

CRS Report for Congress

Air Pollution from Ships: MARPOL Annex VI and Other Control Options

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Summary

This report provides information regarding pollution from ships and port facilities; discusses some of the measures being implemented and considered by local, state, and federal regulatory agencies; discusses the efforts to ratify and to strengthen Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL); and describes legislation Congress is considering to control emissions from ships by amending the Clean Air Act (CAA).

As pollution from cars, trucks, and land-based stationary sources has been more tightly controlled over the last 40 years, the contribution of ships and port operations to air pollution in port cities has become more important. In the same period, foreign trade has grown dramatically; thus, pollution from shipping and port operations would be growing as a percentage of total emissions, even if the emissions were regulated to the same degree as other sectors. In many cities, ships are now among the largest sources of air pollution.

Controlling these sources is complicated by the fact that most ocean-going ships are not registered in the United States and may not even purchase the fuel they are using here. Thus, controlling such pollution would seem to lend itself to an international approach. To date, such efforts have been of little avail. In 1997, the United States and most countries signed an international agreement known as MARPOL Annex VI, setting extremely modest controls on air pollution from ships. The agreement did not enter into force until 2005, and the United States took until July 21, 2008, to enact legislation to implement it (H.R. 802, P.L. 110-280).

While awaiting congressional action, the Environmental Protection Agency (EPA), port cities, and states began to act on their own, and, in Congress, other legislation has been introduced (S. 1499 / H.R. 2548) to require EPA to dramatically strengthen ship emission standards under the Clean Air Act.

Negotiations to strengthen MARPOL Annex VI are also under way. The parties are expected to vote at the next negotiating session (October 6-10, 2008) to approve provisions that would strengthen Annex VI.

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Introduction

Over the last 40 years, air quality in the United States has improved substantially. Since the passage of the Clean Air Act in 1970, annual emissions of the six most widespread (“criteria”) air pollutants have declined 160 million tons (53%), despite major increases in population, motor vehicle miles traveled, and economic activity.¹

Emissions from shipping are a major exception to these trends. Although emission controls have reduced pollution from new cars and trucks by more than 90%, most ocean-going ships operate without any pollution controls at all. New and remanufactured engines on tug boats, ferries, and other smaller ships will be subject to emission controls beginning in 2008 and 2009, but most existing engines in vessels of these types remain uncontrolled.

Pollution from ships is also affected by the fuel they use. Marine vessels other than oceangoing ships have been required to use cleaner fuels, but ocean-going ships generally use bunker fuel, a fuel that contains a high level of contaminants: the average fuel used by oceangoing ships contains 27,000 parts per million (ppm) sulfur, for example — almost 2,000 times as much as would be allowed in trucks operating on U.S. roads.

In the Los Angeles-Long Beach area — which is both the nation’s busiest port² and the nation’s most polluted area³ — the problem is particularly acute. According to the South Coast [L.A.-Long Beach] Air Quality Management District (AQMD):

¹ See U.S. EPA, “Air Emissions Summary Through 2005,” at [http://www.epa.gov/air/airtrends/2006/emissions_summary_2005.html]. The six criteria pollutants are ozone, particulate matter, carbon monoxide, sulfur dioxide, nitrogen oxides, and lead.

² According to the Wall Street Journal, Los Angeles and Long Beach ranked number 1 and number 2 in the value of cargo handled, with a combined total exceeding \$248.5 billion in 2003-2004. The port of New York and New Jersey ranked third with \$132.4 billion. See “The Busiest U.S. Ports,” March 9, 2006, at [<http://americanfuture.net/?p=1447>].

³ The Los Angeles South Coast Air Basin is the only area that EPA considers to be a “Severe” nonattainment area for ozone. The area also has the highest readings in the country for fine particulates (PM_{2.5}), and is among only 8 areas classified as “Serious” nonattainment areas for larger particles (PM₁₀). See U.S. EPA, “Green Book,” at [<http://www.epa.gov/oar/oaqps/greenbk/index.html>].

- Oceangoing vessels are among the largest sources of nitrogen oxides (NO_x) in the area, emitting more NO_x than all power plants and refineries in the South Coast air basin combined. NO_x reacts with volatile organic compounds in the atmosphere to produce ozone/smog.
- 70% of the area's emissions of sulfur dioxide (SO₂) come from ships. These emissions need to be cut by over 90%, according to the AQMD, if the area is to attain the national air quality standard for particulates by the 2014 deadline.
- Particulates from marine vessels also create significant cancer risks.
- More than 700 premature deaths are caused in the Los Angeles area annually by these emissions, according to the AQMD.⁴

While the Los Angeles-Long Beach area may be the most extreme example, the problem is not limited to L.A. or even to California. According to the Environmental Protection Agency (EPA), more than 40 U.S. ports nationwide are located in "nonattainment" areas⁵ for ozone, fine particulates, or both.⁶ In addition, according to EPA, "... the problem is not limited to port areas alone. Santa Barbara County, which has no commercial ports, estimates that by 2020, 67 percent of its NO_x inventory will come from shipping traffic transiting the California coast...."⁷

Oceangoing ships are perhaps the largest source of port emissions, but they are not the only source. Ports make use of tug boats to guide ships entering and leaving the harbor. Ports make connections to land-based transportation networks, such as railroads, and they generally operate large truck terminals. Ships at rest in the port need a source of power, which often comes from running auxiliary engines. And, in many cases, a harbor is served by substantial local boat or barge traffic, sometimes including ferry service. Thus, addressing the sources of pollution in a port may require a multi-faceted approach.

⁴ See testimony of Barry R. Wallerstein, Executive Officer, South Coast Air Quality Management District, at "Legislative Hearing on the Marine Vessel Emissions Reduction Act of 2007, S. 1499," U.S. Senate, Committee on Environment and Public Works, February 14, 2008, p. 1.

⁵ That is, areas where air quality is worse than the health-based standard for ozone, particulates, or both.

⁶ Testimony of Bryan Wood-Thomas, U.S. EPA, Office of Transportation and Air Quality, at "Legislative Hearing on the Marine Vessel Emissions Reduction Act of 2007, S. 1499," U.S. Senate, Committee on Environment and Public Works, February 14, 2008, p. 2.

⁷ Ibid.

MARPOL Annex VI

Pollution from ships (not only air pollution, but pollution of all kinds) is governed by the International Convention for the Prevention of Pollution from Ships, first negotiated through the International Maritime Organization (IMO) in 1973. The Convention, known as MARPOL (for “MARine” “POLlution”) 73/78 (the dates referring to the 1973 Convention and its 1978 amendments), applies to all ships of the flag states that have ratified it. About 150 countries, representing over 98.7% of world shipping tonnage, have done so. The Convention also applies to ships of non-signatory states while they are operating in waters under the jurisdiction of parties to MARPOL. Six annexes to MARPOL 73/78 cover various sources of pollution from ships (oil, noxious liquids, sewage, garbage, etc.) and provide an overarching framework for implementation.

Provisions of Annex VI

Annex VI of the Convention, which was adopted in 1997 but did not enter into force until 2005, addresses the Prevention of Air Pollution from Ships. The annex represents a small first step toward controlling such pollution, particularly if one compares it to pollution controls that the United States and other developed countries impose on land-based sources. Annex VI:

- limits the sulfur content of the fuel used in oceangoing ships (bunker fuel) to 4.5% (45,000 parts per million (ppm)). By comparison, highway diesel fuel in the United States is limited to 15 ppm;
- allows special sulfur oxide (SO_x) Emission Control Areas (currently the Baltic Sea, the North Sea, and the English Channel), where the sulfur content of fuel is limited to 1.5% (15,000 ppm) or SO_x emissions are limited;
- limits NO_x emissions from new engines and engines that have undergone major conversions to a range of 9.8-17.0 grams per kilowatt-hour (g/kwh). By comparison, power plants in the eastern United States are limited to 0.45-0.73 g/kwh;
- allows the regulation of emissions of volatile organic compounds (VOCs) from tankers by parties to Annex VI in their ports and terminals;
- prohibits emissions of ozone-depleting substances;
- prohibits the incineration on ships of polychlorinated biphenyls (PCBs, a class of toxic chemicals widely used in electrical transformers until the 1970s). In the United States, PCB production and use were banned in 1976, and disposal has been strictly regulated since then; and

- prohibits the incineration of garbage containing more than traces of heavy metals and of refined petroleum products containing halogen compounds.⁸

Implementing Legislation (H.R. 802)

The United States is a party to MARPOL 73/78 and most of its annexes, but did not enact legislation to implement Annex VI until the summer of 2008. The Senate gave its consent to ratification of Annex VI on April 7, 2006,⁹ but Congress needed to enact implementing legislation before the United States could submit the instrument of ratification. The House passed H.R. 802 to implement the annex on March 26, 2007. The Senate passed the bill, with an amendment, June 26, 2008, and the House agreed to the Senate amendment July 8. The President signed the bill July 21, 2008 (P.L. 110-280).

The United States has participated in negotiations to strengthen Annex VI. More stringent limits on both fuels and emissions were approved by an IMO committee April 4, 2008 and will be considered for final adoption at the next meeting October 6-10, 2008. The United States supports the strengthening amendments, although it will not be able to vote at the meeting because of the delay in enacting legislation to implement Annex VI. EPA believes that the strengthening amendments will be adopted by unanimous consent of the parties. Thus, the inability of the United States to vote may not be of much significance.

EPA has already promulgated regulations under the Clean Air Act that are as stringent as Annex VI, and shipping companies are already generally meeting the standards. These so-called “Tier 1” standards were promulgated February 28, 2003, and went into effect in 2004.¹⁰ In addition, in October 1999, EPA established a voluntary certification program so that engine manufacturers could show that their engines are compliant with Annex VI. EPA believes that all marine diesel engines sold in the U.S. since January 1, 2000, to which the annex applies (i.e., those rated above 130 kilowatts), meet Annex VI requirements.

The Annex VI standards apply to: any oceangoing vessel that is registered in the United States; ships of any registry in ports, shipyards, terminals, or the internal waters of the United States; ships of any registry bound for or departing from the United States, while they are located in the navigable waters of the United States or designated emission control areas; and ships bearing the flag of any country that has ratified Annex VI traveling through U.S. waters or designated emission control areas, even if they are not bound for or departing from a U.S. destination. To the extent consistent with international law, the Annex also applies to any other ship in the U.S. exclusive economic zone.

⁸ For a more detailed description of Annex VI provisions, see Det Norske Veritas, *MARPOL 73/78 Annex VI, Regulations for the Prevention of Air Pollution from Ships, Technical and Operational Implications*, 21 February 2005 at [http://exchange.dnv.com/Documentation/DNVExchange/Fleet/DNV_paper_Marpol_Annex_VI.pdf].

⁹ The Senate consented to ratification through Treaty Document 108-7.

¹⁰ 68 *Federal Register* 9746, February 28, 2003.

Other Legislation

In addition to the bill to implement Annex VI, other legislation on ship emissions has seen committee action in the Senate. S. 1499, reported by the Environment and Public Works Committee, July 10, 2008 (S.Rept. 110-413), would amend the Clean Air Act to require oceangoing vessels entering or leaving U.S. ports and offshore terminals to use fuel that contains no more than 1,000 parts per million of sulfur (a 98% reduction from the requirement of Annex VI) beginning on December 31, 2010. The restrictions would apply within 200 miles of the West Coast and within such distance of the East or Gulf coast or the shoreline of the Great Lakes or St. Lawrence Seaway as EPA determines to be appropriate.¹¹ The Administrator would be allowed to provide an alternative mechanism of compliance if he determined that a vessel employed a control technology that reduced emissions of sulfur oxides and particulate matter to at least the same degree as the reduction that would be achieved through compliance with the sulfur content limitation.

In addition to the fuel standards, the bill would require EPA to promulgate emission control standards for main and auxiliary engines on oceangoing vessels that enter or leave U.S. ports. The standards would require the greatest achievable emission reduction for four pollutants (nitrogen oxides, particulate matter, hydrocarbons, and carbon monoxide) effective January 1, 2012. The standards could take into account the feasibility, benefits, and costs of specific technologies; could distinguish new from in-use engines; and could vary depending on the age of the engine.

A similar bill, H.R. 2548, was introduced by Representative Solis in the House, but no action has been taken there.

Federal, State, and Local Measures

Beyond Annex VI and the pending Senate and House bills, potentially more stringent actions are being taken at the federal, state, and local level to address emissions from marine engines.

EPA Regulations

EPA has begun to regulate ship emissions under existing Clean Air Act authority. Thus far, the regulations are relatively weak, and it will be at least 2014 before the agency's regulations impose stringent requirements in most cases. Also, when the more stringent requirements do take effect, they will apply only to new and remanufactured engines, so improvements resulting from the standards will be gradual.

¹¹ The Administrator may promulgate regulations that permit sulfur content as high as 2,000 ppm for a specified period if he determines that compliance with the 1,000 ppm limit is not technically feasible by December 31, 2010.

Category 3 Engines. EPA categorizes ship engines in three categories. The largest of these engines — the main engines on oceangoing ships — are diesel engines with a per-cylinder displacement at or above 30 liters. These are referred to as “Category 3” engines. As noted, the agency has already promulgated regulations equivalent to Annex VI for these engines under the Clean Air Act. But, as the agency states on its website, “There is an opportunity to gain large additional public-health benefits from Category 3 marine diesel engines through the application of advanced technology emission controls including high-efficiency catalytic aftertreatment.”¹² The agency has begun the process of developing more stringent regulations, by issuing an Advance Notice of Proposed Rulemaking December 7, 2007. It plans to finalize new Category 3 regulations by December 17, 2009.

Whether or not the agency promulgates more stringent Category 3 emission standards, they may have little effect on the overall level of pollution from Category 3 ships, since they will only apply to engines installed on vessels flagged or registered in the United States. In 2007, only 6.7% of the world’s ships (and only 1.2%, if measured by carrying capacity) were registered in the United States.¹³

Category 1 and 2 Engines. By contrast, the Category 1 and 2 engines (those smaller than 7 liters per cylinder, and those from 7 to 30 liters per cylinder, respectively), are used in boats or ships that operate in U.S. waters — tugs, ferries, Great Lakes freighters, fishing boats, and recreational boats, for example — virtually all of which are registered in the United States. And, compared to Category 3, EPA is further along in regulating the emissions of these categories. Regulations that will reduce emissions of NO_x from new or remanufactured engines by 24% and emissions of particulates by 12% when fully implemented, were promulgated in 1999 and began taking effect between 2004 and 2007. More stringent standards were promulgated May 6, 2008, and will take effect between now and 2014.¹⁴ The final 2014 standards will require ultra low sulfur diesel fuel (15 ppm sulfur) and high efficiency catalytic emission controls capable of reducing particulate matter emissions by 90% and NO_x emissions by 80%, along with “sizeable reductions” of hydrocarbon, carbon monoxide, and air toxic emissions, according to EPA.¹⁵

EPA has also proposed new Annex VI standards, covering both fuel and engines, at international negotiations under the auspices of IMO. As noted earlier, the more stringent limits were approved by an IMO committee April 4, 2008 and will be considered for final adoption at a meeting October 6-10, 2008.¹⁶

¹² U.S. EPA, Office of Transportation and Air Quality, “Oceangoing Vessels,” at [<http://www.epa.gov/otaq/oceanvessels.htm>].

¹³ United Nations Conference on Trade and Development, *Review of Maritime Transport 2007*, pp. 32, 149-153 at [http://www.unctad.org/en/docs/rmt2007_en.pdf].

¹⁴ *73 Federal Register* 25097, May 6, 2008.

¹⁵ For information, see U.S. EPA, Office of Transportation and Air Quality, “Diesel Boats and Ships,” at [<http://www.epa.gov/oms/marine.htm>].

¹⁶ See “International Committee Approves Changes to Rules on Sulfur Content in Ship Fuels,” *Daily Environment Report*, April 8, 2008, p. A-5. In addition to approving limits on
(continued...)

California Emission Reduction Measures

California, being more adversely affected than most other areas, has played a leadership role in identifying and implementing emission reduction measures, as well. The state has focused on port activities, in addition to fuel and emission standards. California's measures fall into four categories: 1) requiring the use of lower sulfur fuel; 2) requiring emission controls on harbor vessels and shore-side equipment; 3) providing alternative (electric) power to ships while they are docked at marine terminals ; and 4) providing grants for the re-powering of harbor craft and short-haul trucks with cleaner engines.

Low Sulfur Fuels. The California Air Resources Board (CARB), at a July 24, 2008, meeting, approved regulations that would require both U.S.- and foreign-flagged vessels sailing within 24 miles of its coast to use low sulfur fuels in both main and auxiliary engines beginning July 1, 2009. Compliant fuels are marine diesel oil with 5,000 ppm or less sulfur or marine gas oil with 15,000 ppm or less sulfur. In January 2012, sulfur in both types of fuel would be limited to 1,000 ppm. The rules replace low sulfur fuel requirements that the state implemented in 2007, but which were overturned by the U.S. Court of Appeals for the Ninth Circuit earlier this year.¹⁷ The original rules would have set a 1,000 ppm limit two years earlier, in 2010.

Emission Controls. California has, in general, led the nation in imposing more stringent requirements on diesel engines. In addition, the ports of Los Angeles and Long Beach have developed procedures to require that trucks serving the ports will be replaced by newer, less-emitting models. According to a description of the ports' plan:

... all pre-1989 trucks will be barred from entering the ports' terminals beginning Oct. 1 [2008]. Effective Jan. 1, 2010, all 1989-1993 trucks and any 1994-2003 trucks without certified pollution control equipment will be banned. By Jan. 1, 2012, all trucks entering the port must meet the 2007 federal standard for heavy-duty diesel trucks....

¹⁶ (...continued)

sulfur content of fuel, the committee approved somewhat more stringent limits on NOx emissions. According to the article, "The proposed amendments will now be circulated among IMO members for comment before final adoption at the next Marine Environment Protection Committee meeting in October, according to a spokeswoman. It is 'extremely unlikely' any changes will be made at this point, the IMO spokeswoman added."

¹⁷ *Pacific Merchant Marine Ass'n v. Goldstene*, 517 F.3d 1108 (9th Cir. 2008). The court held that the state's Marine Vessel Rules were preempted by the federal Clean Air Act because the regulations set emission standards for marine engines without California having received a waiver from EPA to do so. California has since asked EPA for a waiver to enforce the original rules, in addition to developing the rules applying only to fuels. See "California Air Board Seeks Federal Waiver to Enforce Ship Auxiliary Engine Rules," *Daily Environment Report*, May 13, 2008, p. A-1.

A \$35 gate fee for each 20-foot container unit that passes through the port will generate funds to help underwrite subsidies to upgrade and replace trucks.¹⁸

In addition, CARB has adopted regulations for harbor craft, including ferries, tugboats, and tow boats, which will require the replacement of unregulated engines beginning in 2009, and will accelerate the adoption of EPA's Category 1 and Category 2 marine engine pollution controls. These rules are still undergoing public comment prior to final approval.¹⁹

Alternative Power. In June 2004, the Port of Los Angeles opened the world's first Alternative Maritime Power (AMP) terminal for container ships, where cargo ships can plug in to power instead of operating auxiliary engines to generate electricity while at berth. The electrification project was the result of a lawsuit brought by the Natural Resources Defense Council and other groups, who sued the city claiming it failed to fully weigh air quality and other environmental impacts of the new container terminal. As a result of the suit, a state appeals court halted work on the terminal in October 2002, and Los Angeles subsequently agreed to electrify the terminal to cut diesel emissions while ships are at docks, among other measures.²⁰ A second terminal was outfitted with AMP capability in 2005. To encourage shippers to use the AMP facilities, in December 2004, the Los Angeles Board of Harbor Commissioners passed a policy resolution to help each existing Port customer underwrite the cost of building or retrofitting their first container or cruise ship to run on electrical power when docked, a cost estimated at \$320,000 - \$830,000 per vessel.²¹ Cruise ship terminals in San Francisco and Seattle are also implementing AMP, and CARB is in the process of drafting regulations to require the use of AMP at six of the state's ports.²²

Grants. CARB, the Port of Los Angeles, and the South Coast Air Quality Management District are also providing substantial amounts of financial support for the replacement of older, high-emitting engines and the conversion to lower emitting power sources. CARB will award \$221 million in FY2007-08 funds for "goods movement emission reduction" projects, and the Governor has requested a second installment of \$250 million in FY2008-09. Most requests for the funds have come from trucking companies, which would replace older engines or trucks with new

¹⁸ "Los Angeles Harbor Commission Approves Program to Replace Older Diesel Trucks," *Daily Environment Report*, March 24, 2008, p. A-9.

¹⁹ Information on these regulations can be found at [<http://www.arb.ca.gov/regact/2007/chc07/chc07.htm>].

²⁰ *Natural Resources Defense Council v. City of Los Angeles*, 126 Cal. Rptr. 2d 615 (Cal. App. 2002).

²¹ See Port of Los Angeles, "Alternative Marine Power," at [http://www.portoflosangeles.org/environment/alt_maritime_power.asp]. Also see "Alternative Maritime Power "Off and Running," presented by Eric Caris, at [<http://www.ffca2006.com/documents/presentations/marine/Eric%20Caris.pdf>].

²² See California Air Resources Board, "Rulemaking to Consider Adoption of Proposed Regulations to Reduce Emissions from Diesel Auxiliary Engines on Ocean-Going Vessels While at Berth at a California Port," December 6, 2007, at [<http://www.arb.ca.gov/regact/2007/shorepwr07/shorepwr07.htm>].

models that reduce emissions as much as 90%.²³ In addition, as noted, the ports will provide subsidies for truck and engine replacement from a fund generated by a \$35 per container fee. The grants will cover up to 80% of new truck cost.

Conclusion

As pollution from cars, trucks, and land-based stationary sources has been more tightly controlled over the last 40 years, the contribution of ships and port operations to air pollution in port cities has become more important. Simultaneously, foreign trade has grown dramatically, adding to the burden of pollution from these sources. Thus, pollution from ships and the port operations that serve them is now among the most important sources of sulfur oxides, nitrogen oxides, particulates, and other pollutants in numerous U.S. cities.

Controlling these sources of pollution is complicated by the fact that most oceangoing ships are registered in foreign countries. Thus, initial efforts at control were focused on international negotiations through the IMO, which established a basic structure (MARPOL Annex VI) that may be the basis of more stringent future controls. Negotiating, ratifying, and implementing MARPOL agreements is time-consuming, however, and thus far, has not resulted in more than token levels of regulation. Thus, EPA and state and local agencies (particularly those in California) have begun to address pollution from ships using the Clean Air Act and comparable state authorities.

Not all pollution from marine vessels comes from foreign ships. Smaller craft, such as ferries, tugboats, and fishing boats do tend to be registered in the United States, and are thus more amenable to control. Even for these smaller craft, the technical issues can be complex, as the vessels include a wide variety of engine sizes and ship configurations. Safety also poses important considerations, as ships must be able to depend on their sources of power in what may be extreme weather conditions and while dealing with a variety of navigational hazards.

Because ships and port operations are now such significant sources of air pollution, further regulatory and legislative efforts to control their emissions are likely. In addition, ships are a large and growing source of greenhouse gas emissions; how and whether to regulate these emissions are the subject of IMO discussions and may enter into the larger debate over legislation to address climate change.

Congress has begun efforts to address these problems, and enacted legislation to implement MARPOL Annex VI in July 2008. But this is likely to be just the start of Congressional attention to air pollution from ships. Action at the state level, in the courts, and at U.S. EPA will continue to bring the issue to Congress's attention, with numerous opportunities for oversight and legislation.

²³ See CARB, "Emissions Reduction Plan for Ports and Goods Movement in California: Update on Implementation," Staff Presentation, Air Resources Board Meeting, Oakland, CA, April 24, 2008 at [<ftp://ftp.arb.ca.gov/carbis/board/books/2008/042408/08-4-7pres.pdf>].