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Summary

This report discusses EPA's authority to regulate greenhouse gas (GHG) emissions as it pertains to mobile sources, including cars, trucks, aircraft, ships, locomotives, nonroad vehicles and engines, and their fuels. The Supreme Court held in 2007 that the Clean Air Act (CAA) authorizes the agency to address GHG emissions. The key to using this CAA authority was for the EPA Administrator to find that GHG emissions endanger public health or welfare, a step taken in December 2009.

Under the Trump Administration, it is unclear whether this authority will be put to further use. Other questions concern what steps EPA and Congress may take with regard to already promulgated—but not yet implemented—standards for GHG emissions from cars and trucks. In principle, the auto manufacturing and trucking industries have been supportive of EPA's GHG regulations, in part because of concerns that states would implement a patchwork of standards in the absence of federal action. As the standards have been implemented, however, industry concerns have arisen regarding a lack of harmonization between EPA's GHG standards, fuel efficiency (CAFE) standards administered by the National Highway Traffic Safety Administration (NHTSA), and related California GHG and fuel efficiency programs.

One issue concerns the Model Year (MY) 2017-2025 light-duty vehicle regulations. Under these standards, GHG emissions from new light-duty vehicles (i.e., cars, SUVs, crossovers, minivans, and most pickup trucks) will be reduced about 50% compared to 2010 levels, and average fuel economy will rise to nearly 50 miles per gallon by 2025. When EPA and NHTSA promulgated the standards in 2012, EPA committed to a Midterm Evaluation (MTE) of the 2022-2025 portion of the GHG standards. This evaluation was completed on January 12, 2017, with EPA deciding to maintain the standards as promulgated. Given industry concerns about the standards, there is speculation as to whether the Administration will reconsider the MTE decision.

A second issue concerns GHG emission and fuel economy standards for medium- and heavy-duty trucks. EPA and NHTSA promulgated a second phase of these standards on October 25, 2016, covering trucks and engines beginning with the 2021 model year and truck trailers beginning in 2018. These standards could be reconsidered by the two agencies, or Congress could review them under the Congressional Review Act. GHG emissions are directly related to fuel combustion. In order to reduce GHG emissions, EPA expects the standards to increase fuel efficiency, lowering oil consumption by up to 2 billion barrels over the lifetime of 2018-2029 trucks and saving vehicle owners about $170 billion in fuel costs as a result. In general, the truck standards – with the exception of the portion dealing with trailers—have been well-received, leaving in question whether general opposition to GHG rules will shape Congress's and the new Administration's reaction to the rules more than the views of the affected industries.

A third potential issue concerns GHG emission standards for aircraft. In October 2016, the International Civil Aviation Organization (ICAO) agreed on international carbon dioxide (CO_2) emission standards for aircraft, beginning in 2020, and on a system for offsetting future CO_2 emissions from aviation. The emission standards would be implemented in the United States by EPA regulations issued under the CAA. U.S. airlines and aircraft manufacturers participated in the ICAO negotiations and have been supportive of the resulting agreements; whether EPA actions to implement them would run contrary to the President's and the Administration's broader views on regulation and climate change is unclear.

In addition to a discussion of these three issues, this report provides background on GHG emissions from other mobile sources, including ships, nonroad vehicles and engines, locomotives, and fuels.

Contents

Introduction 1
Massachusetts v. EPA and Its Effects 3
Motor Vehicle GHG Emissions 4
Light-Duty Motor Vehicles 5
MY2012-MY2016 Standards 6
MY2017-MY2025 Standards and Mid-Term Evaluation 6
Medium and Heavy-Duty Trucks 8
MY2014-MY2018 Truck Standards 10
MY2021-MY2027 Truck and MY2018-MY2027 Trailer Standards 11
Aircraft 13
Other Mobile Sources 15
Ships 16
Other Nonroad Engines 18
Locomotives 19
Fuels 20
Conclusion 21

Figures

Figure 1. Mobile Source Greenhouse Gas Emissions, 2014 2
Figure 2. Motor Vehicle Greenhouse Gas Emissions, 2006 5
Figure 3. Growth of GHG Emissions from Mobile Sources, 1990-2014 10

Tables

Table 1. Motor Vehicle GHG Emissions, 2014, by Source Category 9
Table 2. Petitions for Regulation of Greenhouse Gas Emissions Under the Clean Air Act 15
Table 3. Nonroad Sector CO_2 Emissions, 2007, by Source Category 19
Table 4. Categories of Sources Whose GHG Emissions Can Be Regulated Under Title II of the Clean Air Act 22

Contacts

Author Information 23

Introduction

This report discusses the Environmental Protection Agency's (EPA's) authority to regulate greenhouse gas (GHG)[1] emissions from mobile sources of pollution. Mobile sources include cars, trucks, aircraft, ships, locomotives, nonroad vehicles (e.g., tractors, bulldozers), portable equipment (including lawnmowers, chain saws, leaf blowers, and backup generators), and the fuels that provide power to each of these.

Mobile sources account for close to 30% of the total U.S. emissions of GHGs. As shown in **Figure 1**, more than three-quarters of the mobile source total comes from cars and trucks.

Over the last eight years, the Obama Administration has worked with major stakeholders in the auto and truck industries and with states and other interested parties to develop and implement GHG standards. Because carbon dioxide (CO_2) from fuel combustion is the major GHG produced by cars and trucks, the White House directed EPA to work with the National Highway Traffic Safety Administration (NHTSA) to harmonize the GHG standards with fuel economy standards under development by NHTSA. In addition, under the Clean Air Act, the state of California enjoys unique status to issue motor vehicle emission standards provided that they are at least as stringent as federal standards and are necessary to meet "compelling and extraordinary conditions." California had already promulgated GHG emission standards prior to 2009, for which it had requested an EPA waiver. EPA granted California a waiver in June 2009, and President Obama directed EPA and NHTSA to harmonize the federal GHG and fuel efficiency standards with those developed by California.

The mobile source GHG standards moved forward even as Congress and the Obama Administration reached an impasse over climate issues. EPA supported economy-wide GHG legislation that passed the House in 2009,[2] but the legislation died in the Senate. Lacking what new authority might have been provided by congressional action, EPA moved ahead with sectoral GHG emission standards using the authority of the existing Clean Air Act (CAA). In *Massachusetts v. EPA*,[3] the Supreme Court had held in 2007 that the existing CAA authorized the agency to address GHG emissions.

The key to using this authority was for the EPA Administrator to find that GHG emissions are air pollutants that endanger public health or welfare, and that motor vehicles cause or contribute to that pollution. EPA Administrator Lisa Jackson issued these "endangerment and cause-or-contribute findings" in December 2009.[4]

Following the issuance of the findings, EPA promulgated four sets of standards for motor vehicles:

1. standards for Model Year (MY) 2012-2016 light-duty motor vehicles (cars, SUVs, crossovers, minivans, and most pickups), May 7, 2010;
2. standards for MY2017-MY2025 light-duty vehicles, October 15, 2012;

[1] The six pollutants or groups of pollutants commonly identified as GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs).

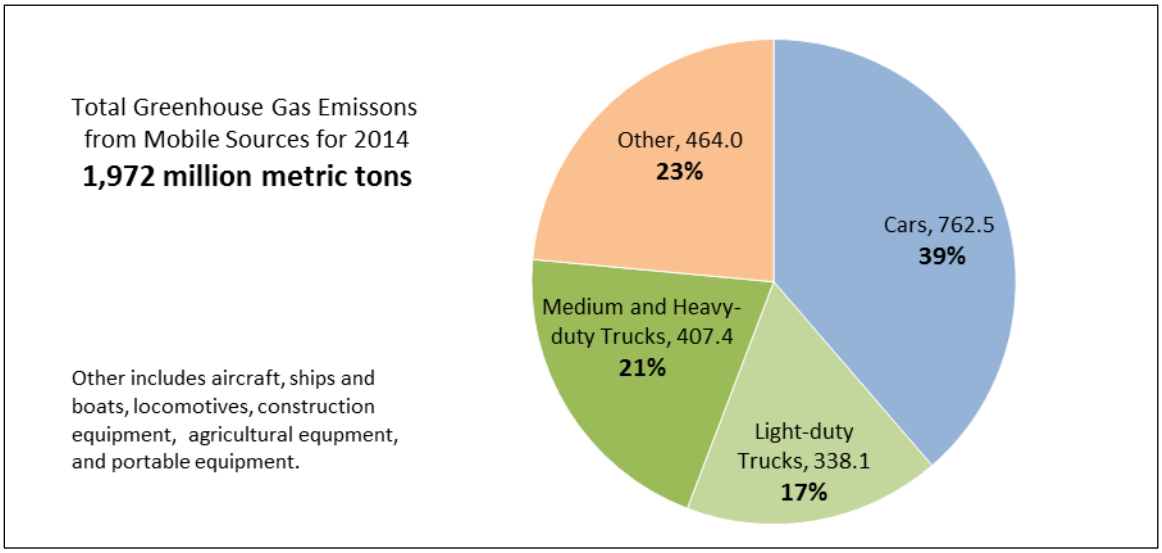
[2] H.R. 2454, the American Clean Energy and Security Act.

[3] 549 U.S. 497 (2007).

[4] See U.S. Environmental Protection Agency, "Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act; Final Rule," 74 *Federal Register* 66496, December 15, 2009. EPA's "endangerment finding" was upheld by the Supreme Court in *Util. Air Regulatory Group v. EPA*, 134 S. Ct. 2427 (2014).

3. standards for MY 2014-2018 medium- and heavy-duty trucks and engines, September 15, 2011; and
4. standards for MY2021-MY2027 medium- and heavy-duty trucks and engines and MY2018-MY2027 trailers, October 25, 2016.

Figure 1. Mobile Source Greenhouse Gas Emissions, 2014



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

Under the Trump Administration, it is unclear whether this authority will be put to further use, and whether some of the standards already promulgated but not yet implemented might be rolled back or modified. Much may depend on the views of the affected industries: auto, truck, and truck engine manufacturers; and their customers, especially those in the trucking industry. In general, the auto manufacturing and trucking industries have been supportive of EPA's GHG regulations, partly because of concerns that states would implement a patchwork of standards in the absence of federal action. As the standards have been implemented, however, industry concerns have arisen regarding a lack of harmonization between EPA, NHTSA, and related California GHG and fuel efficiency programs.

The 2017-2025 light-duty vehicle regulations provided for a Midterm Evaluation of the 2022-2025 standards for these vehicles, which offered an opportunity to modify the standards. As discussed at greater length below, on January 12, 2017, EPA announced a final decision that the MY2022-MY2025 standards remained appropriate and that a rulemaking to change them was not warranted. Congress may take an interest in that final determination.

Congress may also take an interest in the Phase 2 medium- and heavy-duty truck standards. These standards, which were promulgated in October 2016, would reduce oil consumption by up to 2 billion barrels over the lifetime of the vehicles sold under the program, saving vehicle owners fuel costs of about $170 billion according to EPA. The standards will increase the cost of a long haul tractor-trailer, but the buyer would recoup the investment in fuel-efficient technology in less than two years through fuel savings, according to the agency. In general, the truck standards have been well-received by the affected industries, but given the new Administration's general opposition to GHG regulations and the opposition to GHG rules among many in the leadership of the 115th Congress, there could be efforts to review or modify the regulations.

Another looming issue in the mobile source arena concerns GHG emission standards for aircraft. In October 2016, the International Civil Aviation Organization (ICAO) agreed on international CO_2 emission standards for aircraft, beginning in 2020. ICAO also agreed on a system for offsetting future carbon emissions from aviation. The emission standards and the offset system would be implemented in the United States by EPA regulations issued under the CAA. U.S. airlines and aircraft manufacturers participated in the ICAO negotiations and have been supportive of the resulting agreements; whether EPA actions to implement them would run contrary to the President's and the Administration's broader views on regulation and climate change is unclear.

This report focuses on these three actions to limit GHG emissions from mobile sources. Following the discussion of these issues, the report provides background information on GHG emissions from other mobile sources, including ships, nonroad vehicles and engines, locomotives, and fuels. We begin with a brief discussion of the court action that led to EPA's regulatory decisions.

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.[5] 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.[6] 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 the Administrator's 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,[7] 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 (CO_2) and other GHG emissions based on their climate change impacts.[8] 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

[5] 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, at http://www.law.umaryland.edu/environment/casebook/documents/epaco2memo1.pdf.

[6] The lead petitioner was the International Center for Technology Assessment (ICTA). The petition may be found at http://www.ciel.org/Publications/greenhouse_petition_EPA.pdf.

[7] 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).

[8] 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, available at https://yosemite.epa.gov/oa/EAB_Web_Docket.nsf/Filings%20By%20Appeal%20Number/BC82F18BAC5D89FF852574170066B7BD/$File/UARG%20Attchmnt%20G ... 43.pdf.

under the CAA's definition of that term.[9] 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 a finding of endangerment, the act requires the agency to establish standards for emissions of the pollutants.[10]

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 following the Court decision was to issue a detailed information request, called an Advance Notice of Proposed Rulemaking (ANPR), on July 30, 2008.[11]

The Obama Administration's EPA, however, made review of the endangerment issue a high priority. On December 15, 2009, it promulgated a finding that GHGs do endanger both public health and welfare and that GHGs from new motor vehicles contribute to that endangerment.[12]

Motor Vehicle GHG Emissions

Four greenhouse gases are emitted by motor vehicles (CO_2, methane, nitrous oxide, and hydrofluorocarbons).[13] 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 (latest data available when the endangerment finding was being considered). Most of the emissions were (and are) in the form of CO_2 (see **Figure 2**), which is the product of combusting any fuel containing carbon. Hydrofluorocarbons (HFCs), the chemicals used as coolants in vehicle air conditioning systems, are the second-most important motor vehicle GHG; but, as the figure shows, they are a distant second.

[9] 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."

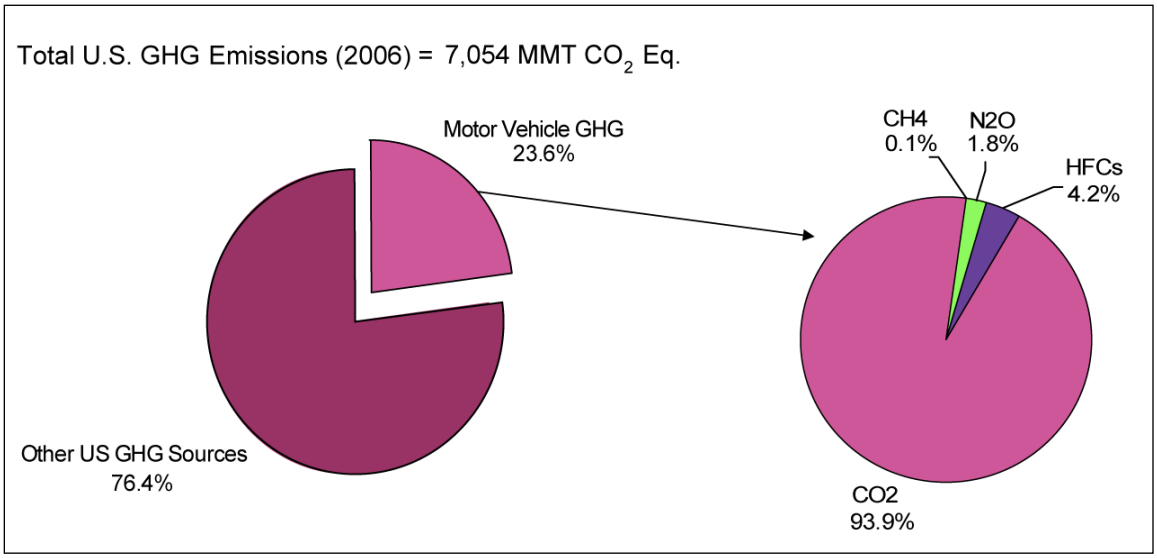
[10] For further discussion of the Court's decision, see CRS Report RS22665, *The Supreme Court's First Climate Change Decision: Massachusetts v. EPA*.

[11] U.S. Environmental Protection Agency, "Regulating Greenhouse Gas Emissions Under the Clean Air Act; Advance Notice of Proposed Rulemaking," 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.

[12] 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.

[13] Two other commonly mentioned greenhouse gases, sulfur hexafluoride (SF_6) and perfluorocarbons, are not emitted by motor vehicles.

Figure 2. 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; CO_2 Eq. = carbon dioxide equivalent; CH_4 = methane; N_2O = nitrous oxide; HFCs = hydrofluorocarbons.

Light-Duty Motor Vehicles

Even before it finalized the endangerment finding, the Obama Administration reached agreement with nine auto manufacturers[14] 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 President Obama, May 19, 2009, EPA and the National Highway Traffic Safety Administration (which administers fuel economy standards for cars and trucks under authorities that began with the Energy Policy and Conservation Act of 1975) 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 "One National Program," with GHG reduction levels similar to those adopted by California, which harmonized its own standards with EPA's as part of the agreement.[15]

As has happened on many previous occasions when EPA set emission standards for conventional pollutants from motor vehicles, the GHG standards have forced the development or implementation 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 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

[14] Letters containing those agreements may be accessed at https://www.epa.gov/regulations-emissions-vehicles-and-engines/presidential-announcements-and-letters-support-related.

[15] 74 *Federal Register* 49468, September 28, 2009.

granted a waiver, other states with air quality problems may adopt identical requirements, thus reinforcing the potential impact of California's standards. Besides adopting national standards for GHG emissions, EPA has granted California waivers beginning in 2009 to enforce its own GHG standards.

MY2012-MY2016 Standards

The EPA/NHTSA joint regulations for light-duty motor vehicles were finalized April 1, 2010, and published in the *Federal Register* the following month.[16] They required the vehicles (cars, SUVs, crossovers, minivans, and other light trucks) to meet combined emissions levels that EPA estimated would average 250 grams/mile of CO_2 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.[17] NHTSA set corresponding fuel economy standards, achieving a combined estimated fuel economy of 34.1 miles per gallon for cars and light trucks in 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 CO_2 emissions-footprint curves, where each vehicle has a different CO_2 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 CO_2 emissions target. As a result, the burden of compliance is distributed across all vehicles and all manufacturers. Manufacturers are not compelled to 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.[18]

(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 have reduced CO_2 emissions by improving the vehicles' fuel economy, but they can also take advantage of options to generate CO_2-equivalent credits by reducing emissions of hydrofluorocarbons (HFCs) and CO_2 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.

MY2017-MY2025 Standards and Mid-Term Evaluation

On October 15, 2012, EPA promulgated a second phase of GHG emission standards, for MY2017-MY2025 light duty vehicles. Like the earlier standards, these were preceded by a multi-party agreement, brokered by the White House; the agreement 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,

[16] 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.

[17] "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.

[18] Ibid., p. 3.

compared to 2010, with fuel economy standards rising to nearly 50 miles per gallon. CO_2 emissions will be reduced to about 160 grams/mile by 2025, under the agreement.[19]

Because of the long lead-time for the later years of these standards, as part of the MY2017-MY2025 rulemaking, EPA made a commitment to conduct a Mid-Term Evaluation (MTE) for the MY2022-MY2025 standards. Through the MTE, EPA was to determine whether the standards for MY2022-MY2025 were still appropriate given the latest available data and information, with the option of strengthening, weakening, or retaining the standards as promulgated.

On November 30, 2016, EPA released a proposed determination under the MTE stating that the MY2022-MY2025 standards remained appropriate and that a rulemaking to change them was not warranted. EPA based its findings on a Technical Support Document, a previously released Draft Technical Assessment Report (which was issued jointly by EPA, NHTSA, and the California Air Resources Board (CARB)), and input from the auto industry and other stakeholders.[20] The proposed determination opened a public comment period that ran through December 30, 2016. On January 12, 2017, the EPA Administrator made a final determination to retain the MY2022-MY2025 standards as originally promulgated.[21]

This action has significantly accelerated the original timeline for the MTE (which called for a final determination by April 2018), and EPA announced it separately from any NHTSA (fuel economy) or California (GHG standard) process. Critics reacted to the accelerated timetable swiftly, vowing to work with the new Administration to revisit EPA's determination—citing a "rush to judgment" that they argued contradicted the objectives of the One National Program.[22] Among the potential revisions suggested by critics have been better harmonization of the existing EPA/NHTSA/CARB standards, easing the MY2022-MY2025 standards, or eliminating them entirely.

It is unclear whether the Trump Administration will reconsider EPA's Mid-Term Evaluation, and if so, how quickly. The standards were promulgated in 2012 and were not modified by the MTE, so the deadlines for judicial review and for the fast-track review authority in the Congressional Review Act would appear to have lapsed. The promulgated standards could be changed through a new rulemaking, a process that normally would take a year or more and would itself be subject to judicial and congressional review upon completion. A rulemaking would probably need to be justified by new or additional data or a reasonable justification to avoid being considered arbitrary and capricious if challenged in court.[23] With options for continued review uncertain, the role of

[19] U.S. 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 76 *Federal Register* 48758, August 9, 2011. The auto manufacturers' letters of support can be found at https://www.epa.gov/regulations-emissions-vehicles-and-engines/2011-commitment-letters-2017-2025-light-duty-national. 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.

[20] The draft and final determinations and supporting documents can be found on EPA's website at https://www.epa.gov/regulations-emissions-vehicles-and-engines/midterm-evaluation-light-duty-vehicle-greenhouse-gas-ghg.

[21] U.S. Environmental Protection Agency, "Final Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation," January 2017, at https://www.epa.gov/sites/production/files/2017-01/documents/420r17001.pdf.

[22] See, for example, "Obama Moves to Lock in Vehicle Greenhouse Gas Rules," Reuters, November 30, 2016, at http://sports.yahoo.com/news/u-epa-finalize-2025-vehicle-161105633.html.

[23] For additional information regarding repealing a regulation, see CRS Legal Sidebar WSLG888, *How to Repeal a Rule*, by Jared P. Cole.

Congress may be one of oversight, at least for now. (For additional information, see CRS Insight IN10619, *EPA's Mid-Term Evaluation of Vehicle Greenhouse Gas Emissions Standards*.)

On the other hand, some changes that have been suggested by industry stakeholders—such as better harmonization of NHTSA's standards to align with those of EPA and California—may be accomplished without major changes to the promulgated EPA standards. Several inconsistencies to the One National Program have been noted in stakeholder petitions to the rulemaking, and include the accounting for off-cycle technologies, air conditioning efficiencies, Lifetime Vehicle Miles Traveled (VMT) values, and credit transfer and adjustment factors. For many of the suggested changes, Congress would likely need to revisit NHTSA's statutory authorities.[24] (For additional information, see CRS Insight IN10550, *Automakers Seek to Align Fuel Economy and Greenhouse Gas Regulations*, by Bill Canis.)

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 car and light truck fleets turn over slowly: in 2015, the average age of U.S. cars and light trucks was 11.5 years.[25] 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. Furthermore, 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.

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-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 promulgated standards for these vehicles on September 15, 2011.[26] These standards cover MY2014-MY2018 trucks. A second round of standards, covering trucks from MY2021-MY2027 and trailers from MY2018-MY2027, was promulgated in October 2016.

Separate from EPA's authority to set GHG standards, the Energy Independence and Security Act of 2007 (EISA, P.L. 110-140), directed NHTSA to study the potential for fuel efficiency standards for medium- and heavy-duty trucks, and, if feasible, set efficiency standards reflecting the

[24] Alliance of Automobile Manufacturers and the Association of Global Automakers, Letter to Mark Rosekind, Administrator, National Highway Traffic Safety Administration, and Gina McCarthy, Administrator, Environmental Protection Agency, "Re: Petition for Direct Final Rule with Regard to Various Aspects of the Corporate Average Fuel Economy Program and the Greenhouse Gas Program," June 20, 2016, at https://www.epa.gov/sites/production/files/2016-09/documents/petition_to_epa_from_auto_alliance_and_global_automakers.pdf.

[25] Oak Ridge National Laboratory, for the U.S. Department of Energy, *Transportation Energy Data Book: Edition 35*, 2016, Table 3.10.

[26] 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.

"maximum feasible improvement."[27] Thus, as with light duty vehicles, in order to harmonize their GHG and fuel efficiency requirements, EPA and NHTSA have cooperated on the setting of standards.

Medium- and heavy-duty trucks are trucks with a gross vehicle weight of 8,500 pounds or more.[28] 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 distances, they consume 67% of all fuel used by these vehicles[29] and presumably emit about the same percentage of medium- and heavy-duty trucks' GHGs.

As shown in **Table 1**, medium- and heavy-duty trucks emitted more than 400 million metric tons of GHGs in 2014, nearly 27% of GHG emissions from motor vehicles. Between 1990 and 2014, emissions from these trucks grew 76%, the fastest growth for any major category of GHG sources. (See **Table 1**.)

Table 1. Motor Vehicle GHG Emissions, 2014, by Source Category

(million metric tons, CO_2-equivalent)

Category	Total GHG Emissions	Percent of Motor Vehicle Total
Passenger Cars	762.5	49.8%
Light Duty Trucks	338.1	22.1%
Medium- and Heavy-Duty Trucks	407.4	26.6%
Buses	19.1	1.2%
Motorcycles	3.9	0.3%
Total	**1,531.0**	

Source: U.S. EPA, *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."

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, he may delay the effective date of regulations as long as he 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

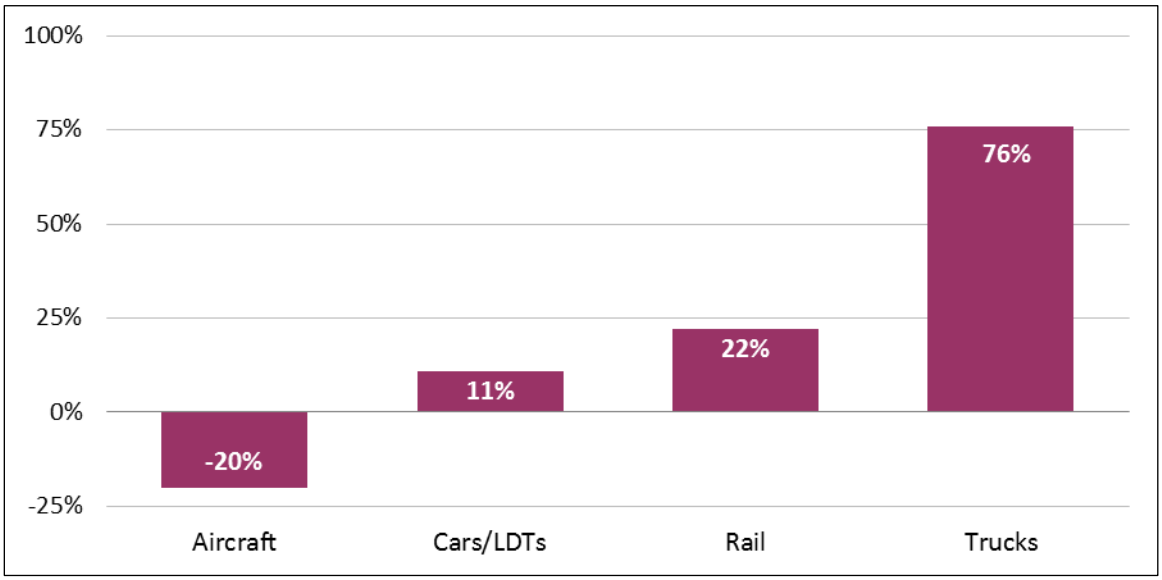
[27] Section 102.

[28] 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.

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

not specify a level of stringency (e.g., best available control technology) for prospective regulations.

Figure 3. Growth of GHG Emissions from Mobile Sources, 1990-2014



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

MY2014-MY2018 Truck Standards

EPA and NHTSA jointly promulgated GHG and fuel economy standards on September 15, 2011. 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.[30]

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.[31]

[30] 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." U.S. Environmental Protection Agency and National Highway Traffic Safety Administration, "Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium and Heavy-Duty Engines and Vehicles," 76 *Federal Register* 57120, September 15, 2011.

[31] "EPA and NHTSA Adopt First-Ever Program to Reduce Greenhouse Gas Emissions and Improve Fuel Efficiency of Medium- and Heavy-Duty Engines and Vehicles," Regulatory Announcement, August 2011, p. 6, at https://nepis.epa.gov/Exe/ZyPDF.cgi/P100BOT1.PDF?Dockey=P100BOT1.PDF.

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.[32]

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 these rules, due to the first-ever nature of this program 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 intend to include them in a future rulemaking.[33]

MY2021-MY2027 Truck and MY2018-MY2027 Trailer 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 were promulgated on October 26, 2016.[34] The new standards cover MY2018-2027 for certain trailers and MY2021-2027 for semi-trucks, large pickup trucks, vans, and all types and sizes of buses and work trucks. According to EPA,

> The Phase 2 standards are expected to lower CO_2 emissions by approximately 1.1 billion metric tons, save vehicle owners fuel costs of about $170 billion, and reduce oil consumption by up to 2 billion barrels over the lifetime of the vehicles sold under the program.[35]

EPA projects the total cost of the rule at $29-$31 billion over the lifetime of MY2018-MY2029 trucks. The standards will increase the cost of a long haul tractor-trailer by as much as $13,500 in MY2027, according to the agency, but the buyer would recoup the investment in fuel-efficient technology in less than two years through fuel savings. In EPA's analysis, fuel consumption of 2027 model tractor-trailers will decline by 34% as a result of the rule.[36]

Given the new Administration's general opposition to GHG regulations and the opposition to GHG rules among many in the leadership of the 115th Congress, there could be efforts to review or modify the truck regulations. If revocation is the goal, one route would be to disapprove the standards under the expedited procedures of the Congressional Review Act (CRA).[37] The CRA

[32] Ibid., pp. 5-6.

[33] Ibid., p. 4.

[34] 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.

[35] U.S. Environmental Protection Agency, Office of Transportation and Air Quality, "EPA and NHTSA Adopt Standards to Reduce Greenhouse Gas Emissions and Improve Fuel Efficiency of Medium- and Heavy-Duty Vehicles for Model Year 2018 and Beyond; Regulatory Announcement," August 2016, at https://nepis.epa.gov/Exe/ZyPDF.cgi/P100P7NL.PDF?Dockey=P100P7NL.PDF.

[36] Ibid.

[37] The potential advantage of the Congressional Review Act lies primarily in the procedures under which a resolution of disapproval is to be considered in the Senate. Pursuant to the act, an expedited procedure for Senate consideration of a disapproval resolution may be used at any time within 60 days of Senate session after the rule in question has been

provides that, if Congress passes a joint resolution disapproving a rule and the resolution becomes law,[38] the rule cannot take effect or continue in effect. Also, the agency may not reissue that rule or any substantially similar one, except under authority of a subsequently enacted law. As explained in more detail in other CRS analyses,[39] under the CRA, an expedited procedure for a resolution disapproving a rule may be used in the Senate at any time within 60 days of Senate session after the rule in question has been published in the *Federal Register* and received by both houses of Congress. During this period of time, a CRA resolution may not be amended or filibustered. CRS has concluded elsewhere that regulations promulgated and received in Congress on or after June 13, 2016, are eligible to use these fast-track Senate procedures during the first 60 legislative days of the 115th Congress.[40] After that, the truck and trailer rule could still be modified through ordinary legislation or through a rider on an appropriations bill, but doing so might require 60 votes for Senate consideration.

In general, however, the truck standards—with the exception of the portion dealing with trailers—have been well-received, leaving in question whether general opposition to GHG rules will shape Congress's reaction more than the views of the affected industries. The American Trucking Associations, for example, described themselves as "cautiously optimistic" that the rule would achieve its targets: "We are pleased that our concerns such as adequate lead-time for technology development, national harmonization of standards, and flexibility for manufacturers have been heard and included in the final rule."[41] The Truck and Engine Manufacturers Association, while describing itself as "in the process of reviewing" the final rule, highlighted its work providing input to assure that EPA and DOT established a single national program, and concluded: "A vitally important outcome is that EPA and DOT have collaborated to issue a single final rule that includes a harmonized approach to greenhouse gas reductions and fuel efficiency improvements."[42] As of the filing deadline (December 27, 2016—60 days after the rule's promulgation in the *Federal Register*), only two organizations had filed petitions for judicial review: the Truck Trailer Manufacturers Association and the Racing Enthusiasts and Suppliers Coalition.

published in the *Federal Register* and received by both houses of Congress. The expedited procedure provides that, if the committee to which a disapproval resolution has been referred has not reported it by 20 calendar days after the rule has been received by Congress and published in the *Federal Register*, the panel may be discharged if 30 Senators submit a petition for that purpose. The resolution is then placed on the Calendar, whereupon a motion to proceed to floor consideration is in order. The Senate has treated a motion to consider a disapproval resolution under the CRA as not debatable, so that this motion cannot be filibustered. After the Senate takes up the disapproval resolution itself, the expedited procedure limits debate to 10 hours and prohibits amendments.

[38] For the resolution to become law, the President must sign it or allow it to become law without his signature, or Congress must override a presidential veto.

[39] See, for example, CRS In Focus IF10023, *The Congressional Review Act (CRA)*.

[40] CRS Insight IN10437, *Agency Final Rules Submitted on or After June 13, 2016, May Be Subject to Disapproval by the 115th Congress*.

[41] American Trucking Associations, "ATA Hopes Final Truck Efficiency Rule Will Achieve Emissions Goals," Press Release, August 16, 2016, at http://www.trucking.org/article/ATA-Hopes-Final-Truck-Efficiency-Rule-Will-Achieve-Emissions-Goals.

[42] Truck and Engine Manufacturers Association, "Truck and Engine Manufacturers Evaluating New Phase 2 Greenhouse Gas Regulations that EPA/DOT Announced Today," Press Release, August 16, 2016, at http://www.truckandenginemanufacturers.org/file.asp?A=Y&F= 2016+08+16+Final++GHG+Phase+II+Press+Release.pdf&N= 2016+08+16+Final++GHG+Phase+II+Press+Release.pdf&C=documents.

Aircraft

On August 15, 2016, EPA issued a finding that greenhouse gas emissions (including CO_2 emissions) from commercial aircraft contribute to the pollution that causes climate change and endangers the health and welfare of Americans.[43] The finding, under Section 231 of the Clean Air Act, is the precondition for GHG emission standards for commercial aircraft. U.S. aircraft emit roughly 11% of GHG emissions from the U.S. transportation sector and 29% of GHG emissions from all aircraft globally.

In October 2016, the International Civil Aviation Organization (ICAO) agreed on international CO_2 standards for aircraft, beginning in 2020. ICAO is a specialized body of the United Nations with 191 member states. For the past five years, ICAO had been working with the aviation industry and other stakeholders to develop international CO_2 emission standards for aircraft engines. EPA and the Federal Aviation Administration, representing the United States, participated in ICAO's process. In October 2016, ICAO's governing council also agreed on a system for offsetting future carbon emissions from aviation—dubbed the Market-Based Mechanism, or MBM.

EPA's endangerment finding lays the necessary foundation for the adoption and implementation of domestic aircraft CO_2 standards, in accordance with the Clean Air Act and the ICAO agreement. The MBM agreed to in the ICAO process is voluntary for the next decade and has been agreed to by the U.S. industry.

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.[44] When other factors are considered, the impact 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*.)

The EPA and ICAO actions come years after five states and seven other parties petitioned EPA to address aircraft GHG emissions (see **Table 2**). 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.[45]

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,

[43] U.S. Environmental Protection Agency, "Finding That Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution That May Reasonably Be Anticipated to Endanger Public Health and Welfare," 81 *Federal Register* 54422, August 15, 2016.

[44] U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014*, 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 CO_2 emissions from consumption of fuel by military aircraft, general aviation, and domestic operation of commercial aircraft. The higher estimate includes CO_2 emissions from international air travel originating in the United States, as well.

[45] 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.

in his 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: 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.

EPA has rarely regulated emissions from aircraft without first negotiating international agreements through ICAO. ICAO's agreements on standards for conventional pollutants from aircraft, unlike 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.[46]

Besides petitioning EPA for action on aviation emissions, environmental groups brought suit in the District Court for the District of Columbia seeking to force EPA to respond to their petitions on aircraft (as well as their petitions on marine vessels, and nonroad engines and vehicles).[47] 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.[48]

By issuing an endangerment finding for GHG emissions from commercial aircraft, EPA has now taken the first step toward setting aircraft GHG emission standards. The endangerment finding itself, although it does not impose standards, is a final rule. As explained earlier, final rules promulgated on or after June 13, 2016, are eligible for fast-track procedures in the Senate under the Congressional Review Act; a CRA resolution of disapproval overturning the rule could be approved by a simple majority, rather than the 60 votes generally needed to invoke cloture. Even more than the truck standards discussed earlier, however, the endangerment finding was welcomed by the affected industries, who participated in the ICAO process that has led to EPA's action. In response to EPA's issuance of the finding, an Airlines for America representative was reported as saying:

> As aviation is a global industry, with airlines operating internationally and manufacturers selling their aircraft in international markets, it is critical that aircraft emissions standards be set at the international level and not imposed unilaterally by one country or set of countries. ... Thus, we commend EPA's action, which will enable the ICAO [carbon dioxide] certification standard for future aircraft to be adopted into U.S. law consistent with the Clean Air Act, U.S. treaty obligations and in harmony with the international community."[49]

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

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

[48] Center for Biological Diversity v. U.S. EPA, 2012 Westlaw 967662 (D.D.C. March 20, 2012).

[49] Statement of Vaughn Jennings, Airlines for America, cited in "EPA Takes First Step Toward Regulating Aircraft Emissions," Bloomberg BNA *Daily Environment Report*, July 26, 2016.

Other Mobile Sources

Following the *Massachusetts v. EPA* decision, the agency 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 (see **Table 2**). These petitions covered 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
1/29/08	New Nonroad Vehicles/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	New York University 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 has been generally believed that the endangerment finding and decision to regulate GHGs in response to the motor vehicle petition could provide precedents for GHG emission standards from other categories of sources. 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.

Ships

Three of the 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 796 million metric tons of carbon dioxide, 2.2% of global CO_2 emissions, in 2012. Including domestic shipping and the CO_2-equivalent of other GHGs emitted by ships, the amount would increase to 961 million metric tons, 2.5% of global emissions.[50] 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 CO_2 emissions.[51]

In addition to the CO_2 emissions, the low-quality bunker fuel that ships use and the general absence of pollution controls result in significant emissions of black carbon, which also contributes to climate change. Thus, the total impact of ships on climate may be greater than the 2.5% 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."[52] 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, he may promulgate such regulations as he 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.

[50] International Maritime Organization, *Third IMO Greenhouse Gas Study*, Executive Summary, 2015, p. 1 at http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Third%20Greenhouse%20Gas%20Study/GHG3%20Executive%20Summary%20and%20Report.pdf. Both estimates exclude emissions from naval vessels.

[51] Oceana, *Shipping Impacts on Climate: A Source with Solutions*, p. 2, at https://archive.org/stream/563649-shipping-impacts-on-climate-oceana/563649-shipping-impacts-on-climate-oceana_djvu.txt.

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

If the Administrator were to conclude that GHG emissions from ships significantly contribute to air pollution reasonably anticipated to endanger public health or welfare, a wide variety of measures might be undertaken to reduce emissions from shipping, ranging 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 CO_2 emissions by more than 15%."[53] Over the period 2007-2015, Maersk reduced its CO_2 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.[54]

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

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 asserted 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 (ADA) 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.[55]

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 urged the International Maritime Organization (IMO) to adopt a sector-wide pledge to reduce international shipping emissions.[56] The IMO's Environment Protection Committee met in April and October 2016, but took no action on GHGs other than to require large ships (ships of greater than 5,000 gross tons) to report their annual CO_2 emissions and fuel consumption.

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

[53] *Preparing for the Future*, The A.P. Moller—Maersk Group's Health, Safety, Security and Environment Report 2008, pp. 28-30.

[54] 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.

[55] 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 C.F.R. 13.65(b)(4). The *Federal Register* citation is 61 *Federal Register* 27008, 27011 (May 30, 1996).

[56] See "Ship Owners Now Calling for CO_2 Pledge, Citing Paris Agreement," ClimateWire, March 1, 2016.

fuels and reduce NOx 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 have all moved 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.

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, the impact of sulfur emissions on climate is more complicated. Sulfate particles are thought by most experts to have a cooling effect on the atmosphere, since they 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.

Other Nonroad Engines

Section 213 of the Clean Air Act 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 could promulgate such regulations as he deems appropriate to control emissions from the classes or categories of nonroad engines that he 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 CO_2 emissions in 2007, according to the two petitions requesting regulation (see **Table 3**), 3.3% of total U.S. emissions of CO_2 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%).[57]

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 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,

[57] 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.

rather than applying one across the board standard. Presumably, any GHG standards for this sector would take the same approach.

Table 3. Nonroad Sector CO_2 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.

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 47.6 million metric tons of greenhouse gases. Although this is less than 1% of total U.S. GHG emissions, GHG emissions from railroads increased by 22% between 1990 and 2014, three times the rate of increase for total U.S. emissions. In addition, locomotives emit substantial amounts of black carbon, 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."[58] As a result, in addition to requesting that EPA set GHG emission standards for locomotives, the petition asked 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 he

[58] U.S. National Aeronautics and Space Administration, Goddard Institute for Space Studies, "Black Soot and Snow: A Warmer Combination," December 22, 2003, at https://www.nasa.gov/vision/earth/lookingatearth/Black_Soot.html.

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).[59] 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. EPA has not taken action to implement these GHG reduction strategies.

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 the Administrator concludes that its emission products may endanger public health or welfare. 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.[60] On April 15, 2010, California's Office of Administrative Law approved regulations to implement the California Low Carbon Fuel Standard (LCFS), which had been under development since 2007.[61] 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 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.

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[59] U.S. Environmental Protection Agency, "Regulating Greenhouse Gas Emissions Under the Clean Air Act; Advance Notice of Proposed Rulemaking," July 30, 2008, 73 *Federal Register* 44463-44464.

[60] For more information, see http://www.arb.ca.gov/regact/2009/lcfs09/lcfs09.htm. For additional background, see CRS Report R40078, *A Low Carbon Fuel Standard: State and Federal Legislation and Regulations*.

[61] 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.

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).[62] 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.[63]

EPA did not pursue an LCFS under the Obama Administration and, given President Trump 's general position on GHG regulation, would appear unlikely to do so in a Trump Administration.

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 three-quarters of all U.S. 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. As discussed, the agency took a step along this path by issuing an endangerment finding for aircraft on August 15, 2016. This action was not particularly controversial, and was not challenged by aircraft manufacturers or airlines.[64] The aircraft manufacturing and aviation industries have participated in international negotiations that have produced agreement on emission standards for new aircraft and a voluntary system to offset what might otherwise be a growth in emissions from air travel. As shown in **Table 4**, aircraft are the largest source of mobile source GHG emissions after cars and trucks.

Although a framework for regulating GHG emissions from the largest categories of mobile sources is now in place, Congress and the Trump Administration face a number of questions regarding GHG emissions from mobile sources in the first months of 2017. In campaigning for election, President Trump promised to overturn EPA regulations, including those addressing GHGs. Congressional Republicans have also been critical of Obama Administration actions addressing climate change. The early months of the new Congress present the opportunity under the Congressional Review Act to rescind EPA regulations promulgated since June 2016,[65] which

[62] 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.

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

[64] The finding was challenged by the Biogenic CO_2 Coalition (Biogenic CO_2 Coalition v. EPA, D.C. Cir. No. 16-1358, filed October 14, 2016, now held in abeyance pending the resolution of other proceedings). The coalition represents growers and processors of agricultural feedstocks that can be used for biofuels. The coalition's challenge is based on the limited grounds that EPA did not distinguish the effects of biofuel CO_2 emissions from the effects of similar emissions from fossil fuels. The coalition maintains that the CO_2 from biofuels is removed from the atmosphere by growing the crops that are processed or used for fuel.

[65] See Maeve P. Carey and Christopher M. Davis, "Major Obama Administration Rules Potentially Eligible to be Overturned under the Congressional Review Act in the 115th Congress," CRS General Distribution Memorandum, January 31, 2017.

could include the Phase 2 emission standards for medium- and heavy-duty trucks and the endangerment finding for aircraft.

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 CO_2-equivalent)	Percent of Total U.S. GHG Emissions in 2014
Passenger Cars	202	762.5	11.1%
Medium- and Heavy-Duty Trucks	202	407.4	5.9%
Light Duty Trucks	202	338.1	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	47.6	0.7%
Ships and Other Boats[a]	213	28.6	0.4%
Buses	202	19.1	0.3%
Motorcycles	202	3.9	<0.1%
Other[a]	213	81.7	1.2%
Total[b]		**1972.0**	**28.7%**

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

a. Does not include international bunker fuel.

b. "Other" includes industrial equipment, lawn and garden equipment, commercial equipment, snowmobiles and other recreational equipment, logging equipment, airport equipment, and railroad equipment.

These rules are not particularly controversial with the regulated industries. Somewhat more controversial is the Mid-Term Evaluation of the light-duty vehicle GHG emissions standards for MY2022-MY2025. It is unclear whether that determination, which left the already promulgated GHG standards in place, could be subject to the Congressional Review Act.[66]

As shown in **Table 4**, after motor vehicles and aircraft, other mobile source categories are less significant: most of them accounted for less than 1% of total U.S. GHG emissions in 2014. Thus, rather than develop standards for additional mobile sources, EPA has expanded its focus to stationary sources. Stationary sources account for about 70% of the nation's GHG emissions; within that group electric power plants account for about 30% of all U.S. GHG emissions, a

[66] For further discussion, see CRS Insight IN10619, *EPA's Mid-Term Evaluation of Vehicle Greenhouse Gas Emissions Standards*.

higher percentage of the nation's total than all mobile sources combined. To address power plant emissions, EPA promulgated the Clean Power Plan (CPP) on October 23, 2015. Although the CPP is currently stayed by the Supreme Court pending the outcome of judicial proceedings, resolving its future arguably poses a higher priority for the Trump Administration and many in Congress than the pending decisions regarding mobile sources. (For additional discussion of the Clean Power Plan, see CRS Report R44341, *EPA's Clean Power Plan for Existing Power Plants: Frequently Asked Questions.*)

Author Information

James E. McCarthy
Specialist in Environmental Policy

Richard K. Lattanzio
Specialist in Environmental Policy

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