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Cars, Trucks, and Climate: EPA Regulation of Greenhouse Gases from Mobile Sources

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Summary

On July 13, 2015, the Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) proposed a second round of greenhouse gas (GHG) emission and fuel economy standards for medium- and heavy-duty trucks. The standards, which will affect trucks beginning with the 2021 model year, are expected to be finalized in July 2016.

The standards will be the fourth set of GHG emission standards for mobile sources. Under standards promulgated in October 2012, GHG emissions from new cars and light trucks (i.e., SUVs, minivans, and most pickup trucks) will be phased in, beginning with model year (MY) 2017. When fully phased in (2025), emissions will be reduced about 50% compared to 2010, and average fuel economy (CAFE) standards will rise to nearly 50 miles per gallon. EPA had previously set GHG emission standards for MY2012-2016 cars and light trucks and for MY2014-MY2018 medium- and heavy-duty trucks.

These steps have been taken as Congress (particularly the House) and the Administration have reached an impasse over climate issues. The Administration has made clear that its preference would be for Congress to address the climate issue through new legislation. Nevertheless, in the wake of a 2007 Supreme Court decision, it has moved forward on several fronts to define how the Clean Air Act (CAA) will be used, and to promulgate regulations.

The key to using the CAA's authority to control greenhouse gases was for the EPA Administrator to find that GHG emissions are air pollutants that endanger public health or welfare. Then-EPA-Administrator Lisa Jackson promulgated such an endangerment finding in December 2009. With the endangerment finding finalized, the agency has proceeded to promulgate standards for emissions from motor vehicles and, subsequently, electric power plants.

In all, EPA has received 13 petitions asking that it make endangerment findings and regulate emissions of greenhouse gases. Eleven of the 13 petitions addressed mobile sources: besides motor vehicles, the petitions cover aircraft, ships, nonroad vehicles and engines, locomotives, and fuels, all of which are covered by Title II of the Clean Air Act. This report discusses the full range of EPA's authority under Title II and provides information regarding other mobile sources that might be regulated under this authority, in addition to describing the car and truck regulations.

Regulation of GHGs from mobile sources has led the agency to establish controls for *stationary* sources, such as electric power plants, as well. Stationary source options, the authority for which comes from different parts of the CAA, are addressed in CRS Report R44341, *EPA's Clean Power Plan for Existing Power Plants: Frequently Asked Questions*, and other CRS reports.

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Introduction

In 2009 and 2010, during the 111th Congress, there was much discussion of legislation designed to address climate change by reducing greenhouse gas (GHG) emissions. The leading alternative was the Waxman-Markey bill (H.R. 2454), which relied heavily on a cap-and-trade approach¹ to reduce emissions. H.R. 2454 passed the House in June 2009, but died in the Senate.

Tax options, generally referred to as a carbon tax, have also been widely discussed in the climate debate. By taxing emissions of GHGs, a carbon tax would provide economic incentives to reduce emissions.²

Despite the focus on these two approaches, establishing greenhouse gas controls has never been simply a choice between these alternatives. A third set of options, using the more traditional regulatory approaches of the Clean Air Act (CAA), was, and remains, available. These regulatory approaches might be modified through new legislation, but unlike a cap-and-trade system or a carbon tax, regulation of GHG emissions under the Clean Air Act does not require new congressional action: the ability to limit the emissions already exists under various CAA authorities that Congress has enacted, a point underlined by the Supreme Court in an April 2007 decision, *Massachusetts v. EPA*.³

Thus, while the 111th Congress and the Administration discussed new legal authority (for cap-and-trade, carbon tax, and targeted emission controls) the Administration, through the Environmental Protection Agency (EPA), proceeded to exercise existing authority under the CAA to begin regulation of GHG emissions.

The agency has taken several steps in this direction. Nevertheless, the EPA Administrator and others in the Administration made clear that their preference would be for Congress to address the climate issue through broad legislation. In an April 2009 press release, for example, the agency stated, “notwithstanding this required regulatory process, both President Obama and Administrator Jackson have repeatedly indicated their preference for comprehensive legislation to address this issue and create the framework for a clean energy economy.”⁴ Similar statements have been made on several occasions since that time; in the meantime, though, the agency has concluded that current law, including the *Massachusetts v. EPA* decision discussed below, compelled the agency to act.

This report focuses on EPA’s completed and potential actions to limit GHG emissions from mobile sources, relying on the authorities in Title II of the CAA. We begin with a brief discussion of the petitions and court action that led to EPA’s regulatory decisions.⁵

¹ For a more detailed discussion of cap-and-trade approaches to GHG emission control, see CRS Report RL33799, *Climate Change: Design Approaches for a Greenhouse Gas Reduction Program*.

² For a discussion of carbon tax options, see CRS Report R42731, *Carbon Tax: Deficit Reduction and Other Considerations*.

³ For a discussion of the Court’s decision, see CRS Report RS22665, *The Supreme Court’s First Climate Change Decision: Massachusetts v. EPA*. Subsequently, in *American Electric Power v. EPA* (131 S. Ct. 2527 (2011)), the Court made clear that the authority to regulate GHGs from mobile sources of pollution under Section 202, announced in *Massachusetts v. EPA*, also extends to New Source Performance Standards for stationary emission sources, which can be regulated under CAA Section 111(b).

⁴ “EPA Finds Greenhouse Gases Pose Threat to Public Health, Welfare / Proposed Finding Comes in Response to 2007 Supreme Court Ruling,” Press Release, April 17, 2009, at <http://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/0ef7df675805295d8525759b00566924>.

⁵ Many in Congress have opposed EPA’s actions. For a discussion of congressional actions and options, see CRS (continued...)

Massachusetts v. EPA and Its Effects

Whether EPA could regulate GHGs through existing CAA authority was under consideration at EPA for more than a decade before the agency took action. In 1998, during the Clinton Administration, EPA General Counsel Jonathan Cannon concluded in a memorandum to the agency's Administrator that greenhouse gases were air pollutants within the CAA's definition of the term, and therefore could be regulated under the act.⁶ Relying on the Cannon memorandum as well as the statute itself, on October 20, 1999, a group of 19 organizations petitioned EPA to regulate greenhouse gas emissions from new motor vehicles under Section 202 of the act.⁷ Section 202 gives the EPA Administrator broad authority to set "standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles" if in her judgment they cause or contribute to air pollution which "may reasonably be anticipated to endanger public health or welfare."

Under the Bush Administration, EPA denied the petition August 28, 2003,⁸ on the basis of a new General Counsel memorandum the same day. The new memorandum concluded that the CAA does not grant EPA authority to regulate carbon dioxide (CO₂) and other GHG emissions based on their climate change impacts.⁹ Denial of the petition was challenged by Massachusetts, 11 other states, and various other petitioners in a case that ultimately reached the Supreme Court. In an April 2, 2007, decision (*Massachusetts v. EPA*), the Court found by 5-4 that EPA *does* have authority to regulate greenhouse gas emissions, since the emissions are clearly air pollutants under the CAA's definition of that term.¹⁰ The Court's majority concluded that EPA must, therefore, decide whether emissions of these pollutants from new motor vehicles contribute to air pollution that may reasonably be anticipated to endanger public health or welfare, or provide a reasonable explanation why it cannot or will not make that decision, such as that there is insufficient information to make the decision. If it makes such a finding of endangerment, the act requires the agency to establish standards for emissions of the pollutants.¹¹

In nearly two years following the Court's decision, the Bush Administration's EPA did not respond to the original petition or make a finding regarding endangerment. Its only formal action

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Report R41212, *EPA Regulation of Greenhouse Gases: Congressional Responses and Options*.

⁶ Memorandum from Jonathan Z. Cannon, EPA General Counsel, to Carol M. Browner, EPA Administrator, "EPA's Authority to Regulate Pollutants Emitted by Electric Power Generation Sources," April 10, 1998.

⁷ The lead petitioner was the International Center for Technology Assessment (ICTA). The petition may be found at <http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2001-0002-0001>.

⁸ The agency argued that it lacked statutory authority to regulate greenhouse gases: Congress "was well aware of the global climate change issue" when it last comprehensively amended the CAA in 1990, according to the agency, but "it declined to adopt a proposed amendment establishing binding emissions limitations." *Massachusetts v. EPA*, 549 U.S. 497 (2007).

⁹ Memorandum from Robert E. Fabricant, EPA General Counsel, to Marianne L. Horinko, EPA Acting Administrator, "EPA's Authority to Impose Mandatory Controls to Address Global Climate Change Under the Clean Air Act," August 28, 2003.

¹⁰ *Massachusetts v. EPA*, 549 U.S. 497 (2007). The majority held: "The Clean Air Act's sweeping definition of 'air pollutant' includes 'any air pollution agent or combination of such agents, including any physical, chemical ... substance or matter which is emitted into or otherwise enters the ambient air....' ... Carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons are without a doubt 'physical [and] chemical ... substances[s] which [are] emitted into ... the ambient air.' The statute is unambiguous."

¹¹ For further discussion of the Court's decision, see CRS Report RS22665, *The Supreme Court's First Climate Change Decision: Massachusetts v. EPA*.

following the Court decision was to issue a detailed information request, called an Advance Notice of Proposed Rulemaking (ANPR), on July 30, 2008.¹²

The Obama Administration's EPA, however, made review of the endangerment issue a high priority. On April 17, 2009, it proposed a finding that GHGs do endanger both public health and welfare and that GHGs from new motor vehicles contribute to that endangerment.¹³ These findings were finalized in the December 15, 2009, *Federal Register*.¹⁴

Standards for New Light-Duty Motor Vehicles

The proposed endangerment finding of April 2009 was followed in a matter of weeks by an announcement that the Administration had reached agreement with nine auto manufacturers¹⁵ and California (which had developed its own GHG emission standards for motor vehicles), as well as other interested parties regarding the major outlines of a joint greenhouse gas/fuel economy rulemaking. As announced by the President, May 19, 2009, EPA and the National Highway Traffic Safety Administration (which administers fuel economy standards for cars and trucks) would integrate corporate average fuel economy (CAFE) standards for new cars and light trucks (collectively known as "light-duty motor vehicles") with national greenhouse gas emission standards to be issued by EPA. The objective of the joint standards was to achieve GHG reduction levels similar to those adopted by California, which harmonized its own standards with EPA's as part of the agreement.¹⁶

Four greenhouse gases are emitted by motor vehicles (CO₂, methane, nitrous oxide, and hydrofluorocarbons).¹⁷ According to EPA, emissions of the four gases from motor vehicles (including trucks) accounted for 23.6% of the total inventory of U.S. GHG emissions in 2006. Most of the emissions were (and are) in the form of CO₂ (see **Figure 1**), which is the product of combusting any fuel containing carbon. Hydrofluorocarbons (HFCs), the chemicals used as

¹² U.S. EPA, "Regulating Greenhouse Gas Emissions Under the Clean Air Act," 73 *Federal Register* 44354, July 30, 2008. The ANPR occupied 167 pages of the *Federal Register*. Besides requesting information, it took the unusual approach of presenting statements from the Office of Management and Budget, four Cabinet Departments (Agriculture, Commerce, Transportation, and Energy), the Chairman of the Council on Environmental Quality, the Director of the President's Office of Science and Technology Policy, the Chairman of the Council of Economic Advisers, and the Chief Counsel for Advocacy at the Small Business Administration, each of whom expressed their objections to regulating greenhouse gas emissions under the CAA. The OMB statement began by noting that, "The issues raised during interagency review are so significant that we have been unable to reach interagency consensus in a timely way, and as a result, this staff draft cannot be considered Administration policy or representative of the views of the Administration." (p. 44356) It went on to state that "... the Clean Air Act is a deeply flawed and unsuitable vehicle for reducing greenhouse gas emissions." The other letters concurred. The ANPR, therefore, was of limited use in reaching a conclusion on the endangerment issue.

¹³ U.S. EPA, "Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act," 74 *Federal Register* 18886, April 24, 2009.

¹⁴ 74 *Federal Register* 66496. Although generally referred to as simply "the endangerment finding," the EPA Administrator actually finalized two separate findings: a finding that six greenhouse gases endanger public health and welfare, and a separate "cause or contribute" finding that the combined emissions of greenhouse gases from new motor vehicles and new motor vehicle engines contribute to the greenhouse gas pollution that endangers public health and welfare.

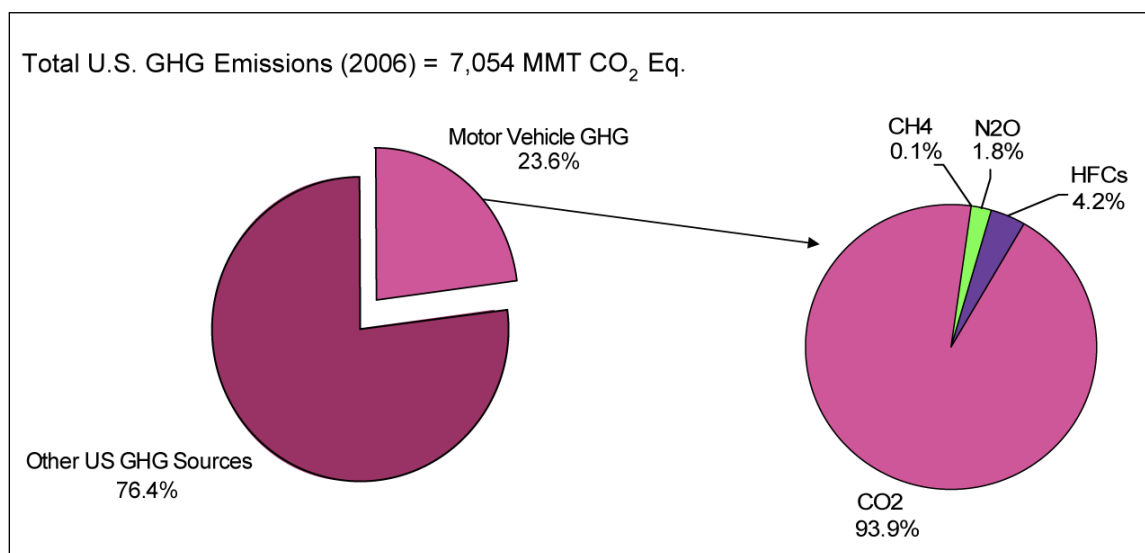
¹⁵ Letters containing those agreements may be accessed at <http://www.epa.gov/otaq/climate/letters.htm#2009al>.

¹⁶ 74 *Federal Register* 49468, September 28, 2009.

¹⁷ Two other commonly mentioned greenhouse gases, sulfur hexafluoride (SF₆) and perfluorocarbons, are not emitted by motor vehicles.

coolants in vehicle air conditioning systems, are the second-most important motor vehicle GHG; but, as the figure shows, they are a distant second.

Figure I. Motor Vehicle Greenhouse Gas Emissions, 2006



Source: U.S. EPA, March 6, 2009, Draft Deliberative Presentation.

Notes: Motor vehicles = passenger cars, light duty trucks, other trucks, buses, and motorcycles, including releases of HFCs from motor vehicle air conditioning. MMT=million metric tons; CO₂ Eq.=carbon dioxide equivalent; CH₄=methane; N₂O=nitrous oxide; HFCs=hydrofluorocarbons.

The EPA/NHTSA joint regulations for light-duty motor vehicles were finalized April 1, 2010, and published in the *Federal Register* the following month.¹⁸ They have required the vehicles (cars, SUVs, minivans, and other light trucks) to meet combined emissions levels that EPA estimates will average 250 grams/mile of CO₂ in model year 2016. The result would be a 21% reduction in fleet-wide emissions by 2030 compared to the level that would occur in the absence of the regulations, according to EPA.¹⁹ NHTSA set corresponding fuel economy standards, achieving a combined estimated fuel economy of 34.1 miles per gallon for cars and light trucks by 2016. In both cases, the standards were gradually phased in; the first reduction targets affected model year 2012.

In setting the GHG standards, EPA used the concept of a vehicle’s “footprint” to set differing standards for different size vehicles. As explained by EPA,

These standards are based on CO₂ emissions-footprint curves, where each vehicle has a different CO₂ emissions compliance target depending on its footprint value (related to the size of the vehicle). Generally, the larger the vehicle footprint, the higher the corresponding vehicle CO₂ emissions target. As a result, the burden of compliance is distributed across all vehicles and all manufacturers. Manufacturers are not compelled to

¹⁸ EPA and NHTSA, “Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards; Final Rule,” 75 *Federal Register* 25324, May 7, 2010.

¹⁹ “EPA and NHTSA Finalize Historic National Program to Reduce Greenhouse Gases and Improve Fuel Economy for Cars and Trucks,” Fact Sheet, April 2010, p. 2, at <http://epa.gov/oms/climate/regulations/420f10014.pdf>.

build light vehicles of any particular size or type, and each manufacturer will have its own standard which reflects the vehicles it chooses it [sic] produce.²⁰

(For a further discussion of vehicle footprints and fuel economy standards, see CRS Report R42721, *Automobile and Truck Fuel Economy (CAFE) and Greenhouse Gas Standards*.)

In general, manufacturers are expected to reduce CO₂ emissions by improving the vehicles' fuel economy, but they can also take advantage of options to generate CO₂-equivalent credits by reducing emissions of hydrofluorocarbons (HFCs) and CO₂ through improvements in their air conditioner systems or by the use of idle reduction technologies, among other strategies. Manufacturers are also allowed to average, bank, and trade emission credits.

On October 15, 2012, EPA promulgated a second phase of GHG emission standards, for MY2017-2025 light duty vehicles. Like the earlier standards, these were preceded by a multi-party agreement, brokered by the White House, that included 13 auto manufacturers, the United Auto Workers, the state of California, and other interested parties. The manufacturers agreed to reduce GHG emissions from new cars and light trucks by about 50% by 2025, compared to 2010, with fuel economy standards rising to nearly 50 miles per gallon. CO₂ emissions will be reduced to about 160 grams/mile by 2025, under the agreement.²¹

The light-duty vehicle rules affect a large group of emission sources that accounts for a significant percentage of total U.S. GHG emissions, but the effectiveness of the standards in reducing total GHG emissions is limited in that they apply only to new motor vehicles. The auto and light truck fleets turn over slowly: the median survival rate for 1990 cars, for example, was 16.9 years, and that for light trucks was 15.5 years.²² Given this durability, the impact of GHG standards on the total emissions of the motor vehicle fleet will take a long time to be felt. If historic experience is any guide, much of the potential reduction in GHG emissions per new vehicle may be offset by growth in vehicle miles traveled. That said, at the time the standards were being considered, the Energy Information Administration projected that a similar CAFE scenario would lead to a 20% decrease in light-duty vehicle CO₂ emissions in 2030 as compared to both the actual 2011 level and the projected 2030 "business-as-usual" level.²³

Medium and Heavy-Duty Trucks

Section 202(a) of the CAA, the section that provided authority for the light-duty vehicle GHG standards, requires the Administrator to set "standards applicable to the emission of any air pollutant from *any class or classes of new motor vehicles or new motor vehicle engines*, which in his judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare" (emphasis added). This authority covers medium- and heavy-

²⁰ Ibid., p. 3.

²¹ Environmental Protection Agency and National Highway Traffic Safety Administration, *2017-2025 Model Year Light-Duty Vehicle GHG Emissions and CAFE Standards: Supplemental Notice of Intent*, Washington, DC, July 29, 2011, at <http://www.epa.gov/otaq/climate/regs-light-duty.htm#new1>. The auto manufacturers' letters of support can be found at <http://www.epa.gov/otaq/climate/letters.htm>. The final emission standards are at EPA and NHTSA, "2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards; Final Rule," 77 *Federal Register* 62624, October 15, 2012.

²² Oak Ridge National Laboratory, for the U.S. Department of Energy, *Transportation Energy Data Book: Edition 27*, 2008, Tables 3.10 and 3.11.

²³ Under the previously promulgated standards for model years 2012-2016, EIA's Reference Case projected that light-duty vehicle CO₂ emissions would drop below current levels until 2025, returning to current levels in 2030 and growing beyond that. U.S. Energy Information Administration, *Annual Energy Outlook 2011 Interactive Table Viewer*, Washington, DC, April 26, 2011, <http://www.eia.gov/oiat/aeo/tablebrowser/>.

duty trucks: in fact, the December 15, 2009, endangerment and cause-or-contribute findings specifically identified the medium- and heavy-duty truck categories as among those that contributed to the GHG emissions for which it found endangerment. As a result, EPA proposed standards for these vehicles on October 25, 2010, and promulgated them on September 15, 2011.²⁴ These standards cover MY2014-MY2018 trucks.

In addition to EPA’s authority to set GHG standards, in the Energy Independence and Security Act of 2007 (EISA, P.L. 110-140), NHTSA was directed to study the potential for fuel efficiency standards for medium- and heavy-duty trucks, and, if feasible, set efficiency standards reflecting the “maximum feasible improvement.”²⁵ Thus, as with light duty vehicles, EPA and NHTSA have cooperated on the setting of standards.

On February 18, 2014, President Obama directed the two agencies to develop a second round of GHG and fuel efficiency standards for medium- and heavy-duty trucks. The standards, which were proposed on July 13, 2015, are expected to be finalized in July 2016.²⁶ In general, the proposed standards would be phased in between model years 2021 and 2027.

Table 1. Motor Vehicle GHG Emissions, 2014, by Source Category
(million metric tons, CO₂-equivalent)

Category	Total GHG Emissions	Percent of Motor Vehicle Total
Passenger Cars	762.6	49.6%
Light Duty Trucks	338.2	22.0%
Medium- and Heavy-Duty Trucks	415.1	27.0%
Buses	19.1	1.2%
Motorcycles	3.9	0.3%
Total	1,538.9	

Source: U.S. EPA, *DRAFT Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2014*, Table 2-13. Prior to 2014, this report showed passenger cars accounting for about 40% of the total and light duty trucks about 35%. In a footnote to the Inventory report published in 2012, EPA explained that, “In 2011, FHWA changed how vehicles are classified, moving from a system based on body-type to one that is based on wheelbase. This change in methodology in FHWA’s VM-1 table resulted in large changes in fuel consumption data by vehicle class, thus leading to a shift in emissions among on-road vehicle classes in the 2007-2010 time period.”

Medium- and heavy-duty trucks are trucks with a gross vehicle weight of 8,500 pounds or more.²⁷ The largest emitters, tractor-trailers (Class 8b trucks), account for roughly 30% of the total number of medium- and heavy-duty trucks, but, because they are heavier and are driven longer

²⁴ U.S. Environmental Protection Agency, U.S. Department of Transportation, “Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles; Final Rules,” 76 *Federal Register* 57106, September 15, 2011.

²⁵ Section 102.

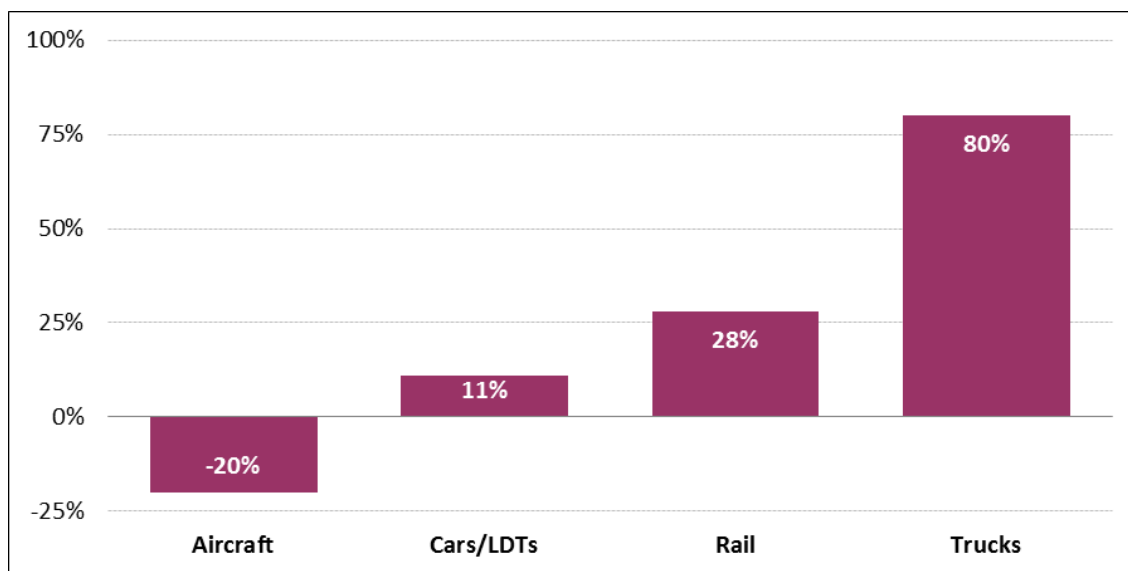
²⁶ White House, Press Office, “FACT SHEET: Opportunity for All: Improving the Fuel Efficiency of American Trucks—Bolstering Energy Security, Cutting Carbon Pollution, Saving Money and Supporting Manufacturing Innovation,” press release, February 18, 2014, at <http://www.whitehouse.gov/the-press-office/2014/02/18/fact-sheet-opportunity-all-improving-fuel-efficiency-american-trucks-bol>.

²⁷ There is one exception to the 8,500 pound limit: medium-duty passenger vehicles (SUVs and vans) that weigh between 8,500 and 10,000 pounds are covered by the light duty truck standards.

distances, they consume 67% of all fuel used by these vehicles.²⁸ Presumably, they emit about the same percentage of medium- and heavy-duty trucks' GHGs. Box trucks, which tend to be lighter and are more frequently used in urban settings, are a distant second in terms of GHG emissions.

As shown in **Table 1**, medium- and heavy-duty trucks emitted more than 400 million metric tons of GHGs in 2014, 27% of GHG emissions from motor vehicles. Between 1990 and 2014, emissions from these trucks grew 80%, the fastest growth for any major category of GHG sources. (See **Figure 2**.)

Figure 2. Growth of GHG Emissions from Mobile Sources, 1990-2014



Source: U.S. EPA, *DRAFT Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2014*, Table 2-13. Graphic created by CRS.

The EPA Administrator is given substantial leeway in the design and implementation of motor vehicle regulations. The act states that the Administrator may establish categories for purposes of regulation based on “gross vehicle weight, horsepower, type of fuel used or other appropriate factors.” In addition, she may delay the effective date of regulations as long as she finds necessary “to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance within such period.” Using this authority in regulating conventional pollutants, EPA has used weight or power classifications to set differing levels of emission standards, particularly for trucks; it has given manufacturers as much as four years lead time to develop emission controls; and it has set different standards based on the type of fuel an engine uses. Except for specific conventional pollutants mentioned in Section 202, the act does not specify a level of stringency (e.g., best available control technology) for prospective regulations.

Although flexible in many respects, motor vehicle standards have often been used to force the development of new technology. In adopting technology-forcing regulations, EPA has generally followed the lead of California. Because of its more severe air pollution and its pioneering role in establishing motor vehicle emission control requirements in the 1960s, California is allowed to

²⁸ National Research Council, *Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles*, The National Academies Press, Washington, April 2010, Table 2-1.

adopt standards more stringent than federal requirements. The state must apply for a waiver of federal preemption under CAA Section 209(b) in order to enforce its more stringent standards, which EPA is to grant if the state meets certain criteria, primarily a showing that the standards are needed to meet “compelling and extraordinary conditions.” If California is granted a waiver, other states with air quality problems may adopt identical requirements, thus reinforcing the potential impact of California’s technology-forcing standards.

EPA discussed several potential strategies for reducing GHG emissions from medium- and heavy-duty trucks in its July 2008 Advance Notice of Proposed Rulemaking,²⁹ including the following:

1. **Improvements in Engine Technology.** Most trucks, particularly tractor-trailers, are powered by diesel engines, which are already quite efficient; but EPA stated that a number of small improvements (such as better lubricants and higher cylinder pressure) could increase diesel engine efficiency by up to 20%. For urban trucks, which engage in stop-and-go driving and may idle frequently in traffic, hybrid engine technologies show promise of substantial reductions in emissions.
2. **Eliminating Aerodynamic Drag.** Aerodynamic drag is an important factor in fuel consumption, particularly for tractor-trailers. EPA estimated that drag accounts for 21% of energy consumed by tractor-trailers at 65 miles per hour. The agency has promoted a number of relatively simple redesigns (high roof fairings, side skirts, side fairing gap reducers, aerodynamic mirrors and bumpers) through its SmartWay voluntary program. These measures can have a significant impact on fuel use.
3. **Reducing Rolling Resistance.** Tire rolling resistance accounted for about 13% of energy consumed by tractor trailers, according to EPA’s Advance Notice. The agency said that 10% or greater reductions in rolling resistance had already been demonstrated and continued innovation has the potential to achieve larger improvements. In addition to better tires with less rolling resistance, tire inflation indicators can improve fuel efficiency.
4. **Addressing Operational Factors.** Operational factors refer to a wide variety of measures that can reduce truck fuel use, including the installation of speed governors (widely used in Europe and by some fleets in the United States). According to EPA, vehicle speed is the single largest operational factor affecting CO₂ emissions from trucks: every one mile per hour increase above 55 mph increases CO₂ emissions by more than 1%. Engine idling is another operational factor affecting fuel consumption and GHG emissions. The addition of auxiliary power units or truck stop electrification can eliminate the need for extended idling, reducing emissions.

All in all, EPA stated in its 2008 analysis of the issues, “... we see a potential for up to a 40% reduction in GHG emissions from a typical heavy-duty truck in the 2015 timeframe, with greater reductions possible looking beyond 2015....”³⁰

As noted earlier, EPA and NHTSA jointly promulgated GHG and fuel economy standards on September 15, 2011. For a variety of reasons, including agency decisions not to address trailer

²⁹ U.S. EPA, “Regulating Greenhouse Gas Emissions Under the Clean Air Act,” Advance Notice of Proposed Rulemaking, July 30, 2008, 73 *Federal Register* 44453-44458.

³⁰ *Ibid.*, p. 44454.

design issues in the first round of standards, the promulgated standards will not achieve anywhere near the 40% reduction that the agency found achievable in 2008.

The standards divided trucks into three main categories: (1) heavy-duty pickup trucks and vans; (2) combination tractors (the power unit of a tractor-trailer combined vehicle); and (3) vocational vehicles.³¹

The standards for heavy-duty pickups and vans use an approach similar to that for light duty vehicles, in which each manufacturer would be required to meet an average standard that would vary depending on its sales mix, with higher capacity vehicles (based on payload, towing capacity, and 4-wheel drive) having less stringent targets. The standards, which are being phased in from 2014 to 2018, are estimated by EPA to cut GHG emissions an average of 17% in diesel vehicles when fully implemented in 2018, and 12% in comparable gasoline-powered vehicles, compared to a model year 2010 baseline.³²

For the other categories of trucks, referred to as vocational vehicles and combination tractors, the standards vary significantly depending on the size of the truck. These standards are expected to reduce GHG emissions up to 23% for combination tractors and 6% to 9% for vocational vehicles by model year 2017, according to the final rule.³³

In addition to engine emission standards, the phase 1 truck rule set a standard for refrigerant leaks, in order to address emissions of HFC greenhouse gases. But trailer design, a major source of efficiency losses (and, thus, higher GHG emissions), was not addressed in the MY2014-MY2018 standards. According to EPA,

Trailers are not covered under this proposal, due to the first-ever nature of this proposal and the agencies' limited experience working in a compliance context with the trailer manufacturing industry. However, because trailers do impact the fuel consumption and CO₂ emissions from combination tractors, and because of the opportunities for reductions, we are soliciting comments on controlling GHG emissions and fuel consumption from trailers, to prepare a foundation for a possible future rulemaking.³⁴

As mentioned earlier, a second phase of standards for medium- and heavy-duty trucks was proposed by EPA and NHTSA on July 13, 2015.³⁵ These standards would affect model year 2021-2027, and trailers beginning in model year 2018. As with earlier motor vehicle standards, EPA and NHTSA have coordinated with the State of California's Air Resources Board with the goal of

³¹ In the preamble to the proposed rule, EPA said, "... vocational vehicles consist of a wide variety of vehicle types. Some of the primary applications for vehicles in this segment include delivery, refuse, utility, dump, and cement trucks; transit, shuttle, and school buses; emergency vehicles, motor homes, tow trucks, among others. These vehicles and their engines contribute approximately 20 percent of today's heavy-duty truck sector GHG emissions." EPA and NHTSA, "Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles," 76 *Federal Register* 57120, September 15, 2011.

³² "EPA and NHTSA Adopt First-Ever Program to Reduce Greenhouse Gas Emissions and Improve Fuel Efficiency of Medium- and Heavy-Duty Engines and Vehicles," August 2011, p. 6, at <http://www.epa.gov/otaq/climate/documents/420f11031.pdf>.

³³ *Ibid.*, pp. 5-6.

³⁴ "EPA and NHTSA Propose First-Ever Program to Reduce Greenhouse Gas Emissions and Improve Fuel Efficiency of Medium- and Heavy-Duty Vehicles: Regulatory Announcement," October 2010, p. 4, at <http://www.epa.gov/otaq/climate/regulations/420f10901.pdf>.

³⁵ U.S. Environmental Protection Agency, U.S. Department of Transportation, "Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles – Phase 2; Proposed Rule," 80 *Federal Register* 40138, July 13, 2015.

allowing manufacturers to continue to build a single fleet of vehicles and engines that meet the GHG and fuel efficiency standards of all three agencies. According to EPA,

In 2027, when the standard is fully phased in, heavy-duty vehicles across all classes would achieve up to the following CO₂ emissions and fuel use reductions.

- 24 percent for combination tractors designed to pull trailers and move freight when compared to Phase 1 standards
- 8 percent for trailers when compared to an average model year 2017 trailer
- 16 percent for vocational vehicles when compared to Phase 1 standards
- 16 percent for pick-up trucks and light vans when compared to Phase 1 standards.³⁶

The agency estimates that the Phase 2 standards will reduce GHG emissions by approximately one billion metric tons and conserve about 1.8 billion barrels of oil over the lifetime of the vehicles sold under the program, saving truck owners about \$170 billion in fuel costs.³⁷

Other Mobile Sources

Since the *Massachusetts v. EPA* decision, the agency has received at least 12 petitions asking it to regulate GHGs from other categories—all but two of the 12 focused on mobile sources and their fuels. These petitions cover aircraft, ocean-going ships and their fuels, motor fuels in general, locomotives, and nonroad vehicles and engines—a category that includes construction equipment, farm equipment, logging equipment, outdoor power equipment, forklifts, marine vessels, recreational vehicles, and lawn and garden equipment.

Table 2. Petitions for Regulation of Greenhouse Gas Emissions Under the Clean Air Act

Date	Subject	CAA Section	Petitioner
10/20/99	New Motor Vehicles	202(a)(1)	International Center for Technology Assessment (ICTA) and 19 other organizations
10/3/07	Ocean Going Vessels	213(a)(4)	California Attorney General
10/3/07	Marine Shipping Vessels and their Fuels	213(a)(4) and 211	Oceana, Friends of the Earth, and the Center for Biological Diversity (CBD)
1/10/08	New Marine Engines and Vessels	213(a)(4)	South Coast Air Quality Management District
12/5/07	Aircraft	231	States of California, Connecticut, New Jersey, New Mexico, Pennsylvania, City of New York, District of Columbia, South Coast Air Quality Management District
12/5/07	Aircraft Engines	231(a)(2)(A) and 231(a)(3)	Friends of the Earth, Oceana, CBD, and the Natural Resources Defense Council

³⁶ U.S. EPA, “EPA and NHTSA Propose Greenhouse Gas and Fuel Efficiency Standards for Medium- and Heavy-Duty Trucks: By the Numbers,” Fact Sheet, June 2015, p. 2, at <http://www3.epa.gov/otaq/climate/documents/420f15903.pdf>.

³⁷ U.S. EPA, “Cutting Carbon Pollution, Improving Fuel Efficiency, Saving Money, and Supporting Innovation for Trucks,” Regulatory Announcement, June 2015, p. 2, at <http://www3.epa.gov/otaq/climate/documents/420f15900.pdf>.

Date	Subject	CAA Section	Petitioner
1/29/08	New Nonroad Vehicles and Engines and Rebuilt Heavy-Duty Engines, excluding Aircraft and Vessels	202(a)(3)(D) and 213(a)(4)	ICTA, Center for Food Safety, and Friends of the Earth
1/29/08	New Nonroad Vehicles and Engines, excluding Aircraft, Locomotives, and Vessels	202 and 213(a)(4)	States of California, Connecticut, Massachusetts, New Jersey, Oregon, and Pennsylvania
7/29/09	Fuels Used in Motor Vehicles, Nonroad Vehicles, and Aircraft	211 and 231	NYU Law School Institute for Policy Integrity
9/21/09	Concentrated Animal Feeding Operations	111(b) and (d)	Humane Society of the United States and 8 other organizations
5/7/10	HFC 134(a) Use in Motor Vehicle Air Conditioners and Other End Uses	612(d)	Natural Resources Defense Council
6/16/10	Coal Mines	111(b) and (d)	Earthjustice, Wild Earth Guardians, CBD, Environmental Integrity Project, and Sierra Club
9/21/10	Locomotives	213(a)(5)	CBD, Friends of the Earth, and ICTA

Source: U.S. EPA and the petitioning organizations.

The specifics of the CAA sections that give EPA authority to regulate pollution from these sources vary somewhat, but it is generally believed that the endangerment finding and decision to regulate GHGs in response to the first of the petitions will make it difficult for the agency to avoid regulating at least some of the other categories. With that in mind, we look at other mobile source categories, the authorities provided under Title II for each, and what EPA's use of these authorities for conventional pollutants emitted by these sources indicates with regard to its ability to regulate greenhouse gases. (A separate report, CRS Report R41212, *EPA Regulation of Greenhouse Gases: Congressional Responses and Options*, discusses the potential CAA regulatory tools for stationary sources.)

Ships

Three of the 13 petitions to EPA asking the agency to control greenhouse gas emissions concern ocean-going ships (also referred to as marine engines and vessels) and (in two of the petitions) their fuel. Although there is a wide range of estimates, the International Maritime Organization's consensus is that international shipping emitted 843 million metric tons of carbon dioxide, 2.7% of global CO₂ emissions, in 2007. Including domestic shipping and fishing vessels larger than 100 gross tonnes, the amount would increase to 1.019 billion metric tons, 3.3% of global emissions.³⁸

³⁸ International Maritime Organization, *Updated Study on Greenhouse Gas Emissions from Ships*, Executive Summary of Phase 1 Report, 1st September 2008, p. 5 at egserver.unfccc.int/seors/attachment/file_storage/6ep77qqvcujba7k.doc. Both estimates exclude emissions from naval vessels.

At these levels, only five countries (the United States, China, Russia, India, and Japan) individually account for a higher percentage of the world total of CO₂ emissions.³⁹

In addition to the CO₂ emissions, the low-quality bunker fuel that ships use and the absence of pollution controls result in significant emissions of black carbon and nitrogen oxides, which also contribute to climate change. Refrigerants used on ships (hydrofluorocarbons and perfluorocarbons—HFCs and PFCs) are also potent greenhouse gases when released to the atmosphere. Thus, the total impact of ships on climate is likely greater than the 3.3% estimate above.

The authority to control pollution from ships is found in Section 213(a)(4) of the CAA, which provides general authority to the Administrator to promulgate standards for emissions other than carbon monoxide, oxides of nitrogen, and volatile organic compounds from “nonroad engines and vehicles.”⁴⁰ Fuels are regulated separately under Section 211 of the act.

The language of Section 213 is similar to that for new motor vehicles in Section 202, except that in place of the words “cause, or contribute,” Section 213 uses the phrase “significantly contribute”: if the Administrator determines that emissions of GHGs from ships significantly contribute to air pollution which may reasonably be anticipated to endanger public health or welfare, she may promulgate such regulations as she deems “appropriate.” Except for the specific conventional pollutants mentioned in Section 213(a)(2), there is no level of stringency (such as best available control technology) specified for prospective regulations. The Administrator may establish classes or categories of ships for the purposes of regulation. There is no deadline for the promulgation of standards, and in setting them, the Administrator may take into account costs, noise, safety, and energy factors associated with the application of technology.

A wide variety of measures might be undertaken to reduce emissions from shipping, from simple operational measures, such as reducing speed or using cleaner fuels, to various hull and propeller design features that would increase fuel economy. Reducing speed can save substantial amounts of fuel. A.P. Moller-Maersk, which operates the world’s largest fleet of containerships, has reported that “reducing speed 5-10% does increase the number of days at sea, but reduces fuel consumption and CO₂ emissions by more than 15%.”⁴¹ Over the period 2007-2015, Maersk reduced its CO₂ emissions per container shipped by 42%. The company has set a target of 60% reduction per container as compared to 2007 emissions by 2020. In addition to reducing speed, the company has reduced emissions through “operational optimization,” newer (more efficient) vessels, and reductions of energy use in ports.⁴²

The petitions to EPA mention improved fleet deployment planning, use of shore-side power while in port, heat recovery systems, the use of sails as supplemental propulsion sources, and NO_x controls, such as selective catalytic reduction (SCR) or exhaust gas recirculation, as potential emission control measures.

³⁹ Oceana, *Shipping Impacts on Climate: A Source with Solutions*, p. 2, at http://www.oceana.org/fileadmin/oceana/uploads/Climate_Change/Oceana_Shipping_Report.pdf.

⁴⁰ CO, NO_x, and VOCs are regulated under §213(a)(3), which requires the imposition of best available control technology, and set a deadline for such regulation.

⁴¹ See *Preparing for the Future*, The A.P. Moller—Maersk Group’s Health, Safety, Security and Environment Report 2008, pp. 28-30, at http://media.maersk.com/da/PressReleases/2009/Documents/Maersk%20HSSE%202008_Final.pdf.

⁴² A.P. Moller—Maersk A/S, Sustainability Progress Report 2015, p. 11, at http://www.maersk.com/~media/the%20maersk%20group/sustainability/files/publications/2016/files/maersk_group_sustainability_report_2015_a3_final.pdf.

A complicating factor in the regulation of emissions from ocean-going vessels would be that, for the most part, their GHG emissions occur in international waters, and the sources (the ships) are not registered in the United States: according to California's petition, 95% of the fleet calling on U.S. ports is foreign-flagged. The petitioners assert that these factors are not a bar to EPA regulation, however, citing as precedent a Supreme Court case that held that the Americans with Disabilities Act could be applied to foreign-flagged cruise ships so long as the ADA-required accommodations did not interfere with the ships' internal affairs or require major, permanent modifications to the ships.⁴³

The shipping industry has generally opposed international regulation of ships' GHG emissions, but following the United Nations' climate agreement reached in Paris in December 2015, the International Chamber of Shipping has now urged the International Maritime Organization (IMO) to adopt a sector-wide pledge to reduce international shipping emissions.⁴⁴ The IMO's Environment Protection Committee may consider the issue at an April 2016 meeting.

In addition to petitioning for regulation of emissions from ships, the petitions submitted by California and Oceana et al. stated that EPA should regulate the composition of marine shipping vessel fuel to control global-climate-change-related emissions, or should require use of marine diesel fuel oil instead of bunker fuel. The purpose would be to limit the sulfur content of marine fuels and reduce NO_x emissions. We discuss EPA's authority to regulate fuels in a separate section below, but note here that EPA, the state of California, and the International Maritime Organization are all moving forward with regulations to limit the sulfur content of bunker fuel for the purpose of reducing conventional pollutants. California's low sulfur fuel requirements went into effect July 1, 2009. In addition, on March 26, 2010, the International Maritime Organization (IMO) approved an EPA proposal that the entire U.S. coastline except portions of Alaska be designated as an Emission Control Area, subject to lower sulfur limits in bunker fuel. On July 15, 2011, the IMO officially added the waters around Puerto Rico and the U.S. Virgin Islands as Emission Control Areas.⁴⁵

Sulfur emissions form fine particles of sulfate in the atmosphere, with significant impacts on public health and welfare. (For a further discussion of these impacts, see CRS Report RL34548, *Air Pollution and Greenhouse Gas Emissions from Ships*.) Although harmful as a conventional pollutant, sulfur emissions are thought by most experts to be beneficial or at least neutral in the climate context. Sulfates have a cooling effect on the atmosphere, since the particles tend to reflect solar radiation back into space rather than absorbing it. On the other hand, removing sulfur might be necessary to prevent the fouling of pollution control equipment that reduces other pollutants that do lead to warming.

⁴³ *Spector v. Norwegian Cruiseline*, 545 U.S. 119 (2005). In addition, according to the California petition, the United States can and does enforce pollution standards on ships in its territorial waters, "as can be seen by the fact that the National Park Service has imposed air pollutant emissions controls on cruise ships, including foreign-flagged cruise ships (the vast majority of such ships are foreign-flagged), that sail off the coast from Glacier Bay National Park, in Alaska." See *People of the State of California Acting by and Through Attorney General Edmund G. Brown, Jr.*, "Petition for Rule Making Seeking the Regulation of Greenhouse Gas Emissions from Ocean-Going Vessels," October 3, 2007, p. 13. The cited regulations are at 36 CFR 13.65(b)(4). The *Federal Register* citation is 61 *Federal Register* 27008, 27011 (May 30, 1996).

⁴⁴ See "Ship Owners Now Calling for CO₂ Pledge, Citing Paris Agreement," *ClimateWire*, March 1, 2016.

⁴⁵ For information on the Emission Control Areas, see the EPA "Ocean Vessels and Large Ships" web page, at <http://www.epa.gov/oms/oceanvessels.htm#emissioncontrol>.

Other Nonroad Engines

Section 213 can also be used to regulate other nonroad vehicles and engines. An endangerment finding similar to that promulgated for motor vehicles would first be required, following which the Administrator may promulgate such regulations as she deems appropriate to control emissions from the classes or categories of nonroad engines that she determines “significantly contribute” to the air pollution that endangers public health or welfare. The Administrator is to take into account costs, noise, safety, and energy factors in setting standards. There is no deadline for setting standards.

The nonroad sector is a broad category that includes construction equipment, farm equipment, forklifts, outdoor power equipment, lawn and garden equipment, and recreational vehicles. This group accounted for 199.7 million metric tons of CO₂ emissions in 2007, according to the two petitions requesting regulation (see **Table 3**), 3.3% of total U.S. emissions of CO₂ in that year. According to the ICTA petition, GHG emissions from the nonroad sector increased 49% between 1990 and 2005, a higher rate of emissions increase over the same period than for on-road vehicles (32%), aircraft (3%), boats and ships (36%), and rail (32%).⁴⁶

Table 3. Nonroad Sector CO₂ Emissions, 2007, by Source Category
(million metric tons)

Category	CO ₂ Emissions	Percent of Nonroad Total
Construction and Mining Equipment	63.9	32.0%
Agricultural Equipment	39.6	19.8%
Industrial Equipment	27.8	13.9%
Lawn and Garden Equipment	23.8	11.9%
Commercial Equipment	16.4	8.2%
Pleasure Craft	15.8	7.9%
Recreational Equipment	9.4	4.7%
Logging Equipment	1.9	1.0%
Airport Equipment	1.0	0.5%
Railroad Equipment	0.2	0.1%
Total	199.7	

Source: ICTA et al., *Petition for Rulemaking Seeking the Regulation of Greenhouse Gas Emissions from Nonroad Vehicles and Engines*. According to the petition, the emissions data were compiled by the Western Environmental Law Center using EPA’s nonroad emissions model.

Given their smaller impact on overall emission levels, EPA has been slower to regulate conventional (criteria) pollutants from nonroad engines than from motor vehicles. Many of these engines had few emission control requirements for as many as 25 years after the regulation of automobiles. In the last decade, however, often following the lead of California, EPA has promulgated standards for many nonroad categories. Some of these standards, particularly for

⁴⁶ International Center for Technology Assessment et al., “Petition for Rulemaking Seeking the Regulation of Greenhouse Gas Emissions from Nonroad Vehicles and Engines,” January 29, 2008, p. 5.

diesel-powered equipment and for lawn and garden equipment, have been technology-forcing. Others, such as for snowmobiles, have been less so.

In general, given the wide variety of engine types and sizes and the configurations of the equipment itself, the agency has based its standards on a review of individual subcategories and the technologies available to reduce emissions from specific types of machinery or equipment, rather than applying one across the board standard. Presumably, any GHG standards for this sector would take the same approach.

Locomotives

On September 21, 2010, EPA received a petition from three environmental organizations to regulate GHG emissions and black carbon from locomotives. In 2014, locomotives emitted 50 million metric tons of greenhouse gases. Although this is less than 1% of total U.S. GHG emissions, GHG emissions from railroads increased by 28% between 1990 and 2014, three-and-a-half times the rate of increase for total U.S. emissions. In addition, locomotives emit substantial amounts of black carbon (i.e., soot), which is thought to have significant global warming potential through its ability to absorb solar radiation and to reduce the reflectivity of snow and ice. According to a report from NASA's Goddard Institute for Space Studies cited in the locomotive petition, "... black soot may be responsible for 25 percent of observed global warming over the past century."⁴⁷ As a result, in addition to requesting that EPA set GHG emission standards for locomotives, the petition asks EPA to set standards for locomotives' black carbon emissions.

The CAA requires EPA to set emission standards for new locomotives (and new engines used in locomotives) in Section 213(a)(5). Unlike almost every other CAA section dealing with mobile sources, the locomotive subsection does not require an endangerment finding for the Administrator to act. Instead, it requires the Administrator to set standards that achieve the greatest degree of emission reduction achievable through the application of technology which she determines will be available, giving appropriate consideration to cost, noise, energy, and safety factors.

As it did with the medium- and heavy-duty truck category, EPA discussed several potential strategies for reducing GHG emissions from locomotives in its July 2008 Advance Notice of Proposed Rulemaking (ANPR).⁴⁸ The ANPR identified more than 20 strategies for reducing emissions from rail transport, including idle reduction equipment, auxiliary power units, hybrid engines, regenerative braking, and reduction of refrigerant leaks from railcars.

Aircraft

EPA has also received petitions to regulate GHG emissions from aircraft and aircraft engines. In the United States, aircraft of all kinds were estimated to emit between 2.2% and 3.2% of the nation's total greenhouse gas emissions in 2014.⁴⁹ When other factors are considered, the impact

⁴⁷ U.S. National Aeronautics and Space Administration, Goddard Institute for Space Studies, "Black Soot and Snow: A Warmer Combination," December 22, 2003, at http://www.gcio.org/OnLnDoc/pdf/black_soot.pdf.

⁴⁸ U.S. EPA, "Regulating Greenhouse Gas Emissions Under the Clean Air Act," Advance Notice of Proposed Rulemaking, July 30, 2008, 73 *Federal Register* 44463-44464.

⁴⁹ U.S. EPA, *DRAFT Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014*, February 22, 2016, Tables 3-12 and 2-1, at <http://www3.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2016-Main-Text.pdf>. Percentages calculated by CRS. The lower percentage includes CO₂ emissions from consumption of fuel by military aircraft, general aviation, and domestic operation of commercial aircraft. The higher estimate includes CO₂ emissions from international air travel originating in the United States, as well.

of U.S. aviation on climate change is perhaps twice that size. These factors include the contribution of aircraft emissions to ozone formation, the water vapor and soot that aircraft emit, and the high altitude location of the bulk of aircraft emissions. (For additional information on aircraft GHG emissions, see CRS Report R40090, *Aviation and Climate Change*.)

Two December 2007 petitions requested that EPA address aircraft GHG emissions. Specifically, the petitions asked that EPA make a finding that aircraft GHG emissions endanger public health or welfare, and that the agency adopt regulations that allow a range of compliance approaches: these might include emission limits, operational practices, fees, a cap-and-trade system, minimizing engine idling time, employing single engine taxiing, or use of ground-side electricity measures to replace the use of fuel-burning auxiliary power units at airport gates.⁵⁰

EPA has authority to regulate emissions from aircraft under Section 231 of the CAA. The language is similar to that for other mobile sources. It requires the Administrator to issue standards for the emission of any air pollutant from any class or classes of aircraft engines which, in her judgment, causes or contributes to air pollution which may reasonably be anticipated to endanger public health or welfare. The regulations are to take effect “after such period as the Administrator finds necessary ... to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance.”

Compared to other mobile sources, EPA’s CAA authority vis-à-vis aircraft and aircraft engines contains an important difference, however: the Administrator must consult with the Administrator of the Federal Aviation Administration and the Secretary of Transportation in developing emission standards, and is not allowed to impose new standards if doing so would significantly increase noise and adversely affect safety. The President may also disapprove any such standards if the Secretary of Transportation finds that they would create a hazard to aircraft safety.

Unlike ships, aircraft operating in the United States are generally registered here: EPA has cited data that foreign carriers accounted for only 3% of major carrier operations in the United States in 1999.⁵¹ Thus, whether GHG regulations could be applied to foreign flag carriers might seem to pose less of an issue, at least in terms of whether any potential regulations would address the bulk of the sector’s U.S. emissions. On the other hand, international air travel is extremely competitive, and issues of whether regulations can be imposed on foreign carriers have already been raised in the context of the European Union’s adoption of cap-and-trade requirements for international aviation as part of the EU Emissions Trading Scheme (EU-ETS), although these requirements have been delayed.⁵² U.S. airlines generally maintain that the imposition of requirements on foreign-flag airlines (i.e., themselves, in the European Union) violates international trade agreements. Their preference is that any controls be negotiated through the International Civil Aviation Organization (ICAO) and be applied equally to all carriers. ICAO is a specialized body of the United Nations with 191 member states.

EPA has rarely regulated emissions from aircraft without first negotiating international agreements through ICAO. ICAO’s regulation of conventional pollutants from aircraft, unlike

⁵⁰ For a brief discussion of the petitions, see 73 *Federal Register* 44460, July 30, 2008. Some of these measures, such as minimizing engine idling time, employing single engine taxiing, and use of ground-side electricity measures to replace the use of fuel-burning auxiliary power units, are already widely used by the airlines as fuel-saving measures.

⁵¹ U.S. EPA, Office of Air and Radiation, *Emission Standards and Test Procedures for Aircraft and Aircraft Engines, Summary and Analysis of Comments*, November 2005, p. 10, at <http://www.epa.gov/oms/regs/nonroad/aviation/420r05004.pdf>.

⁵² For more information, see CRS Report R42828, *Update on Controlling Greenhouse Gases from International Aviation*, by (name redacted).

EPA's regulation of the same pollutants from motor vehicles, has consistently avoided forcing technology. The most recent standards for nitrogen oxides, for example, essentially ratified what the principal aircraft manufacturers had already achieved.⁵³

Besides petitioning EPA for action on aviation emissions, environmental groups have brought suit in the District Court for the District of Columbia seeking to force EPA to respond to their petitions on aircraft, marine vessels, and nonroad engines and vehicles.⁵⁴ On July 5, 2011, the court found that EPA has a mandatory duty to determine whether aircraft emissions endanger public health or welfare, and may be sued for unreasonable delay in doing so. In March 2012, however, the court ruled that plaintiffs had not shown that EPA had unreasonably delayed such a decision.⁵⁵

Recently, however, both EPA and ICAO have taken steps toward regulating commercial aircraft GHG emissions. On June 10, 2015, EPA proposed to find that greenhouse gas emissions (including CO₂ emissions) from commercial aircraft contribute to the pollution that causes climate change and endanger the health and welfare of Americans.⁵⁶ Such a finding, if finalized under Section 231 of the Clean Air Act, would be the precondition for GHG emission standards for commercial aircraft.

At the time that it released the proposed endangerment finding, the agency also released information about a process underway by ICAO to develop international CO₂ standards for aircraft. For the past five years, ICAO has been working with the aviation industry and other stakeholders to develop international CO₂ emission standards for aircraft. EPA and the Federal Aviation Administration, representing the United States, are participating in the ICAO process.

An ICAO committee agreed on coordinated CO₂ emission standards for aircraft on February 8, 2016; the organization's governing council is expected to consider the agreement later this year. EPA's proposed endangerment finding, which the agency expects to finalize by June 2016, would lay the necessary foundation for the adoption and implementation of a domestic aircraft CO₂ standard, in accordance with the Clean Air Act and the ICAO process.

Fuels

Fuel regulation, whether of bunker fuel, gasoline, or any other type of fuel used in motor vehicles, their engines, or non-road vehicles and engines, is authorized under Section 211 of the CAA. Section 211 gives the Administrator authority to control or prohibit the manufacture and sale of any fuel or fuel additive if she concludes that its emission products may endanger public health or welfare, or if they will impair to a significant degree the performance of emission control devices. As with the regulation of engines and vehicles themselves, the Administrator is given substantial leeway in the design and implementation of fuel regulations and there is no deadline for their promulgation even after an endangerment finding is made.

GHG emissions from fuels have already been targeted for regulation by the state of California.⁵⁷ On April 15, 2010, California's Office of Administrative Law approved regulations to implement

⁵³ "EPA Proposal to Bring Certain Aircraft Up to International Engine Standard," *Daily Environment Report*, September 30, 2003.

⁵⁴ *Center for Biological Diversity v. U.S. EPA*, 794 F.Supp. 2d 151 (D.D.C. 2011).

⁵⁵ *Center for Biological Diversity v. U.S. EPA*, 2012 Westlaw 967662 (D.D.C. March 20, 2012).

⁵⁶ For information, see U.S. EPA, "EPA Takes First Steps to Address Greenhouse Gas Emissions from Aircraft," at <http://epa.gov/otaq/aviation.htm>.

⁵⁷ For more information, see <http://www.arb.ca.gov/regact/2009/lcfs09/lcfs09.htm>. For additional background, see CRS (continued...)

the California Low Carbon Fuel Standard (LCFS), which had been under development since 2007.⁵⁸ The standard's goal is to reduce GHG emissions from transportation fuels per unit of energy 10% by 2020. The regulations address emissions from the production, transportation, and consumption of gasoline, diesel fuel, and their alternatives, including biofuels. They envision compliance both through the use of lower carbon fuels and through the development of more efficient, advanced-technology vehicles, such as plug-in hybrids, electric vehicles, and hydrogen fuel cells.

As has been the case with motor vehicles, California has often led the way in the development of cleaner conventional fuels through technology-forcing regulation, with U.S. EPA later adopting similar standards. Thus, many have viewed the Low Carbon Fuel Standard as the prototype of another possible use of existing CAA authority to regulate greenhouse gas emissions nationally. On July 29, 2009, the Institute for Policy Integrity at NYU Law School petitioned EPA to establish a cap-and-trade system to limit greenhouse gas emissions from fuels used in motor vehicles, nonroad vehicles, and aircraft.

Regulation of fuels would be a way for California or U.S. EPA to obtain reductions from existing vehicles and engines. As noted earlier, the slow turnover of the vehicle fleet means that emission reductions from new vehicles will only gradually affect emission levels from the fleet as a whole. By requiring low carbon fuels, California and EPA could obtain GHG reductions from the entire fleet more quickly.

On the other hand, measuring the carbon content of fuels is more complicated than it may seem, particularly if one considers the life-cycle emissions, including indirect impacts of production. EPA has been embroiled in a controversy over this issue already, as it attempted to develop a methodology for measuring greenhouse gas emissions from biofuels, as required by the Energy Independence and Security Act of 2007 (P.L. 110-140).⁵⁹ For regulations implementing that provision, EPA developed and later modified a methodology to measure the GHG effects of indirect land-use changes, such as the switching of land from forest to cropland.⁶⁰

Conclusion

Table 4 summarizes EPA's existing authorities over mobile source GHG emissions and the emissions of the sources discussed in this report. Given the Supreme Court's remand in *Massachusetts v. EPA*, the agency initially focused its efforts on motor vehicles, which account for the majority of mobile source GHG emissions.

By issuing endangerment findings similar to the one it issued for motor vehicles, EPA could move forward to control GHG emissions from other categories of mobile sources and/or their fuels. On

(...continued)

Report R40078, *A Low Carbon Fuel Standard: State and Federal Legislation and Regulations*.

⁵⁸ The LCFS was re-adopted by the California Air Resources Board (CARB) in substantially the same form on September 25, 2015. The re-adoption was a response to a state appeals court decision that the process of adopting the 2010 regulations had violated certain state procedural requirements. The court allowed the 2010 regulations to remain in place pending CARB's re-adoption of the standards. (POET LLC v. CARB, Cal. Ct. App. No. F064045, July 15, 2013) See "California Acts on Low-Carbon Fuel Standard," *Daily Environment Report*, September 28, 2015.

⁵⁹ Section 202 of the act mandates the use of "advanced biofuels"—fuels produced from non-corn feedstocks and with 50% lower lifecycle greenhouse gas emissions than petroleum fuel—starting in 2009. Of the 36 billion gallons of renewable fuel required in 2022, at least 21 billion gallons must be advanced biofuel.

⁶⁰ For information, see CRS Report R40460, *Calculation of Lifecycle Greenhouse Gas Emissions for the Renewable Fuel Standard (RFS)*.

the other hand, as **Table 4** shows, by focusing on the setting of emission standards for passenger cars, light duty trucks, and medium- and heavy-duty trucks, EPA has addressed the categories responsible for more than three-fourths of all mobile source GHG emissions.

The next largest category, aircraft, is likely to be the next mobile source category subject to regulation. EPA, ICAO, and the European Union are all taking steps toward such regulation, with agreement on specifics likely later this year.

After motor vehicles and aircraft, other mobile source categories are less significant: most of them account for less than 1% of total U.S. emissions in 2014. Thus, besides working on aircraft standards and strengthening its car and truck standards, EPA has expanded its focus to stationary sources rather than additional mobile sources. Stationary sources account for about 70% of the nation’s GHG emissions; within that group electric power plants account for about one-third of all U.S. GHG emissions, a higher percentage of the nation’s total than all mobile sources combined. New and modified power plants (as well as other major stationary sources) have been subject to permit requirements and the imposition of Best Available Control Technology for newly constructed facilities since January 2, 2011, under EPA’s interpretation of Section 165 of the CAA. On October 23, 2015, the agency promulgated New Source Performance Standards for GHG emissions from new electric power plants and “Clean Power Plan” regulations addressing emissions from existing power plants. The Clean Power Plan has been stayed by the Supreme Court pending court action on litigation that involves more than 40 states and about 100 other parties. The D.C. Circuit Court of Appeals has placed the litigation on an expedited schedule, with oral argument scheduled for June 2, 2016. (For additional discussion, see CRS Report R44341, *EPA’s Clean Power Plan for Existing Power Plants: Frequently Asked Questions*.)

Table 4. Categories of Sources Whose GHG Emissions Can Be Regulated Under Title II of the Clean Air Act

(assuming an endangerment finding for the category)

Category	CAA Authority (Section #)	2014 GHG Emissions (million tons CO₂-equivalent)	Percent of Total U.S. GHG Emissions in 2014
Passenger Cars	202	762.6	11.1%
Medium- and Heavy-Duty Trucks	202	415.1	6.0%
Light Duty Trucks	202	338.2	4.9%
Aircraft (domestic operation)	231	151.5	2.2%
Construction and Mining Equipment	213	80.4	1.2%
Agricultural Equipment	213	51.2	0.7%
Locomotives	213	50.0	0.7%
Ships and Other Boats ^a	213	28.3	0.4%
Buses	202	19.1	0.3%
Motorcycles	202	3.9	<0.1%

Category	CAA Authority (Section #)	2014 GHG Emissions (million tons CO₂-equivalent)	Percent of Total U.S. GHG Emissions in 2014
Other ^a	213	81.7	1.2%
Total^b		1982.0	28.8%

Source: U.S. EPA, *DRAFT Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2014*, Tables 2-13 and A-113.

- a. "Other" includes industrial equipment, lawn and garden equipment, commercial equipment, snowmobiles and other recreational equipment, logging equipment, airport equipment, and railroad equipment.
- b. Does not include international bunker fuel.

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