulgation of a proposed rule,[411] "designed to address the urgent and closely intertwined challenges of dependence on oil, energy security, and global climate change."[412] The proposed rule was "the first time that NHTSA and EPA would regulate the heavy-duty sector for fuel consumption and GHG emissions, respectively."[413]

On September 15, 2011, EPA and NHTSA promulgated final rules applicable to HDVs.[414] These vehicles range from large pickups to sleeper-cab tractors and are the second largest contributor to oil consumption and GHG emissions from the mobile source sector, after light-duty passenger cars and trucks.[415] HDVs primarily are diesel powered, although about 37% have gasoline engines.[416] The use of HDTs had increased over the last

396. *See* Andrew Childers, *Supreme Court Asked to Overturn Decision Upholding EPA's 2009 Endangerment Finding*, 44 Env't Rep. (BNA) 897 (Mar. 29, 2013); Dawn Reeves, *D.C. Circuit Delays Suits on EPA GHG Rules Pending High Court Challenge*, 24 Clean Air Rep. (Inside EPA) 11:26 (May 23, 2013).
397. 134 S. Ct. 418 (Oct. 15, 2013).
398. Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, *supra* note 392, at 25328.
399. *Id.*
400. *Id.* at 25408.
401. Steven D. Cook, *Automobile Industry Drops Lawsuits Against States Adopting California Standards*, 41 Env't Rep. (BNA) 778 (Apr. 9, 2010) (The cases dismissed include *Central Valley Chrysler-Jeep v. Goldstene*, No. 08-17378 (9th Cir. Apr. 7, 2010), *Association of International Automobile Manufacturers v. Sullivan*, No. 09-1023 (1st Cir. Apr. 7, 2010), and *Green Mountain Chrysler-Plymouth-Dodge v. Crombie*, No. 07-4342-cv (2d Cir. Apr. 7, 2010)). *See also Automakers Drop Challenge to GHG Rules, Reserve Right for Post-2016 Suits*, 21 Clean Air Rep. (Inside EPA) 8 (Apr. 15, 2010); *Jackson Vows to Begin Negotiations Over Post-2016 Vehicle Rules*, 21 Clean Air Rep. (Inside EPA) 10 (May 13, 2010).
402. Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, *supra* note 392, at 25330.
403. *Id.*
404. *Id.*
405. *Id.* The final CAFÉ standards for passenger cars from the MY 2011 base are 30.4 in fiscal year (FY) 2011; 33.4 in FY 2012; 34.2 in FY 2013; 34.9 in FY 2014; 36.2 in FY 2015; and 37.8 in FY 2016. *Id.* For light trucks, the standards are 24.4, 25.4, 26.0, 26.6, 27.5, and 28.8 mpg. *Id.* The fuel economy of the combined fleet is estimated at 27.6 mpg in FY 2011 and increases to 34.1 mpg in FY 2016. *Id.*
406. *2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards*, 77 Fed. Reg. 62624 (Oct. 15, 2012).
407. *Id.* at 62640.
408. *Id.* This is an estimate. DOT often claims that the 2025 average fuel economy will be 54.5 mpg. *See* Nora Macaluso, *Automakers Seen Meeting Fuel Standards Through Combination of Adjustments*, 43 Env't Rep. (BNA) 2969 (Nov. 23, 2012).
409. Dawn Reeves, *Few Groups Challenge EPA Vehicle GHG Rule as Lawsuit Deadline Passes*, 23 Clean Air Rep. (Inside EPA) 26:28 (Dec. 20, 2012); Dawn Reeves, *Automakers Seek to Defend EPA's Vehicle GHG Rule From Lawsuits*, 24 Clean Air Rep. (Inside EPA) 2:14 (Jan. 17, 2013).
410. *Improving Energy Security, American Competitiveness and Job Creation, and Environmental Protection Through a Transformation of Our Nation's Fleet of Cars and Trucks*, 75 Fed. Reg. 29399 (May 26, 2010).
411. Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, 75 Fed. Reg. 74152 (proposed Nov. 30, 2010) (to be codified at 49 C.F.R. pts. 523, 534, & 535).
412. *Id.* at 74156.
413. *Id.* at 74157-58.
414. Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, 76 Fed. Reg. 57106 (Sept. 15, 2011) [hereinafter Heavy-Duty GHG Rule].
415. *Id.* at 57107.
416. *Id.* at 57108.

decade because of increased imports and exports of finished goods and increased shipping of finished goods due to Internet purchases.[417]

EPA and NHTSA's heavy-duty vehicle regulations aim to achieve reductions in CO_2 emissions and fuel consumption through increased engine efficiency and changes in the vehicle to reduce the work demanded of the engine.[418] EPA's rules also impose hydrofluorocarbon standards to control leakage from air conditioning systems in combination tractors, and pickup trucks and vans. It also regulates N_2O and CH_4 emissions with standards that apply to all heavy-duty engines, pickup trucks, and vans.[419] EPA's GHG emission standards will begin with MY 2014. NHTSA's fuel consumption standards are voluntary in MYs 2014 and 2015, in order to provide the four full model years of regulatory lead-time required by EISA,[420] but the standards become mandatory with MY 2016 for most regulatory categories.

The heavy-duty category is defined to include all on-road vehicles rated at a GVWR of 8,500 lbs. or more and the engines that power them, except medium-duty vehicles covered by the current CAFÉ standards for MYs 2012-2016 LDVs.[421] EPA is including recreational on-highway vehicles within its rulemaking, but NHTSA is not, because its statutory authority is limited to regulating commercial vehicles.[422] "Congress emphasized that the test methods, measurement metrics, standards, and compliance and enforcement protocols must all be appropriate, cost-effective, and technologically feasible for commercial medium-duty and heavy-duty on-highway vehicles and work trucks."[423]

NHTSA and EPA have the authority to create categories of HDVs for regulatory development.[424] This resulted in regulations based on the three vehicle categories identified by the agencies: heavy-duty pickups and vans; combination tractors used primarily for freight transport; and vocational vehicles.[425] There are also seven categories of HDTs (Classes 2b through 8)[426] based on their GVWR, which is the maximum load that the vehicle can haul, including the weight of a loaded trailer and the vehicle itself.[427]

HDVs with GVWR between 8,501 and 10,000 lbs. are classified as Class 2b motor vehicles. Class 2b includes MDPVs that are regulated under the light-duty vehicle rule and are not subject to the GHG rule.[428] HDVs with GVWR between 10,001 and 14,000 lbs. are classified as Class 3 motor vehicles. About 90% of these vehicles are 3/4-ton and 1-ton pickup trucks, 12- and 15-passenger vans, and large work vans that are primarily manufactured by Chrysler, Ford, and General Motors.[429] EPA regulates these vehicles with GHG standards expressed as gpm, which is consistent with the way these vehicles are regulated for criteria pollutants. NHTSA uses a similar approach based on gallons per 100-mile fuel consumption standards. Both agencies use a complete vehicle approach that imposes a new vehicle fleet average standard for each manufacturer in each model year, and the determination of these fleet average standards is based on production volume-weighted targets for each model, with the requirements varying based on vehicle footprint, which is the wheelbase times the average track width.[430]

Vocational vehicles can be in any weight class and include delivery, refuse, utility, dump, and cement trucks; transit, shuttle, and school buses; emergency vehicles; motor homes; and tow trucks.[431] These vehicles are responsible for contribute approximately 20% of the heavy-duty truck sector's GHG emissions.[432] EPA and NHTSA expect the GHG and fuel consumption standards apply to chassis manufacturers that produce the chassis with engine and transmission that are the primary technologies that affect GHG emissions and fuel economy. From an enforcement perspective, they are a much more limited group of manufacturers for purposes of developing and implementing a regulatory program. Regulating body manufacturers would be less practical because they are a diverse set of manufacturers, many of whom are small businesses.[433]

Combination tractor-trailers are subject to the requirements of categories 7 & 8.[434] Class 7 vehicles have a GVWR of 26,001 to 33,000 lbs.; Class 8 vehicles exceed 33,001 lbs. GVWR.[435] "Class 7 and 8 combination tractors and their engines contribute the largest portion of the total GHG emissions and fuel consumption of the heavy-duty sector, approximately 65%, due to their large payloads, their high annual miles traveled, and their major role in national freight transport."[436] These vehicles have a cab and engine (tractor) and a detachable trailer. The heavy-duty combination tractor industry consists of tractor manufacturers (which manufacture the tractor and purchase and install the engine) and trailer manufacturers. A relatively limited number of manufacturers produce the vast majority of heavy-duty tractors and engines, but the trailer manufacturing industry "includes a large number of companies, many of which are relatively small in size and production volume."[437] For this reason, the trailers that are attached to the tractors are exempted from regulation at this time.[438]

EPA and NHTSA regulations for Class 7 and 8 combination tractor manufacturers are based on several attributes identified by the agencies. The agencies have created nine

417. *Id.*
418. *Id.* at 57114.
419. *Id.* at 57106.
420. 49 U.S.C. §32902.
421. Heavy-Duty GHG Rule, 76 Fed. Reg. at 57109.
422. *Id. See also* 49 U.S.C. §32901(a)(7) & (a)(19).
423. Heavy-Duty GHG Rule, 76 Fed. Reg. at 57112.
424. *See* 49 U.S.C. §32902 (2007) and CAA §202(a)(1), 42 U.S.C. §7521(a)(1).
425. Heavy-Duty GHG Rule, 76 Fed. Reg. at 57114.
426. *Id.* at 57114, tbl. I-2.
427. *Id.* at 57114.
428. *Id.* at 57118.
429. *Id.*
430. *Id.*
431. *Id.* at 57120.
432. *Id.*
433. *Id.*
434. *Id.* at 57114.
435. *Id.* at 57114, tbl. I-2.
436. *Id.* at 57115.
437. *Id.*
438. *Id.* at 57106, 57111, 57116.

subcategories within the Class 7 and 8 combination tractor category based on the differences in expected emissions and fuel consumption associated with the key attributes of GVWR, cab type, and roof height.[439] The agencies are imposing standards beginning with MY 2014 with more stringent standards following MY 2017.[440]

Heavy-duty combination tractors and vocational truck standards are expressed in terms of the mass of emissions from carrying one ton of cargo over a distance of one mile (g/ton-mi).[441] The NHTSA standards are based on gallons of fuel consumed over a set distance (1,000 miles), or gal/1,000 ton-mile.[442] For engines, EPA's standards are in the form of g/bhp-hr, which is the same approach that is used for the heavy-duty highway engine standards for criteria pollutants.[443] Similarly, NHTSA's standards for heavy-duty engines are in the form of gallons of fuel consumption per 100 units of work (gal/100 bhp-hr).[444] To meet the emissions reduction requirements will require focusing on improved technologies that consider aerodynamic features, weight reductions, tire rolling resistance, the presence of idle-reducing technology, and vehicle speed limiters.[445]

The 2011 GHG rule is a large document with many provisions that cover issues in addition to the limits on GHG emissions that remain to be implemented. Nevertheless, change continues. In May 2013, EPA announced amendments to the GHG rule and changes to other nonroad requirements. The amendments deal with reporting requirement, reduce differences between the EPA and NHTSA programs, and make changes in the testing procedures. The amendments cover new replacement engines, provide hardship provisions for nonroad diesel engines, and include other amendments for small nonroad spark-ignition engines.[446] On August 16, 2013, EPA made a partial withdrawal of the direct final rule and made revisions to both the direct final rule and the proposed rule, and the process continues.[447]

VIII. Conclusion

EPA and NHTSA estimate the net benefits of the heavy-duty vehicle regulations at $27 billion to $41 billion, based on a social cost of carbon (SCC) and using a discount rate of 7% and 3% for MYs 2014-2018 HDVs.[448] EPA standards proposed for 2018 (including a separate standard to control air conditioning system leakage) are projected to reduce average per-vehicle emissions of GHGs by 17% for diesel vehicles and 12% for gasoline vehicles, compared to a common baseline.[449] EPA and NHTSA expect that the new tractor cab and separate standard for the engines installed in the tractor will reduce fuel consumption up to 20% by 2018.[450] The agencies project that by 2020 the program will result in no cost or negative costs because fuel savings will offset the costs.[451] For vocational vehicles and combination tractors, payback periods are much shorter and actually are expected to occur within the first year of ownership because these trucks travel more miles in a given year.[452] In addition to the benefits to heavy-duty truck operators, EPA estimates the proposed rule will reduce oil imports by 0.177 million barrels per day in 2020 and will increase to 0.463 million barrels per day in 2040.[453]

For the period 1970 to 2012, U.S. transportation petroleum consumption by the transportation sector increased by 1.1% per year, but the increase in petroleum consumption by the transportation sector has been slowing, and from 2002 to 2012, transportation petroleum annual consumption decreased by 0.5%.[454]

The program to increase motor vehicle fuel efficiency is an important step in the right direction. Unlike the programs to control stationary sources, the fuel economy improvements required in the recent EPA/NHTSA rules have little or no net cost because the cost of compliance is offset by the reduced cost of fuel. Moreover, the rules should help reduce the growth in petroleum imports that adversely affect the nation's trade balance and makes the nation a hostage to oil-producing nations. These rules do not materially expand the size or the power of the federal government, and they have low transactional costs. Finally, the more stringent fuel economy standards appear to have the support of both industry and environmental groups.[455]

An important benefit of the effort to reduce emissions from HDVs is the effect it will have on state efforts to develop revised SIPs to deal with areas that have failed to attain the National Ambient Air Quality Standards.[456] For example, in April 2012, EPA designated 46 areas as not being in attainment of the 2008 ozone standard.[457] The emissions reductions of NO_x, VOC, $PM_{2.5}$, and air toxics that are projected to be achieved by the proposed Tier 3 standards would lead to significant decreases in ambient concentrations of ozone, $PM_{2.5}$, and air toxics by 2030 when Tier 3 vehicles would make up the majority of the

439. *Id.* at 57116.
440. *Id.*, tbl. I-3 presents the agencies' respective standards for combination tractor manufacturers for MY 2017.
441. *Id.* at 57115.
442. *Id.*
443. *Id.*
444. *Id.*
445. *Id.* at 57116.
446. U.S. EPA, *Heavy-Duty Engine and Vehicle, and Nonroad Technical Amendments*, 78 Fed. Reg. 36135 (proposed June 17, 2013). *See also* the direct final rule at 78 Fed. Reg. 36370 (June 17, 2013).
447. 78 Fed. Reg. 49963 (Aug. 16, 2013).
448. Heavy-Duty GHG Rule, 76 Fed. Reg. at 74167, tbl. I-4. *See also* Andrew Childers, *Up to 20 Percent Improvement by 2018 Sought in Fuel Economy for Large Trucks*, 42 Env't Rep. (BNA) 1812 (Aug. 12, 2011).
449. Heavy-Duty GHG Rule, 76 Fed. Reg. at 74164.
450. *Id.* at 74173.
451. *Id.* at 74312, tbls. VIII-3 to VIII-6.
452. *Id.* at 74315, tbl. VIII-9.
453. *Id.* at 74325, tbl. VIII-16.
454. Davis et al., *supra* note 1, at 1-17, tbl. 1.13.
455. *Industry Shows Early Support for GHG Truck Rules at Public Hearings*, 21 Clean Air Rep. (Inside EPA) 25 (Dec. 9, 2010). *See also* Childers, *supra* note 448.
456. *See generally* Arnold W. Reitze Jr., *Air Quality Using State Implementation Plans—Thirty-Seven Years of Increasing Complexity*, XV Vill. Envtl. L. Rev. 209 (2004).
457. Andrew Childers, *EPA Proposal Would Allow More Flexibility for States to Implement Ozone Plans*, 44 Env't Rep. (BNA) 1577 (May 31, 2013).

fleet, and ozone reductions would begin in 2017 when the proposed sulfur controls take effect.[458] The proposed Tier 3 regulations would reduce NO_x and VOC emissions from on-highway vehicles by about 25%, CO emissions would be reduced by about 30%, and emissions of many air toxics from on-highway vehicles would be reduced by 10 to nearly 40%.[459] This would provide some relief to states working on SIP revisions that would otherwise need to reduce emissions from stationary sources and other sources subject to state control in amounts approximating the reductions being achieved by the Tier 3 rule.[460]

458. Tier 3 proposed rule, 78 Fed. Reg. at 29826.

459. Tier 3 proposed rule, 78 Fed. Reg. at 29820.

460. In Utah, the governor is supporting the Tier 3 proposed rule because the reductions could be used to offset increased emissions from the state's five refineries. Judy Fahys, *Herbert Backs New Emission Standards*, Salt Lake Trib., June 25, 2013, at A5.