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Diesel Fuel and Engines: An Analysis of EPA's New Regulations

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Brent D. Yacobucci, James E. McCarthy, John W. Fischer,
Alejandro E. Segarra, and Lawrence C. Kumins
Resources, Science, and Industry Division

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Summary

This report reviews the final regulations on diesel fuel and diesel engine emissions signed by Environmental Protection Agency Administrator Carol Browner December 21, 2000. The engine regulations would be phased in beginning with Model Year 2007, with full compliance required by Model Year 2010. As compared to current engines, engines meeting the proposed standards would emit 90% less particulate matter (a respiratory irritant and likely human carcinogen) and 95% less nitrogen oxides, a group of gases that contribute to the formation of ozone. Because sulfur interferes with the operation of the emission control technologies to be used, the regulation also requires a reduction of 97% in the allowable concentration of sulfur in diesel fuel, from 500 to 15 parts per million, effective in June 2006.

Reactions to the new regulations are mixed. State and local air pollution officials, environmental groups, the auto industry, and diesel engine manufacturers appear largely satisfied with the rule, although some want EPA to modify its implementation schedule or require even greater reductions in fuel sulfur. Refiners, service station owners, the trucking industry, and agricultural groups have largely opposed the rule, arguing that it would be difficult and costly to meet, could result in refinery closures, and would cause shortages of diesel fuel, with associated price spikes. Instead of 15 parts per million (ppm), the refining industry has backed a 50 ppm sulfur standard. EPA, the engine manufacturers, and the manufacturers of emissions controls say that 50 ppm would not be sufficiently stringent to permit optimal operation of pollution controls.

While the refining industry has generally opposed the rule, two refiners (BP and Tosco) are supportive. Conversely, while engine manufacturers have generally supported the rule, Cummins Engine has expressed reservations about the availability of the technology and suggested that EPA delay promulgation of the final rule pending further development and demonstration of the necessary pollution controls. Some reactions to the rule are influenced by the knowledge that, in the absence of strong federal standards, states (including California) have begun to adopt their own standards. Thus, the California Trucking Association supports the EPA proposal, in hopes of leveling the playing field between them and out-of-state trucking firms.

This report examines the rule's potential impacts on fuel supply, summarizes the issues related to pollution controls, discusses potential impacts on the economy, and discusses issues raised by the timing and implementation schedule of the proposed rule.

EPA held 5 public hearings on the proposed rule during the month of June 2000 and accepted public comment until August 14. The Clean Air Subcommittee of Senate Environment and Public Works held hearings June 15 and September 21, 2000. Continued congressional oversight is considered possible.

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Introduction

Since the beginning of federal regulation of vehicle emissions in the late 1960s, diesel vehicles and engines have faced less stringent emission standards than their gasoline counterparts. The most significant reason is that passenger vehicles (which generally have gasoline engines) were seen as the greatest contributor to mobile source pollution and were targeted first. As emissions from gasoline engines have improved, and the share of emissions from diesel engines has increased, more attention is now being paid to reducing the emissions from diesels.[1]

On June 2, 2000, under authority of the Clean Air Act, the Environmental Protection Agency (EPA) proposed tighter rules for emissions from heavy-duty trucks and buses starting in model year (MY) 2007. These regulations were finalized December 21, 2000.[2] To ensure that the emission control technologies necessary to meet the tighter standards will operate effectively, EPA has proposed a reduction of 97% in the allowable sulfur level of diesel fuel. The new regulations are in addition to earlier regulations on light- and heavy-duty vehicles starting in MY2004.

The Agency's move to regulate diesel engine and vehicle emissions more stringently responds to concerns over the health effects of certain components of diesel exhaust, especially fine particulate matter and nitrogen oxides. In addition to the standards for diesel trucks and highway fuel, the Agency also recently promulgated standards to control emissions from diesel locomotives, light-duty diesel vehicles, and marine diesel engines.[3] Additionally, EPA expects to propose standards for diesel engines and fuel used in off-road vehicles (e.g. farm and construction equipment) in 2001.

The Subcommittee on Clean Air, Wetlands, Private Property, and Nuclear Safety of the Senate Environment and Public Works Committee held hearings June 15 and September 21, 2000, on the proposed rules. Given the broad nature of the rules'

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[1]Several states have been active in creating new policies that would tighten highway and nonroad diesel emissions, especially in the Northeast, Southwest, and West Coast.

[2]The proposed regulations and extensive background information can be found at 65 Federal Register, pp. 35430-35559, June 2, 2000. Additional background information is available on EPA's web site at [http://www.epa.gov/otaq/diesel.htm]. The final regulations were signed by EPA Administrator Browner December 21, 2000. They are expected to appear in the Federal Register the week of January 16, 2001.

[3]Information on these regulations can be found at [http://www.epa.gov/otaq/nonroad.htm].

potential impacts, others in Congress have expressed an interest, and congressional interest is considered likely to continue in the 107th Congress. Anticipating continued interest, this report provides an analysis of EPA's proposal.

Why Are Diesel Emissions A Concern?

The regulation of diesel fuel and engines presents a growing environmental policy issue in the United States and other countries. On one hand, the better fuel economy of diesel engines leads to lower emissions of carbon dioxide.[4] Furthermore, since diesel fuel burns more completely, diesel engines tend to have lower hydrocarbon and carbon monoxide emissions.[5] On the other hand, diesel fuel tends to lead to higher emissions of particulate matter (PM) and nitrogen oxides (NO_x).

Particulate matter emissions from diesel vehicles are a key concern because of the potential health effects, including asthma and reduced lung function. Particulate matter is one of six so-called "criteria" air pollutants for which EPA has set nation-wide health standards (National Ambient Air Quality Standards) to be attained by states and local areas. Currently, 76 metropolitan areas with a combined population of 29.8 million have not attained the National Ambient Air Quality Standard (NAAQS) for PM. Under stricter standards promulgated by the Agency in 1997 but not yet implemented, many additional areas would be added to the list.

Diesel particulates are also increasingly considered to be toxic air pollutants. Because of the reported health effects of diesel PM, the California Air Resources Board in 1998 declared diesel PM a toxic air contaminant;[6] in 1990, California had identified diesel exhaust as a chemical "known to the State to cause cancer."[7] A study undertaken by California's South Coast Air Quality Management District in 1999 concluded that diesel emissions account for 71% of the estimated cancer incidence from urban air toxics -- an estimated 16,250 cases of cancer in the Los Angeles area alone.[8] EPA is also currently investigating the health effects of diesel exhaust,

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[4]Although not a regulated pollutant, carbon dioxide is an environmental concern because it is considered a greenhouse gas.

[5]Both regulated pollutants, carbon monoxide and hydrocarbons contribute to ground-level ozone.

[6]State of California, Air Resources Board, *Resolution 98-35*. August 27, 1998. The validity of this study has been criticized by engine manufacturers because, they argue, it relies on tests using outdated engine technology and because it improperly uses existing health data. See Engine Manufacturers Association, *Engine Manufacturers Challenge California Report on Diesel Exhaust.* April 23, 1998.

[7]State of California, Air Resources Board, Scientific Review Panel Chairman's Cover Letter and Panel Findings on Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant, May 27, 1998, available at [http://www.arb.ca.gov/regact/diesltac/diesltac.htm].

[8] See "Diesel Soot Emerges as Leading Cancer Threat in Air Toxics Study," *Daily Environment Report*, November 8, 1999, p. A-8. The study referred to is the Multiple Air Toxics Exposure Study (MATES-II) Draft Report, November 5, 1999, undertaken by South

(continued...)

including its cancer-causing potential; the Agency's draft health assessment, undergoing final revision after a decade of review, concludes that diesel emissions are a "likely human carcinogen."[9]

Nitrogen oxide emissions from diesel engines are also a key concern: NO_x is a precursor of ozone, which can cause respiratory problems and aggravate existing respiratory conditions. As of January 2001, 272 counties with a combined population of 109.3 million have not attained the NAAQS ozone standard. While other ozone precursors (volatile organic compounds and carbon monoxide) have decreased over the past ten years, emissions of NO_x, including those from on-road vehicles, have increased.[10]

New Regulations

EPA's new regulations on diesel fuel and vehicles cover light-duty vehicles, heavy-duty vehicles, and sulfur in diesel fuel. Light-duty vehicles include all highway vehicles under 8,600 pounds of gross vehicle weight, and passenger vehicles below 10,000 pounds gross vehicle weight.[11] Heavy-duty vehicles are highway vehicles above these weight ratings.

Light-Duty Vehicles

On February 10, 2000, EPA promulgated new rules regulating emissions from light-duty vehicles, including both passenger cars and light trucks.[12] These standards will be phased in between Model Year 2004 and MY2009. In addition to requiring substantial reductions in emissions, these so-called "Tier 2" standards were notable for two features: 1) for the first time, the regulations required light trucks and passenger cars to meet identical standards (trucks, including vans and sport utility vehicles, had previously been allowed greater emissions); and 2) the regulations require vehicles to meet the same standards regardless of fuel type.[13] Under previous regulations, diesel vehicles have been allowed to emit higher levels of NO_x than gasoline vehicles. Few light-duty vehicles are diesel-fueled, so the existing difference in standards has had little effect; but EPA was concerned that less stringent standards

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[8](...continued)
Coast Air Quality Management District. The final report (in which the conclusions did not change) is available at [http://www.aqmd.gov/matesiidf/matestoc.htm].

[9]See [http://www.epa.gov/ncea/dieslexh.htm].

[10]EPA, *National Air Quality and Emissions Trends Report, 1998,* March 2000, pp. 11, 27, 122.

[11]Gross vehicle weight is defined as the weight of the vehicle plus the weight of passengers and a full load of cargo.

[12]The category of light trucks includes pickups, sport utility vehicles (SUVs), and vans.

[13]For an analysis of the Tier 2 standards, see CRS Report RL30298, *Air Quality and Motor Vehicles: An Analysis of Current and Proposed Emission Standards.*

for diesel vehicles might lead to an increase in their use, with negative effects on air quality.

Figure 1. Effective Dates of New Diesel Regulations

MY2004

- **Light-duty vehicles:** Emissions standards for light-duty vehicles must be significantly reduced under the Tier 2 regulations; diesel and gasoline standards are equalized under "fuel neutral" strategy.
- **Heavy-duty vehicles:** NO_x standards for heavy-duty diesel engines will be decreased by 50%.

MY2007

- **Heavy-duty vehicles:** Engine NO_x standards will be decreased a further 90% (a 95% decrease from current levels) and PM standards take effect, a 90% reduction from current levels. The standards apply to 50% of vehicles sold in MY2007-2009, with full compliance required in MY2010.
- **Diesel Fuel:** Allowable sulfur levels in diesel fuel will be decreased from 500 ppm to 15 ppm–a 97% reduction from current levels. Approximately 25% of fuel will be allowed to meet the old standard until June 1, 2010.

The fuel-neutral approach to regulation embodied in the Tier 2 standards concerns some engine manufacturers who think that making diesel vehicles that meet the new standards will lead to higher consumer costs. EPA predicts that the new regulations will cost less than $100 per vehicle for most passenger cars, less than $200 for most light trucks, and less than $300 for the largest (8,600 - 10,000 pound) passenger vehicles, with no increases in the cost of vehicle care and maintenance.[14] In the public comment period for the proposed rule, critics argued that EPA did not look at diesel-fueled light-duty vehicles specifically, and that per vehicle costs for diesels could be as high as $1,000. In response, EPA contended that while diesel costs were not specifically addressed, additional costs will be negligible compared to the costs for gasoline vehicles, because increased costs will be spread over large production runs and across multiple models.[15]

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[14]Environmental Protection Agency, *Tier 2/Gasoline Sulfur Final Rulemaking: Regulatory Impact Analysis - Review Draft.* December 22, 1999. p. V-26.

[15]Environmental Protection Agency, *Tier 2 Motor Vehicle Standards and Gasoline Sulfur Control Requirements: Response to Comments.* p. 23-2.

Heavy-Duty Vehicles

In addition to the Tier 2 rules, in 1997, EPA promulgated tighter emission standards for heavy-duty vehicles that will take effect in MY2004. In October 1999, EPA reaffirmed the technological feasibility, cost-effectiveness, and appropriateness of these standards. These new standards will cut NO_x emissions from heavy-duty highway engines by approximately 50% from the MY1998 standards.[16] Responding to concerns that engine manufacturers were building engines that emitted higher amounts of pollution on the road than during testing, on October 6, 2000, EPA promulgated more accurate emissions testing procedures and standards to guarantee that actual emissions are reduced to the levels that the new standards require. As part of this rule, all heavy-duty vehicles under 14,000 pounds gross vehicle weight will be required to have on-board diagnostic equipment to monitor the performance of emission control devices.[17]

In addition to the MY2004 standards, on December 21, 2000, EPA finalized further heavy-duty engine standards that take effect in MY2007. (These proposed standards are the focus of this report.) These standards will reduce NO_x emissions by approximately 90% below the MY2004 levels, and PM by 90%.[18] The technology necessary to meet the PM standard has been demonstrated on the road and is available, but the NO_x reduction technology has not been demonstrated outside the lab. (Whether this technology will be available in time for engine manufacturers to meet the proposed standard is one of the major issues raised by the new rule. The issue is discussed below, on pp. 13-16.)

Sulfur in Diesel Fuel

Meeting the proposed emission standards will require very low levels of sulfur in diesel fuel. Sulfur can corrupt emission control devices, and the newest technologies for emissions control are especially sensitive to sulfur. Supporters of tightened standards argue that in addition to allowing the use of advanced technology in new vehicles, lower sulfur levels will lead to decreased emissions from existing vehicles, as well.[19]

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[16]Environmental Protection Agency, *Control of Emissions of Air Pollution From Highway Heavy-Duty Engines; Final Rule.* 62 FR 54693-54730. October 21, 1997.

[17]Environmental Protection Agency, *Emissions Control, Air Pollution From 2004 and Later Model Year Heavy-Duty Highway Engines and Vehicles; Light-Duty On-Board Diagnostics Requirements, Revision; Final Rule.* 65 FR 59895-59978. October 6, 2000. Because the Clean Air Act requires four years of lead time for new requirements, and because the rule was finalized after the start of MY2001, the testing and on-board diagnostic requirements will be delayed until MY2005 (MY2006 for some manufacturers). The emissions standards were finalized in 1997, so those will still go into effect starting in MY2004.

[18]Environmental Protection Agency, Office of Transportation and Air Quality, "Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements," Regulatory Announcement, December2000, available at [http://www.epa.gov/otaq/diesel.htm].

[19]Environmental Protection Agency, *Control of Diesel Fuel Quality; Advance Notice of* (continued...)

Currently, highway diesel fuel is regulated at a maximum of 500 parts per million (ppm) sulfur, and averages around 300 ppm. EPA has proposed a reduction to 15 ppm to allow for the use of advanced emission controls. Agency officials argue that any higher level would jeopardize the efficiency and reliability of emission control systems, and any lower level would produce little benefit compared to the added expense.[20]

Refiners have criticized this standard as too costly and likely to lead to supply disruptions and market instability.[21] The American Petroleum Institute, the industry's trade association, contends that a standard of 50 ppm, the same as that being adopted in 2005 by Japan and the European Union (EU),[22] would achieve clean air goals without substantial disruption of supply or price. (This issue is further discussed below, on pp. 6 - 12.)

Key Issues

The new diesel fuel and engine regulations will likely promote long-term improvements in air quality and public health. However, several issues have been raised by various stakeholders. The four main issue areas are: the cost of meeting the diesel fuel standards, and the possibility of fuel supply disruptions; the availability, performance, and cost of new emissions control technology; the economic effects on users of diesel fuel and on consumers in general; and the timing of the new standards. These four areas will be addressed in turn.

Cost and Supply of Low-Sulfur Diesel

One of the key issues in the debate over the proposed rule is the potential cost to refiners, and the ultimate cost to consumers of the new ultra-low sulfur diesel fuel. The refining industry argues that the cost will be high, that some refiners will choose not to make the required investments, and that, as a result, there will be shortages of diesel fuel for as long as two years after the deadline for implementation (September 1, 2006).[23] According to the refining industry, these shortages, combined with difficulties in distributing the new fuel, will cause price spikes and supply disruptions, with negative effects that will ripple through the economy.

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[19](...continued)
Proposed Rulemaking. 64 Federal Register 26142-26158, May 13, 1999.

[20]Environmental Protection Agency, *Control of Air Pollution from New Motor Vehicles: Proposed Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements*, 65 Federal Register 35480, June 2, 2000.

[21]American Petroleum Institute, *API Comments on the 2007 Heavy-Duty Engine/Diesel Sulfur Proposed Rule*, August 14, 2000.

[22]EU members have the option of mandating lower sulfur ppm standards if they choose.

[23]Personal communication, David Montgomery, Charles River Associates, October 4, 2000. Mr. Montgomery was the principal consultant on a study of the rule's potential impact, conducted for the American Petroleum Institute.

Technology Concerns. EPA argues that there are many reasons to believe that scenarios in which refiners cannot produce the necessary fuel and distributors cannot distribute it are unlikely. According to EPA and most independent industry analysts, there are no significant technological barriers to reducing sulfur levels to 15 ppm.[24] Sulfur is removed from diesel fuel in refinery units called hydrotreaters. In hydrotreaters, oil is heated and subjected to high pressure with hydrogen as an added input. The oil reacts with the hydrogen in the presence of a catalyst, separating the sulfur from the fuel. To remove additional amounts of sulfur in a hydrotreater requires higher temperatures and pressures, improved catalysts, and increased hydrogen purity.

EPA says that existing hydrotreaters and other equipment used to meet the 500 ppm standard can be expanded, and additional systems can be added. Given the lead-time of six years, the Agency expects that refiners will be able to plan the necessary expansions during scheduled down times. Also, EPA believes that some refiners will experience synergy in meeting both the diesel sulfur regulations and the related Tier 2 gasoline sulfur regulations, which begin to take effect in 2004.

Refiners claim that those promoting the proposed sulfur standard underestimate the barriers to the expansion of desulfurization technology. Refining industry representatives argue that while some existing equipment can be used, because of the very low level of sulfur, significant additional desulfurization equipment will be necessary. Furthermore, they contend that because of the higher pressures called for in refinery units making the new fuel, some existing equipment will need to be completely replaced.

Refiners are also concerned that ultra-low sulfur diesel will require additional capital investment without added profits. Small refiners especially have raised this as an issue; they contend that less investment capital is available to them.[25] These smaller refiners believe that the new regulations could force them out of the diesel fuel market.

Because of these concerns, EPA granted refiners additional flexibility in the final rule. Large refiners will be allowed to produce up to 20% of their total highway fuel at the old 500 ppm standard during a transition period that stretches from 2006 until June 1, 2010. During this period, credit trading within five geographic areas will allow refiners who choose not to meet the 80% requirement to purchase credits from others who exceed the requirement. Small refiners will be entirely exempt from the standard until June 1, 2010, provided that the refiners ensure the existence of sufficient volumes of 15 ppm fuel in the marketing area they serve. Small refiners who produce 15 ppm fuel prior to June 1, 2010, will generate credits that may be sold to other refiners and used as a method of compliance. Credits can also be generated by any refiner for early compliance after June 1, 2005. There are also special provisions for refiners in 8 western states, and a general hardship provision for which

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[24] See 65 Federal Register, pp. 35483-35486, June 2, 2000.

[25] Statement of J. Louis Frank, President of Marathon Ashland Petroleum (for the American Petroleum Institute), before the Senate Committee on Environment and Public Works Clean Air Subcommittee, June 15, 2000.

any refiner may apply. These provisions essentially give refiners who expect difficulty in meeting the new standard four extra years to achieve compliance.[26]

Cost. Whatever disagreements there may be concerning the capability of the refining industry to produce lower sulfur fuel, all stakeholders agree that the new fuel will cost more to manufacture. While many stakeholders – including some major refiners – are confident that 15 ppm sulfur fuel can be produced in the quantities necessary to meet demand, estimates for the increase in production cost cover a wide range. EPA predicts that the added production cost for ultra-low sulfur diesel will be approximately 4.4¢/gallon,[27] while a study by MathPro, Inc. for the Engine Manufacturers Association estimates the cost at 4.6 to 6.2¢/gallon.[28] In its comments on EPA's proposed rule, the Department of Energy's Oak Ridge National Laboratory (ORNL) predicted that it would cost approximately 4.3¢ to 5.9¢ per gallon to convert 50% of domestic highway diesel production capacity to ultra-low sulfur diesel, and approximately 7.5¢ to 9.9¢ per gallon to convert the last quartile of domestic capacity to produce the proposed fuel.[29] The American Petroleum Institute (API) estimated the cost at 8.9¢ per gallon.[30]

Most of these cost estimates assume that current technologies will be used to produce the ultra-low sulfur fuel. Technology may improve, however, bringing lower costs. For example, on October 3, 2000, Phillips Petroleum announced that it has developed a new sulfur removal technology that uses significantly lower pressures than conventional hydrotreating processes, uses less hydrogen, and permits the regeneration of sorbent material while the unit is operating, allowing for "prolonged run times between shutdowns." While not being specific regarding cost savings, the

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[26]A quick summary of these provisions is provided in the EPA Office of Air and Radiation Fact Sheet (EPA 420-F-00-057), "Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements," December 2000, p. 3, available at [http://www.epa.gov/otaq/diesel.htm#documents]. More complete details are provided in Sections V. A., B., and C. of the Preamble to the Final Rule, pp. 146-186, available at the same web-site.

[27]These costs would be partially offset, in EPA's analysis, by engine maintenance savings averaging one cent per gallon, for a net increase in cost of 3 to 4 cents per gallon.

[28] The value from the MathPro study is actually an interpolation made by EPA, since MathPro looked at the refining costs for 2 ppm and 20 ppm sulfur diesel fuel, as opposed to the 15 ppm required in the proposed rule. See U.S. EPA, Office of Air and Radiation, *Draft Regulatory Impact Analysis for the Proposed Heavy Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements Rule*, p. V-89.

[29]EnSys Energy & Systems, Inc. for Oak Ridge National Laboratory, *Modeling Impacts of Reformulated Diesel Fuel: Interim Report*, August 14, 2000, p. 16. The ORNL study notes, however, that rather than domestic refiners investing to convert the most difficult domestic fuel streams to low sulfur diesel, it might be cheaper to have refiners outside the United States process their "easiest" streams to less than 10 ppm (at lower cost) and export those to the United States, thus lowering the total cost of compliance with the rule. Ibid., p. 12.

[30]American Petroleum Institute, "API Comments on the 2007 Heavy-Duty Engine/Diesel Sulfur Proposed Rule," p. 74. API adds that incorporating additional distribution costs (discussed below) and losses in fuel economy brings the cost to manufacture and distribute the fuel to 11.0¢ per gallon.

company stated that, "The technology is expected to help minimize capital costs and everyday operating expenses while achieving targeted product quality."[31]

Distribution Issues. Stakeholders opposing the rule are also concerned that distributing the new fuel could be expensive. Segregating ultra-low sulfur diesel from other distillates in pipeline transport may be difficult. The specification ratio (the ratio of a given specification of two abutting streams in a pipeline or at a terminal – in this case, the ratio of the sulfur content of 15 ppm diesel fuel with other distillates such as off-road diesel fuel) could be as much as 300:1. The only comparable situation was the introduction of unleaded gasoline, where the ratio was approximately 50:1. Because of the difference in the two fuels, more fuel is required as an interface between the abutting streams. Fuel contaminated in spacing batches of distillate would be downgraded to a lower specification or returned to the refinery for reprocessing, with the loss in value due to downgrading considered part of the added cost of distributing the lower sulfur fuel.

EPA estimates that the added cost of distributing ultra-low sulfur diesel fuel will be approximately 0.5¢/gallon long term (i.e., once the sulfur standard is fully effective in 2010). In the initial period between 2006 and 2010, when two grades of highway fuel would be available, costs of distribution will be higher because of the need to provide additional tanks at refineries, terminals, and truck stops for an extra grade of fuel: EPA estimates the distribution costs during this initial period as 1.1¢/gallon.[32] Another study, by Turner, Mason & Company for the American Petroleum Institute, estimates that the added long term cost could be as much as 0.9¢/gallon.[33] This discrepancy arises from the fact that Turner Mason assumes a higher percentage of each batch of diesel fuel will need to be downgraded than does EPA.

Turner, Mason & Company also identify another potential problem. Downgrading of large batches of fuel could lead to localized supply disruptions. According to their study, some terminals may not have enough demand for the other distillate fuels to which contaminated ultra low sulfur diesel would be downgraded, and may not have the additional tankage necessary to store the downgraded fuel. If this is the case, some terminals may need to return fuel to the refinery for reprocessing or face a situation where they have no storage space available for a new batch of uncontaminated ultra-low sulfur diesel.[34] However, if terminals are permitted to expand and if they have the available capital, it appears that the five-and-a-half years of lead-time provided by the proposal should allow for construction of more storage capacity.

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[31]Phillips Petroleum Company, "Phillips Announces S Zorb Sulfur Removal Technology for Diesel," press release, October 3, 2000, available at [http://phillips66.com/newsroom/].

[32]U.S. EPA, *Regulatory Impact Analysis,* p. V-124.

[33]Turner, Mason & Company, *Revised Supplement to Report - Costs/Impacts of Distributing Potential Ultra Low Sulfur Diesel,* August 8, 2000, Table 2.

[34]Turner, Mason & Company, *Costs/Impacts of Distributing Potential Ultra Low Sulfur Diesel,* February 2000, p. 16.

Other Factors Affecting Supply. A few other supply concerns have also been presented. A key concern raised by fuel marketers is that the technology does not exist to produce low sulfur diesel from certain blendstocks. Specifically, one blendstock, light cycle oil (LCO), has a very high sulfur content, in addition to a high aromatic content.[35] Fuel marketers argue that it would be economically infeasible to use it to produce low-sulfur diesel fuel. Therefore, they argue, the diesel supply could be limited from the start.[36] EPA argues that, due to the higher weight of LCO, it is a relatively easy process to remove LCO from the input blend. Then, it is possible to use the remaining, purer blendstock for low-sulfur diesel, while using LCO to produce other fuels such as heating oil or non-road diesel.[37]

Another issue raised by diesel suppliers is that the United States would be unable to import diesel to meet domestic shortages. Because the proposed sulfur level is below that of most other countries, unless foreign refiners upgrade their refineries to meet the new U.S. standard, their supplies would be unavailable to U.S. markets.[38]

Effects of Supply Disruptions. A related concern is the question of supply disruptions with the introduction of the new fuel. According to a study by Charles River Associates for API, some refiners will be unlikely to expand production of diesel fuel, and may even reduce or eliminate diesel fuel production in light of the uncertainty brought on by the proposed sulfur rule. They predict that this could lead to price spikes of 15¢ to 50¢ per gallon until such time as production capacity can expand and/or imports can increase.[39] In addition, the National Petroleum Council (NPC), which is composed largely of industry executives, but acts in an advisory capacity to the Secretary of Energy, states that there is a significant risk of supply disruptions if ultra-low sulfur diesel is required before 2007, since the introduction would overlap with the introduction of low-sulfur gasoline.[40]

However, according to the Turner, Mason study, as well as the EPA rulemaking documents, over the last 25 years the petroleum industry has faced many challenges with introducing new fuels, and most changes were relatively benign. In many cases, including the introduction of the current low sulfur (500 ppm) diesel in response to Clean Air Act requirements in 1993, the refining industry converted more equipment than necessary to meet the new standards, resulting in overproduction and leading to

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[35]The high aromatic content of LCO makes it especially difficult to remove sulfur because the aromatics must first be removed or chemically altered.

[36] Statement of James A. Haslam, Pilot Oil Corporation, before the Subcommittee on Clean Air, Wetlands, Private Property and Nuclear Safety, Senate Committee on Environment and Public Works, June 15, 2000, available at [http://www.senate.gov/~epw/has_0615.htm].

[37]U.S. EPA, *Draft Regulatory Impact Analysis,* p. IV-25.

[38]James A. Haslam, op. cit.

[39] Charles River Associates, Inc., *An Assessment of the Potential Impacts of Proposed Environmental Regulations on U.S. Refinery Supply of Diesel Fuel,* August 2000, p. 3.

[40]National Petroleum Council, *U.S. Petroleum Refining - Executive Summary,* June 20, 2000, p. 24. Under the Tier 2 rule, low sulfur gasoline will be required beginning in 2004.

prices lower than those predicted.[41] That is not to say that changes in fuel specifications have not come at some difficulty and expense, but major price spikes have been uncommon.

In the Clinton Administration's final discussions concerning this issue, the Department of Energy argued that cost impacts and the potential for price spikes could be substantially lowered by phasing in the rule. DOE suggested a 9-year phase-in, with 20% of highway diesel fuel required to meet the 15-ppm standard in 2007 and additional increments each year until 100% compliance would be reached in 2015. DOE estimated the cost savings from such a phased implementation at $14-27 billion.[42]

DOE's position was opposed not only by EPA, but also by the petroleum industry. Spokesmen for the American Petroleum Institute and the National Petrochemical and Refiners Association termed a phase-in "expensive" and "awkward"; in addition to causing distributional difficulties and requiring large investments to keep the two fuels separate during the phase-in period, the additional costs would be stranded when the market reverted to a single fuel in 2015, according to the industry groups.[43]

As noted, the final rule will allow several exemptions from the 15 ppm standard during a 4-year transition period. (The exemptions are described above, on page 7.) These provisions are expected to allow up to 25% of highway diesel fuel to continue to be produced at the 500 ppm sulfur standard until 2010. This fuel will need to be separated from 15 ppm fuel in the distribution system, however, and may only be used in pre-2007 model year engines.

Petroleum Industry Alternative. While two major refiners (BP and Tosco) supported EPA's 15 ppm proposal,[44] and another (Phillips) has announced the development of new technology to help meet its requirements, the bulk of the petroleum refining, transportation, and marketing industry opposes the 15-ppm rule. Instead of EPA's proposal, the American Petroleum Institute (API) and the National Petrochemical and Refiners Association (NPRA) developed an alternative proposal to limit diesel sulfur to 50 ppm.

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[41]Personal communication, David Montgomery, Charles River Associates, October 4, 2000.

[42]Margaret K. Singh, Center for Transportation Research, Argonne National Laboratory, for U.S. Department of Energy, Office of Policy and Office of Transportation Technologies, *Analysis of the Cost of a Phase-in of 15 ppm Sulfur Cap Diesel Fuel*, November 2000, p. 2.

[43] See "Groups Make Last Pitch for Diesel Rule in Letter to Clinton, Talks with Officials," *Daily Environment Report*, December 7, 2000, p. A-1, and "EPA vs. DOE: The Diesel Battle," *Air Daily*, December 6, 2000, p. 1.

[44] "BP's Comments on EPA's Proposed Rulemaking for Heavy Duty Diesel Engines, Vehicle Standards and Diesel Fuel Sulfur," August 14, 2000, and "Tosco Corporation Announces Support of Low-Sulfur Diesel Proposal and Results of 2000 Annual Meeting of Stockholders," Press Release, May 18, 2000. The latter is available at [http://www.prnewswire.com/cgi-bin/micro_site.pl?Tick=tos].

As stated by Jerry Thompson of CITGO Petroleum, representing NPRA at a Senate hearing, June 15, 2000:

> The refining industry agrees that the sulfur levels in diesel must be reduced, but the program must be reasonable. The industry proposed a plan to EPA that would lower the current limit of 500 ppm of sulfur in diesel fuel to a limit of 50 ppm – a 90% reduction. This is a very significant step. It will enable diesel engines to meet the particulate matter standards sought by EPA and also achieve significant NO_x reductions. Our plan can yield a 90% reduction in particulate matter and a 75% reduction in NO_x emissions from new heavy-duty diesel engines. Industry's plan is still expensive – we estimate it will cost the industry roughly $4 billion to implement. But, unlike EPA's extreme and much more costly proposal, the level of sulfur reduction proposed by industry is attainable and sustainable.[45]

The petroleum industry plan, like EPA's, relies on the use of particle filters (or "traps") to capture particulate matter; but the additional sulfur in 50 ppm fuel would affect the performance of the filters, require more frequent maintenance, and shorten their expected life, according to manufacturers of the equipment.[46]

NO_x, on the other hand, would be removed by a completely different technology, in the oil industry's plan: selective catalytic reduction (SCR), rather than the NO_x adsorbers that the engine manufacturers expect to use (and on which EPA based the rule).[47] SCR is a promising NO_x removal technology, modeled on controls used by power plants and other stationary sources; but, it requires the use of urea (a compound of ammonia that is commonly used as a fertilizer) to react with the sulfur. The urea would have to be supplied to the nation's truck stops and diesel fueling stations through an entirely new distribution system; this approach would put the burden on truckers to maintain urea levels in their emission control systems (according to API, urea would need to be replenished every 5,000 - 10,000 miles). If the urea were not replenished, the emission control system would not function.[48] For this and other reasons, engine manufacturers, the emission controls industry, and

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[45] Statement of Jerry Thompson, CITGO Petroleum, on behalf of the National Petrochemical & Refiners Association, Highway Diesel Fuel Sulfur Regulations Hearing, Senate Environment and Public Works Committee, Subcommittee on Clean Air, Wetlands, Private Property, and Nuclear Safety, June 15, 2000, p. 1.

[46] Written Statement of the Manufacturers of Emission Controls Association on the U.S. Environmental Protection Agency's Proposed Heavy-Duty Engine and Vehicle Standards and Highway Diesel Sulfur Control, Docket No. A99-06, August 14, 2000, pp. 7-8.

[47] For a discussion of SCR technology, including API's analysis of its feasibility, see API Comments on the 2007 Heavy-Duty Engine/Diesel Sulfur Proposed Rule, August 14, 2000, pp. 37-39.

[48] Ibid., p. 38. EPA discusses this issue, and its preference for NO_x adsorbers at 65 Federal Register 35470, June 2, 2000.

EPA have concluded that such a system would be impractical for long haul trucks, although it might be an option in the case of centrally fueled and maintained fleets.

Availability and Performance of Emissions Control Technology

In addition to the price and availability of diesel fuel, stakeholders (particularly engine manufacturers) are concerned that the technology necessary to meet the new emissions standards may be unavailable. While PM control technology is commercially available now, NO_x control technology is still in research and development. If the emissions control technology that EPA relies on fails to meet commercialization goals or fails to provide the expected benefits, EPA would be unable to certify engines as meeting the proposed standard. Without certification, engines cannot legally be offered for sale.

Engine Manufacturers. In comments filed with EPA, the Engine Manufacturers Association outlined a number of concerns with the proposed rule, arguing that the standards are not technologically feasible within the proposed time frame, that the test methods specified by the Agency cannot accurately measure compliance, that the NO_x and PM standards need to be made less stringent, and that – in contrast to the views of the petroleum industry – the sulfur content of diesel fuel should be capped at 5 ppm (10 ppm less than EPA is requiring).[49]

In its oral statement at EPA's public hearings, the association appeared more supportive, however. Its comments focused almost exclusively on the need to remove "essentially all sulfur from diesel fuel"; otherwise, the industry's spokesman sounded optimistic about the industry's ability to perform:

> As we sit here today, we are on the cusp – the critical turning point – of something spectacular. We have within our grasp the potential to dramatically reduce the emissions of the most fuel efficient, reliable and durable source of motive power available today ....
>
> There are issues which will require a great deal of work by manufacturers and the Agency. But it is no longer a question of if. Give us fuel improvements, sufficient time, compliance flexibility, and testing certainty, and tremendous emission reduction can be achieved.[50]

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[49] Statement of the Engine Manufacturers Association, Control of Air Pollution from New Motor Vehicles: Proposed Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, EPA Docket No. A-99-06, August 14, 2000.

[50] Oral Statement of the Engine Manufacturers Association, Control of Air Pollution from New Motor Vehicles: Proposed Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, Docket No. A-99-06, Public Hearings, June 2000, available at [http://www.engine-manufacturers.org/rulemaking/].

If the industry has been generally supportive, one of the major engine manufacturers, Cummins Engine Company, has been vocal in asking that EPA take additional time before finalizing the regulations. In testimony before the Senate Environment and Public Works Committee's Clean Air Subcommittee, a Cummins representative stated:

> Cummins' current best estimate of the system of aftertreatment devices necessary for compliance includes four components: a particulate trap, a sulfur trap, a NO_x adsorber and an oxidation catalyst. These devices, however, are in varying stages of early development. Particulate traps are in limited production with more development required. Sulfur traps [are] being developed, but are not developed yet. The NO_x adsorber is currently in the lab, but is still years away from field-testing. And, finally the oxidation catalyst is in production, but on limited applications.
>
> We can neither evaluate the pieces individually nor as an integrated system with the potential to achieve the proposed reductions. Moreover, we can only guess as to what impact the envisioned system of aftertreatment technologies will have on engine performance, fuel economy and cost.[51]

Cummins has not publicly argued with the implementation date of 2007, however. Rather, the company has asked that EPA delay finalizing the rule until further research and development can be done:

> We are urging EPA to provide an additional 18 to 24 months so that stakeholders can assess these issues, which are critical to the success of the ultimate rule. EPA can do this and still implement a rule for 2007.[52]

Manufacturers of Emission Controls. In achieving the mandated reductions, the engine manufacturers will work with companies that provide emission control equipment and catalysts. Representatives of these companies are confident of the standards' attainability, and are fully supportive of the proposal. In an October 2000 press release, the industry's trade association (MECA, the Manufacturers of Emission Controls Association) stated that "the Agency's proposal constitutes a carefully crafted and balanced program .... If the program is finalized, it will result in substantial, cost-effective emission reductions over the next several decades."[53]

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[51] Statement of Tina Vujovich, Cummins Inc., before the Subcommittee on Clean Air, Wetlands, Private Property and Nuclear Safety, Senate Committee on Environment and Public Works, September 21, 2000, available at [http://www.senate.gov/~epw/stm1_106.htm#09-21-00].

[52] Ibid.

[53] Statement of Bruce Bertelson, Executive Director, Manufacturers of Emission Controls Association, in "MECA Voices Support for Finalizing U.S. EPA's Heavy-Duty Engine Standards/Diesel Sulfur Limits," press release, October 3, 2000, available at

(continued...)

The MECA statement went on to address the question of whether the proposal offers sufficient time to develop and implement technology not yet demonstrated:

> If the EPA delays this important regulatory initiative, the substantial commitment in financial and human resources that is being made by MECA member companies and many others to develop and/or optimize the necessary technology solutions likely will be scaled back. ... Further, suggestions that EPA should wait until the necessary technological solutions are commercially available is totally unrealistic. Virtually no investment in technology development will occur based on the vague prospect that if technology is developed, regulations may be adopted. Such logic flies in the face of the 30-year success story of the Clean Air Act.[54]

Whether the technology to meet the standards can be developed in time will need to be apparent several years in advance of the rule's effective date: manufacturers expect to design and test prototypes and make manufacturing decisions by late 2004.[55] If the technology chosen by the manufacturers meets the emission standards for test engines and vehicles, the rule as finalized would presumably go forward. If the technology does not meet the standards, EPA would be faced with a choice of altering the standard, extending the deadline for compliance, or allowing manufacturers to produce and sell noncomplying engines "under limited circumstances in exchange for paying a penalty to the government."[56]

An Historical Analogy. The situation in which EPA and the engine manufacturers find themselves is not unlike that faced in the early 1970s by auto manufacturers and the Agency. The Clean Air Amendments of 1970, signed by President Nixon on December 31 of that year, required reductions in auto emissions by model year 1975 that would necessitate the use of technology not yet demonstrated on any motor vehicle in production. The manufacturers had less time than that offered by the diesel rule (only a little over three and a half years) between the enactment of the law and the effective date of its standards.

Representatives of the automotive industry appear to have been unanimous in stating that it would not be possible to meet standards by 1975, and ultimately EPA granted repeated suspensions of the standards. While granting suspensions, the

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[53](...continued)
[http://www.meca.org].

[54]Ibid.

[55] Personal communication, Tina Vujovich, Vice President, Environmental Policy and Product Strategy, Cummins Engine Company, Inc., September 14, 2000.

[56]The quote is from the EPA Federal Register notice, in which the Agency asked, among other things, for comment on the role such "nonconformance penalties" might play in the final rule. See 65 Federal Register, p. 35479, June 2, 2000.

Agency set interim standards to assure progress toward the ultimate goals.[57] Following the EPA suspensions, Congress eventually modified the statute, relaxing the standards, in 1977. It wasn't until 1980 and 1981 that the original standards for hydrocarbons and carbon monoxide were met; not until 1994 did the original NO_x standard of 0.4 grams per mile go into effect.

While the standards themselves were implemented more slowly than envisioned, the basic technologies on which EPA and the manufacturers relied (unleaded gasoline and catalytic converters) were implemented in time for the 1975 model year. The auto manufacturers and their suppliers gradually improved both engine and converter technologies after that date to achieve lower emissions. Unleaded fuel and catalytic converters still play key roles in auto emission control systems 25 years later.

Technology Review. In order to guarantee the effectiveness of the proposed diesel rules, EPA considered conducting a technology review in 2003 or 2004. This would allow the Agency to revisit the standards before implementation, and determine whether the necessary technology was likely or unlikely to be available by MY2007. A technology review was criticized by some as promoting inaction by the regulated entities. Notably, the Engine Manufacturers Association was among those opposed to a technology review, arguing that it would create additional uncertainty and "effectively prevent engine manufacturers from fully developing and investing resources toward achieving the standards finally adopted."[58] The final rule did not incorporate a technology review.

Cost. Engine manufacturers and users of heavy-duty vehicles are also concerned about the potential cost of the new technology. EPA predicts that new vehicle costs could increase by $1,990 for a lighter heavy-duty truck to $3,230 for the heaviest trucks in 2007, with a 40% decrease (to $1,170 and $1,870, respectively) by 2012. The Agency expects operating costs (including increased fuel cost) to increase by about $600 (for a light heavy-duty truck) to as much as $4,030 (for the heaviest trucks) in the long term.[59] Engine manufacturers argue that with so many uncertainties, engine costs could be much higher, and that in the short term, costs will certainly be higher.[60]

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[57] For information regarding two of the suspensions, see Bureau of National Affairs, *Environment Reporter*, August 3, 1973 and March 7, 1975.

[58] Statement of the Engine Manufacturers Association, EPA Docket No. A-99-06, August 14, 2000, pp. 64-65.

[59] EPA, Office of Air and Radiation, *Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements*, December 2000, pp. vii-viii. Available at [http://www.epa.gov/otaq/diesel.htm#documents].

[60] Statement of Cummins Inc. to EPA, Docket No. A-99-06. August 14, 2000. See also Statement of the Engine Manufacturers Association, previously cited, p. 93.

Economic Effects of the New Fuel and Engine Standards[61]

Whether the new regulations will have broad impacts on the U.S. economy primarily depends on whether large fuel price increases or disruptions in the supply of diesel fuel occur. As noted previously, diesel fuel cost increases have been estimated by four different sources to range from 4.3 cents to 9.9 cents per gallon. Net costs could be lower if adjustments are made for maintenance cost savings or the likely introduction of lower-cost sulfur removal technology. Supply disruptions could cause increased prices, fuel shortages, and other short-term problems if introduction of the new fuel is not properly managed. Whether this occurs depends to a large extent on whether distributors of diesel fuel and other distillates use the next five-and-a-half years to prepare the distribution and fuel storage infrastructure to handle potential problems.

A recent CRS report addressed the potential for fuel price increases to affect broader economic variables. In *Rising Oil Prices: What Dangers Do They Pose for the Economy?*, Marc Labonte noted that several recent studies had concluded that the effects of recent increases in the price of crude oil or even the effect of a further $10 per barrel increase would be modest.[62]

A $10-per-barrel crude oil price increase would translate to a 25-cent-per-gallon cost increase that could affect all liquid fuels (gasoline, diesel, kerosene, home heating oil, etc.). The projected cost increase from the proposed regulations are substantially less than that (4.3 to 9.9 cents), and affect only highway diesel fuel, which accounts for roughly 10% of oil consumption. Thus, the impact of diesel fuel price increases economy-wide would be substantially less than the impact of recent crude oil price increases.

Nevertheless, the price of diesel fuel is an important consideration in certain industries, notably trucking, transit, and long distance bus (motorcoaches). Farmers, who use diesel fuel to power a majority of the nation's farm machinery, have also expressed concerns. Potential effects on these sectors are addressed below.

Trucking. The trucking industry accounts for more than 80% by revenue of all freight moved in the United States.[63] It is a large and fragmented industry dominated by small businesses. More than 450,000 firms participate in this industry, with a large

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[61]This section focuses on the impact of the proposed fuel standards, as has most comment on the economic effects of the proposed rule. The fuel standards have attracted more comment most likely because an increase in fuel costs or a disruption in fuel supply would have immediate impacts across most sectors of the economy, whereas an increase in the cost of new trucks or engines would initially affect a smaller segment of the economy.

[62]See CRS Report RL30634, August 15, 2000, pp. 14-18. Among the reasons cited in that report that recent oil price increases have had little impact are that the U.S. economy uses less energy per capita and per unit of Gross Domestic Product than it did during the oil shocks of the 1970s -- using just half the fuel per dollar of Gross Domestic Product in 1999 that it did in 1973.

[63]All data on trucking, unless otherwise noted, are from McGraw-Hill Companies, *U.S. Industry & Trade Outlook 2000*. Trucking. p. 54-1.

percentage of them being owner-operators. The largest 50 firms in the industry accounted for only 13% of industry revenues in 1997. There were 1.79 million combination trucks in the U.S. in 1997, and they consumed almost 20.3 billion gallons of primarily diesel fuel during the same year.[64]

Many of the small firms in this industry, especially owner-operators, are very sensitive to cost increases. The average profit margin in the trucking industry is only 1.95%. Because of the large amount of competition in the industry, it is difficult for individual firms to raise rates. Fuel costs average roughly 15% of the industry's total operating costs, according to recent estimates.[65] The industry will, therefore, be especially concerned about cost increases associated with low sulfur fuels.

Equipment and maintenance costs are also a major concern. There seems to be considerable doubt in the industry that EPA's truck cost estimates are accurate. Even if they are accurate, the American Trucking Association argues, the combined new purchase and life cycle cost estimates are $6,230 per truck in the short term, which is a significant sum, especially for small operators.[66]

The trucking industry also believes that EPA's proposed diesel emission standards unfairly discriminate against it vis-a-vis its principal intermodal competitors: railroads and barges. The American Trucking Association (ATA) has taken the position that there should be only one diesel standard for all freight transportation carriers. EPA has recently implemented new standards for locomotives, which require emission reductions of about two-thirds for NO_x and about 50 percent for hydrocarbons and particulate matter. These standards began taking effect this year.[67] Barges powered by marine diesel engines must meet standards that take effect in 2004 and 2007. These standards will result in only a 24% reduction in NO_x and a 12% reduction in particulate matter when fully implemented, however.[68] These standards are not as stringent as the proposed standards for diesel trucks.

On the other hand, some sectors of the trucking industry face standards at least as stringent as those proposed by EPA, as a result of planned state or local regulations. California and the Los Angeles area's South Coast Air Quality Management District, for example, have adopted standards for diesel fuel and engines

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[64]U.S. Department of Transportation. Bureau of Transportation Statistics. *National Transportation Statistics 1999.*Washington, D.C. p. 301.

[65]See John W. Fischer and Bernard A. Gelb, *Transportation Fuel Taxes: Impacts of a Repeal or Moratorium*, CRS Report RS20521, March 28, 2000, p. 3.

[66]Statement of Beth Law, Vice-President for Law and Environmental Affairs, American Trucking Association, at EPA Public Hearing, June 29, 2000, Denver, CO.

[67]The locomotive standards were signed in December 1997 and published in the Federal Register, April 16, 1998. For more information, see U.S. EPA, Office of Air and Radiation, "Environmental Benefits of Emission Standards for Locomotives," December 1997, available at [http://www.epa.gov/otaq/locomotv.htm].

[68]For information on the marine engine standards, see [http://www.epa.gov/otaq/marine.htm].

more stringent than those promulgated by EPA.[69] The California requirements will require ultra-low sulfur fuel and retrofit of existing engines, in addition to controls on new engines. Facing these state and local requirements, California-based truckers are strongly supportive of EPA's new national standards: they perceive that it will help level the playing field between them and out-of-state trucking firms.[70]

Other areas are also moving forward with state or local requirements on diesel fuel and engines. In its proposed State Implementation Plan (SIP) for the Houston-Galveston area, for example, Texas proposed to require the use of 30 ppm ultra-low sulfur diesel fuel for both on-highway and off-highway purposes in East and Central Texas beginning in May 2004, with a further reduction to 15 ppm in May 2006.[71] The final version of the SIP dropped the 2004 requirement, but includes limits on the aromatic content of diesel fuel and other requirements applicable to both on and off-highway diesel fuels, beginning in 2002.[72] The state is also imposing restrictions on the use of heavy equipment to reduce emissions.

Faced with what they consider inadequate federal standards for diesel emissions in the 2005-2006 period, at least 17 states are adopting standards for diesel engine emissions that are stricter than the federal standards for those years.[73] Had EPA not acted, this tendency toward fragmentation of the national market for fuels and engines might have continued; the result of such fragmentation could have been increased costs in the affected areas beyond those projected for compliance with EPA's rule.

Transit. There were approximately 698,000 buses in the United States in 1997.[74] The majority of these were school buses. School buses mostly use gasoline engines for propulsion and are not subject to the diesel standard. (There are, however, new standards for heavy-duty gasoline engines in another part of the rule, and low sulfur gasoline requirements that begin to take effect in 2004.)

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[69]See "CARB to Begin Writing Rules to Implement Major Diesel Emission-Reduction Program," *Daily Environment Report*, October 3, 2000, p. AA-1. In addition, the South Coast Air Quality Management District (covering the Los Angeles metropolitan area), voted September 15, 2000, to require a 15 ppm limit on sulfur in diesel fuel beginning January 1, 2005. See "AQMD Board Votes for Cleaner Diesel to Reduce Cancer," at [http://www.aqmd.gov/news1/Governing_Board/Bs9_15_00.htm].

[70]See "Commenters at California Hearing Urge EPA to Strengthen Diesel Regulation," *Daily Environment Report*, June 29, 2000, pp. A-4, A-5. See also, Stephanie Williams, "The Fight for a National Diesel Standard: CTA comments on federal EPA low-sulfur diesel fuel proposal," September 4, 2000, available at the California Trucking Association website [http://www.caltrux.org/].

[71]See Texas Natural Resource Conservation Commission, "Houston-Galveston Clean Air Rules and Plans," at [http://www.tnrcc.state.tx.us/oprd/hgasip.html].

[72]Personal communication, Morris Brown, Texas Natural Resource Conservation Commission, January 16, 2001.

[73]See "California Adopts 'Not-to-Exceed' Rule for 2005-2006 Model Year Diesel Engines," *Daily Environment Report*, December 14, 2000, p. A-2.

[74]U.S. Department of Transportation. Bureau of Transportation Statistics. *National Transportation Statistics 1999.* Washington, D.C. p. 300.

According to the American Public Transit Association (APTA) there were 72,170 transit buses in service in 1997.[75] Of these, just over 47,000 used diesel as their primary fuel. Total diesel fuel consumption for these vehicles in 1997 exceeded 563 million gallons.

Unlike the other industries discussed here, the transit industry is not a profitable one. Only 40.1% of transit's operating costs are recovered directly from its principal customer base in the form of passenger fares. The remainder of transit operating funding, and much of its capital funding, are provided by federal, state, and local governments. Experience has shown that it is difficult for the transit industry to pass all of its cost increases through to its passengers in the form of higher fares without losing ridership. It is, therefore, likely that any cost increases imposed on the industry will affect both passengers and the budgets of various government subsidy providers.

An important concern to this industry is the life of its equipment. Transit buses are heavily used and have a life span of over a decade; new buses cost, on average, over $250,000. It is not uncommon for a transit bus to be re-engined several times during its useful life. APTA and transit operators have expressed a concern that the use of ultra-low sulfur fuel and associated engine technology could seriously reduce the expected service life of transit engines. If this occurred, it would result in costs significantly above those suggested by EPA.

On the other hand, transit systems throughout the country are under pressure from regulators and the public to reduce emissions from their existing bus fleets. Many (including New York, Los Angeles, and Washington, D.C.) are purchasing buses powered by compressed natural gas (CNG) because of public concerns about diesel emissions. Without marked improvement in diesel emissions, more of this industry is likely to switch to CNG or other alternative fuels, with many of the same concerns regarding the cost and reliability of a new technology.

Motorcoach. According to the American Bus Association, there are approximately 44,000 commercial motorcoaches in service in 2000 in the United States and Canada,[76] the vast majority of which are based in the United States. About 12% are used in regularly scheduled passenger service (as opposed to providing charter service); these account for roughly half of all of the mileage operated by the industry. Most of the 4,000 firms in this industry are small businesses, but the largest 50 firms in the industry account for 56% of all passengers. In 1999, the motorcoach industry consumed approximately 498 million gallons of fuel, most of which was diesel.

The motorcoach industry has some of the same concerns as the transit industry. This industry's largest concerns are likely to be the cost of low sulfur fuel and the cost of new equipment.

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[75]All data on transit are from: American Public Transit Association. *APTA 1999 Transit Fact Book.* Washington. 1999.

[76]The Department of Transportation does not have specific data on this industry segment. This discussion relies on: American Bus Association. Motorcoach Industry Facts. [www.buses.org/industryprofile/index.cfm].

Motorcoach use patterns, however, differ from those of the transit industry. Motorcoaches provide longer distance service without the harsh stop and go service patterns typical of transit. Hence, motorcoaches are likely to have even longer service lives than their transit counterparts, making the issue of long term maintainability of new technology engines a paramount concern. At the same time, because of these long service lives, the motorcoach industry may be able to spread out replacement of many engines until the technology has been more clearly demonstrated.

Agriculture. A number of agricultural organizations have expressed concerns about the impact on farmers and their capacity to produce if fuel supply disruptions occur as a result of the new rule. (It should be noted that off-road equipment and fuel, including farm equipment, are exempt from the rule, which addresses highway fuel and trucks only. But off-road use of diesel fuel is relatively small compared to highway use – of total diesel fuel consumption, about 15% is off-road vs. 85% on – so some have suggested that highway fuel may be used for off-road purposes in rural areas, where it simplifies distribution of diesel fuel to do so.[77])

Agricultural organizations have raised two possibilities: 1) that changes in the price of diesel fuel have the potential to affect farm production costs; and 2) that potential disruptions in the distribution system serving farmers could have a significant structural impact on petroleum cooperatives. Other off-farm impacts could affect agricultural production costs if fuel price increases cause changes in transportation costs.

Energy costs in U.S. agriculture represent a higher proportion of total costs than in many other major sectors such as manufacturing.[78] According to the U.S. Department of Agriculture (USDA), agricultural production in the United States relies heavily on technologies that require energy inputs in relatively expensive forms, such as electricity and petroleum-based fuels. In addition, many experts believe that the impact of fuel price increases is potentially greater in agriculture than in other sectors, given its limited capacity for switching to alternative energy sources in the short run.[79]

Recent estimates by USDA showed that 4.3% of total farm expenditures came from energy consumption in 2000, up from 3.8% in 1999. U.S. farmers' energy costs were forecast by USDA to be $7.7 billion in 2000, of which 36% ($2.8 billion) will be for diesel fuel.[80]

Despite sizeable energy expenditures in the farm sector, the USDA's Economic Research Service (ERS) estimates that higher oil and fuel prices generally boost the

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[77]There is also a counterargument, raised by some petroleum cooperatives, that large refiners will dump off-spec highway fuel in the off-road market, depressing prices.

[78] U.S. Department of Agriculture, Economic Research Service, *Agricultural Resources and Environmental Indicators, 1996-97*. Agricultural Handbook No. 712.

[79] N.D. Uri and M. Gill, "The Agricultural Demand for Electricity in the United States," *International Journal of Energy Research*, Volume 19, 1995.

[80] Personal communication. James Duffield. USDA Office of Energy Policy and New Uses. September 7, 2000.

overall rate of inflation only slightly and usually mean very modest gains in food costs.[81] Calculations by CRS of the impact of increasing on-farm fuel costs (i.e., diesel only) on production costs support ERS' conclusion. For instance, using USDA figures, it appears that a 3% (5¢) increase in the price of diesel would increase agricultural fuel costs by $84 million nationwide and push the price of production up by about 0.05%. Similarly, a 9% (15¢) increase in diesel price translates into an estimated nationwide fuel cost increase of $252 million, and thus increases production costs by 0.14%.[82]

The other major concern raised by agricultural organizations is the potential effect of the diesel rule on farm cooperatives. Since the 1930s, cooperatives have provided the fuel supplies needed by a sizable proportion of U.S. farmers. In 1993 (the last year when a USDA study collected these data) cooperatives provided 37% of diesel fuel sold to farmers in the United States.[83] Today, the situation seems little changed. According to cooperatives' spokespersons, cooperatives account for about 40% of all the on-farm fuel used in the United States, even though they represent less than 2% of petroleum refining industry capacity. Similarly, farmer cooperatives supply much of the highway diesel and home heating oil needs in rural America, according to these sources. According to industry sources, cooperative diesel sales are strongest in the Corn Belt and the Great Lakes States (40%) and weakest in the Southeast and the Delta Region (12%).[84]

Cooperatives maintain that EPA's new diesel sulfur requirements could: (1) induce supply disruptions (or price spikes) by reducing diesel production capacity in established co-op distribution channels; (2) force cooperative and other small refiners to produce costly ultra-low sulfur diesel fuel for farm and other off-highway uses, which are not required to use it (this assumes that, rather than produce two grades of fuel, the co-ops would produce fuel that meets the more stringent standard and sell it for both highway and off-road uses); (3) jeopardize the economic viability of farmer-owned refineries, leading to further concentration in the petroleum industry serving rural America; and (4) impose major capital investment costs with no return on investment. Estimates for capital investment needed to achieve compliance vary

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[81] USDA, Economic Research Service, *The Impact of a Sustained Oil Price Increase on the Agricultural Sector*, May 22, 2000. Available at [http://www.ers.usda.gov/whatsnew/issues/oilprices/index.htm].

[82] These estimates assume a base diesel price of $1.70 per gallon, which is higher than the U.S. average of $1.609, according to U.S. Department of Energy (as of 09/04/00), but closer to prices on the West Coast, where prices are closer to $2.00 per gallon. Estimate does not include indirect costs increases.

[83]USDA, Rural Business and Cooperative Development Service, *Petroleum Cooperatives: 1995*. E.E. Eversull & J.R. Dunn. RBCDS Research Report 143.

[84]Mr. Jesse Sevcik, Farmland Industries Inc. Personal communication. September 11, 2000.

from $80-$200 million per refinery, according to a co-op source.[85] EPA's estimates, on the other hand, are $14 million for small refineries.[86]

Petroleum cooperatives have asked:

- that EPA not require a phase-in period which would allow two sulfur levels in on-road diesel fuels (500 ppm and 15 ppm). Spokespersons for the petroleum coops state that the local coops and farmers' fuel retail businesses cannot afford to add thousands of new tanks and pumps to accommodate two fuels temporarily. In addition, petroleum coops have an extensive network of pipelines and distribution terminals that would have to be renovated to accommodate two fuel grades. As noted, the final rule will allow two fuel grades in the 2006-2010 transition period, but there is no requirement that a distributor, terminal, or retailer offer both grades;

- that the date for petroleum coops and other small producers to achieve compliance with EPA low-sulfur rules on diesel and gasoline be extended from 2006 to 2010. [The final rule does provide that a small refiner may continue to produce and sell diesel fuel meeting the current 500 ppm sulfur standard until June 1, 2010, "provided that it reasonably ensures the existence of sufficient volumes of 15 ppm fuel in the marketing area(s) that it serves."[87]] Coops state that this time is needed to absorb the shock of renovating their refining, storage and distribution facilities; and

- that financial assistance, in terms of loan guarantees, be provided by the federal government to coops allowing these to secure private financing of refinery and distribution upgrades. [The Preamble to the Final Rule states that "The U.S. Department of Agriculture (USDA) has indicated an interest and willingness to review its existing authorities for the potential mechanisms to provide financial assistance to refiner cooperatives who do invest in desulfurization programs.[88]] Coop sources maintain that creditors will be reluctant to lend capital due to the severe risk of default by petroleum coops during the phase-in

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[85]Ibid.

[86]U.S. EPA, Office of Air and Radiation, *Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements*,p. V-100, available at [http://www.epa.gov/otaq/diesel.htm#documents].

[87]U.S. EPA, Office of Air and Radiation, *Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements*, Executive Summary, p. xviii. Available at [http://www.epa.gov/otaq/diesel.htm#documents]. Not all of the cooperative refiners will qualify for this provision, because most don't qualify as "small" under EPA's definition; but the Agency believes that the larger coops will be able to postpone desulfurization investments, if necessary, through the purchase of credits from other refiners, or by applying to the Agency for hardship relief. For discussion of the status of each cooperative refiner, see Section IV. C. 2. of the Preamble to the Final Rule, pp. 181-182, available at the same web site.

[88]Ibid., p. 183.

period. Coops expect that larger refiners will "dump" diesel fuel below cost to increase market share during this period, thus jeopardizing their existence.[89]

Small refining operations have similar concerns about the capital costs of switching over to ultra-low sulfur diesel.

Timing of the New Standards

As EPA worked to finalize the new standards in the fall of 2000, several concerns were expressed regarding the timing of the new heavy-duty engine and diesel sulfur standards. Some stakeholders believed that EPA was "in a rush" to finalize the rules before the end of 2000. They argued that the Agency should take more time to further analyze the feasibility and cost of the proposed rules. These concerns were magnified by the nature of the proposal: both the degree of emission reduction and the role to be played by yet-to-be-demonstrated technology are larger in this regulation than in many other EPA rules.

Whether the rule was rushed is difficult to judge on objective criteria. While the specifics of the proposal were not finalized until early 2000, EPA and the engine manufacturers have been engaged in discussions regarding the need for additional regulations since at least 1995.[90] These discussions did not, at first, envision the level of emission reductions eventually proposed; but the need to obtain greater emission reductions (driven by air quality considerations) and advances in available technology appear to have combined to produce a stricter EPA proposal than initially envisioned.

Another factor in the discussion of the rule's timing was that, under the Agency's schedule, the decision was finalized in the last days of the Clinton Administration. Failure to promulgate the rule before a new Administration took office might have caused substantial delay, resulting in less lead time for industry compliance, or a delay in the date of implementation. On the other hand, the Bush Administration clearly can review the regulation, even though it is already promulgated[91]; thus, the change in Administrations may result in delay, irrespective of whether the regulation had been promulgated, if the new Administration decides that a review of the rule would be advisable.

As noted previously, if the availability and ultimate cost of the technology are the main concerns, one way of addressing them might have been through a formal "technology review" at some point after promulgation but before major investment

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[89]National Council of Farmer Cooperatives, press release, May 17, 2000, and personal communication, Jesse Sevcik, previously cited.

[90] See "Control of Air Pollution from Heavy-Duty Engines," Advance Notice of Proposed Rule, 60 Federal Register 45580, August 31, 1995.

[91]For example, when it took office in January 1981, the Reagan Administration issued a 60-day freeze on regulations and ordered the Office of Management and Budget to review major rules promulgated in the last days of the Carter Administration. See "Several Air, Water Regulations Termed 'High Priority' Targets by OMB," *Environment Reporter*, January 30, 1981, p. 1852, and "Task Force to Look at Frozen Rules, to Spearhead Regulatory Reform Efforts," *Environment Reporter*, February 6, 1981, p. 1924.

decisions must be made. In its diesel proposal, EPA asked for comments on whether it should conduct such a reassessment of diesel NO_x control technology and associated fuel sulfur requirements in 2003, allowing it to modify the standards or extend the compliance date based on its review.[92] The Agency did not promulgate such an approach, however. Many argued that it would create uncertainty regarding the standard and provide a disincentive for industry to invest in the equipment necessary to achieve compliance. As noted previously, engine manufacturers and manufacturers of emission controls both argued against a technology review in comments submitted on the proposed rule.

Congressional Action

While no legislation was introduced in the 106th Congress concerning diesel fuel or engines, several committee oversight hearings were held on the Tier 2 emissions regulations and the heavy-duty truck and diesel sulfur issues discussed in this report.[93] Such oversight activities may continue in the 107th Congress, even though final rules are now in place.

In the final weeks of the 106th Congress, there reportedly was an attempt to add language delaying the diesel rule to EPA's annual appropriation.[94] Draft legislative language was circulated that would have directed the National Academy of Sciences to study the feasibility and cost-effectiveness of EPA's proposed diesel rule, and issue a final report by June 2001. The amendment would have required EPA to take public comment on the NAS study before finalizing or implementing a rule. The amendment was not adopted.

Ultimately, Congress has the ability not only under appropriations measures, but also under the Congressional Review Act, to disapprove EPA regulatory measures. If congressional dissatisfaction with the final rule were sufficiently strong, there would be a number of legislative options available for addressing those concerns. That does not appear to be the case at present. Nevertheless, there remains some uncertainty regarding the new regulations, in part because the position of the new Administration remains to be seen. This uncertainty, coupled with the wide range of potential impacts from the rule, may fuel continued congressional interest in the early days of the 107th Congress.

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[92]See 65 Federal Register, pp. 35478-9, June 2, 2000.

[93]These include hearings by the Senate Committee on Environment and Public Works on June 15 and September 21, 2000 on heavy-duty engines and diesel sulfur and on May 18 and 20, 1999 on Tier 2.

[94]See "White House Fighting Possible Rider Meant to Delay EPA Diesel Regulation," *Daily Environment Report*, October 4, 2000, p. AA-1.