

OCTANE, CLEAN AIR, AND RENEWABLE FUELS: A MODEST STEP TOWARD ENERGY INDEPENDENCE

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I. INTRODUCTION: THE MANY COSTS OF PETROLEUM
DEPENDENCE—AND A FIRST-RATE OPPORTUNITY TO REDUCE
THEM

Americans' nearly exclusive reliance on petroleum for transportation fuel has become an increasing threat to U.S. economic and security interests. The major dangers of oil dependence, to name a few, include volatile and increasing oil prices, now projected to average about \$63 a barrel in 2006;¹ growing uncertainty over long-term oil supply; high current account deficits; and the financing of terrorism and tyranny by U.S. petrodollars.² One 2000 estimate, cited in the Department of Energy's 2004 Transportation Energy Data Book, put the cost of U.S. oil dependence at \$7 trillion in 1998 dollars over a thirty-year period.³ But petroleum dependence is also a threat to the environment, human health, and the goal of spurring global trade and development by reducing agricultural subsidies.

1. See ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, DEC. 6, 2005 RELEASE, SHORT-TERM ENERGY OUTLOOK 1 & 6 fig.1 (2005), available at <http://www.eia.doe.gov/emeu/steo/pub/dec05.pdf>. EIA recently announced that in its Annual Energy Outlook for 2006, its estimate of 2025 oil prices will be raised by \$21 per barrel (in 2004 dollars) from \$33 to \$54—an increase of more than 60% over the 2005 Annual Energy Outlook estimate for 2025. See Press Release, Energy Information Administration, New Energy Market Outlook Raises Projected World Oil Price Path and Adds More Coal and Nuclear Power (Dec. 12, 2005), available at <http://www.eia.doe.gov/neic/press/press265.html>.

2. See, e.g., *Reliable, Affordable, and Environmentally Sound Energy for America's Future: Report of the National Energy Policy Development Group* 1-1, available at <http://www.whitehouse.gov/energy/National-Energy-Policy.pdf> ("Our increased dependence on foreign oil profoundly illustrates our nation's failure to establish an effective energy policy."). Cf. *id.* at xiii ("One aspect of the present crisis is an increased dependence, not only on foreign oil, but on a narrow range of energy options.").

3. See Stacy C. Davis & Susan W. Diegel, *Transportation Energy Data Book: Edition 24*, at 1-10 (Dec. 2004), available at <http://cta.ornl.gov/data/Index.shtml> ("[T]he oil market upheavals caused by the OPEC cartel have cost the U.S. in the vicinity of \$7 trillion (present value 1998 dollars) in total economic costs, which is about as large as the sum total of payment of the national debt over the same period.") (citing David L. Greene & Nataliya I. Tishchishyna, *Costs of Oil Dependence: A 2000 Update* (May 2000) (ORNL/TM-2000/152), available at http://www.cta.ornl.gov/cta/Publications/pdf/ORNL_TM_2000_152.pdf). "Military, political, and environmental costs of oil dependence (which are also substantial)" are not included in this estimate. Greene & Tishchishyna, *supra* at 7. For a newer version of the same estimate, see David L. Greene & Sanjana Ahmad, *Costs of Oil Dependence: 2005 Update*, at xi (Feb. 2005) (ORNL/TM-2005/45), available at http://www.cta.ornl.gov/cta/Publications/pdf/ORNL_M2005_45.pdf ("Reckoned in terms of present value using a discount rate of 4.5%, the costs of U.S. oil dependence since 1970 are \$8 trillion, with a reasonable range of uncertainty of \$5 to \$13 trillion.").

Next year, the Bush Administration and the Environmental Protection Agency (EPA) will have a superb opportunity to make great strides in reducing this threat. To settle an environmental lawsuit for delay in carrying out the Clean Air Act (CAA), EPA has bound itself to begin a rulemaking proceeding in 2006 to comply with CAA section 202(l). This provision mandates requiring the maximum achievable reductions in toxic emissions from motor fuels. Over a quarter of the gasoline used by Americans is made up of benzene and other aromatic hydrocarbon compounds that are categorized as hazardous air pollutants (HAPs, also known as air toxics) under the Clean Air Act.⁴ These literally poisonous chemicals are being phased out in every other sector of the U.S. economy. In gasoline, they are used to enhance fuel octane.

Aromatic emissions are bad enough by themselves. Benzene, for example, is a known carcinogen. But aromatic emissions are also precursors to other pollutants that have major effects on the environment and on human health. To the extent that they can be quantified, the cumulative effects of gasoline air toxics pollution may cost Americans tens, or even hundreds, of billions of dollars per year.

EPA has recently signaled that it may be preparing soon to take a more aggressive approach to regulating aromatics in gasoline.⁵ This would be a salutary development. Under a second Clean Air Act mandate,⁶ EPA is responsible for reducing

4. In this article, we use “aromatic compounds”—“aromatics” for short—in its narrower sense, to refer to “hydrocarbon molecules that form rings and are unsaturated.” JAMES G. SPEIGHT, *THE CHEMISTRY AND TECHNOLOGY OF PETROLEUM* 847 (3d ed. 1999). Compare “aromatic compound,” Encyclopedia Britannica Online, <http://search.eb.com/eb/article-9009593> (last visited Nov. 19, 2005) (the term was first applied around 1860 to a group of hydrocarbons, but later came to denote a larger class of compounds that have similar chemical behavior). Benzene (the simplest aromatic hydrocarbon), toluene, and xylene are three of the most important of the aromatic hydrocarbons. See SPEIGHT, *supra* at 847. Cf. “benzene,” Encyclopedia Britannica Online, <http://search.eb.com/eb/article-9078683> (last visited Nov. 19, 2005). They are also designated as hazardous air pollutants (HAPs), or air toxics, under the Clean Air Act, 42 U.S.C. § 7412(b)(1) (2000).

5. See, e.g., *EPA Mobile Source Rule Prompts Clash Between Oil, Auto Industries*, ENERGYWASHINGTON WK., Oct. 12, 2005 (“EPA’s upcoming mobile source air toxics rule appears to be moving toward placing limits on fuel content rather than on new automobile engine controls . . .”) [hereinafter ENERGYWASHINGTON WK.].

6. Particulate matter (PM) is one of six “criteria” pollutants for which EPA has set national air quality standards. See 42 U.S.C. §§ 7408–09 (2000). See also Alan J. Krupnick, *Focus on Particulates More Than Smog*, in *NEW APPROACHES ON ENERGY AND THE ENVIRONMENT* 68 (Richard D. Morgenstern & Paul R. Portney eds., 2004), available at http://www.rff.org/rff/FF_Press/CustomBookPages/NewApproachesonEnergyandtheE

concentrations of fine particulate matter (PM_{2.5}, also known as fine PM)—the single most pressing air pollution problem that EPA currently faces.⁷ And in September 2005, EPA declared that aromatics are considered to be the most significant of the gases caused by humans that react to form carbon-based PM.⁸

Curtailling the use of aromatics would not just benefit the environment. A substitute source of octane would be needed. As they have been for 100 years, the main candidates would be alcohols, such as ethanol, and related products such as ethers. An air toxics requirement that mandated the use of clean octane enhancers would jump-start the renewable fuels market. This, in turn, could pave the way to absorbing the First World agricultural surpluses that have stalled free trade talks and devastated Third World development. Fostering developing-world agricultural markets and reducing our petroleum dependence are two powerful ways of enhancing American security, both immediately and over the long term. It is for these interrelated reasons that we believe that the 2006 rulemaking could result in one of the most important air quality regulations that the U.S. government has ever issued.

II. SUBSIDIES, REGULATORY DISPARITIES, AND DEPENDENCE

The current status of aromatic chemicals as octane enhancers for gasoline reflects a pattern of subsidies and unique treatment for petroleum and its products that has lasted for well over half a century. This pattern is one of the most critical and yet least understood causes of America's petroleum dependency and, it must be understood, was originally imposed for reasons of national security.

nvironment/loader.cfm?url=/commonspot/security/getfile.cfm&PageID=15679; THE CLEAN AIR ACT HANDBOOK 13 (Robert J. Martineau, Jr., & David P. Novello eds., 2d ed. 2004); EPA, Six Common Air Pollutants, What Are the Six Common Air Pollutants?, <http://www.epa.gov/air/urbanair/6poll.html> (last visited Nov. 25, 2005).

7. See OFFICE OF AIR QUALITY PLANNING & STANDARDS, U.S. ENVTL. PROTECTION AGENCY, THE PARTICLE POLLUTION REPORT: CURRENT UNDERSTANDING OF AIR QUALITY AND EMISSIONS THROUGH 2003, at ii (2004), available at http://www.epa.gov/airtrends/pmreport03/report_2405.pdf. Ninety million people live in areas that do not meet national air quality standards for PM_{2.5}. See Proposed Rule To Implement the Fine Particle National Ambient Air Quality Standards, 70 Fed. Reg. 65,984, 65,990 (proposed Nov. 1, 2005) (to be codified at 40 C.F.R. pts. 51 & 52).

8. See Proposed Rule To Implement the Fine Particle National Ambient Air Quality Standards, 70 Fed. Reg. 65,984, 65,996 (proposed Nov. 1, 2005) (to be codified at 40 C.F.R. pts. 51 & 52).

Perhaps the most well known subsidy for Middle East oil is the one described in Daniel Yergin's superb history of oil in the United States and the world, *The Prize: The Epic Quest for Oil, Money, and Power*. Yergin recounts how in 1950, the U.S. government responded to Saudi demands for more oil revenues by devising an arrangement whereby Saudi Arabia's 12.5% royalty became a fifty percent income tax for which Aramco received a dollar-for-dollar credit against its U.S. income tax liabilities.⁹ The tax credit arrangement, which soon spread to other Middle Eastern countries,¹⁰ transferred billions of dollars from U.S. taxpayers to foreign coffers.

There were, of course, other distinctive arrangements for oil based on national security considerations, some of which remain in force today. They have included not just tax subsidies, which stretch back to 1916,¹¹ but also unusual regulatory arrangements.¹² In tax law, two of the biggest subsidies were the percentage depletion allowance and the rapid write-off for so-called intangible drilling and development costs. The General Accounting Office estimated that these two subsidies alone cost the United States somewhere between \$125 and \$137 billion, respectively, between 1968 and 2000 (in 2000 dollars).¹³ In the

9. Because of the U.S. tax credit for taxes paid to foreign countries, "a substantial flow of revenues was diverted from the U.S. Treasury to that of Saudi Arabia" after 1950. DANIEL YERGIN, *THE PRIZE: THE EPIC QUEST FOR OIL, MONEY, AND POWER* 447 (Simon & Schuster 1991). In that year, the State Department told Aramco's parent companies that to preserve their position in Saudi Arabia, they should start paying income taxes there. It does not appear that the subsidy was "a special dispensation" to Aramco that bent the tax laws, but it was a subsidy nonetheless. *Id.* "Whereas the Treasury had collected \$43 million in taxes from Aramco in 1949, compared to \$39 million in royalties paid to Saudi Arabia, by 1951 the division of rents was completely different. In that year, Saudi Arabia collected \$110 million from the company, while, after the application of the tax credit, Aramco paid only \$6 million to the United States Treasury." *Id.* See also M.A. ADELMAN, *THE GENIE OUT OF THE BOTTLE: WORLD OIL SINCE 1970*, at 50-51 (1995); RICHARD H.K. VIETOR, *ENERGY POLICY IN AMERICA SINCE 1945: A STUDY IN BUSINESS-GOVERNMENT RELATIONS* 30-32 (1984).

10. See YERGIN, *supra* note 9, at 447-48.

11. See VIETOR, *supra* note 9, at 16, 20.

12. See, e.g., NORMAN MYERS & JENNIFER KENT, *PERVERSE SUBSIDIES: HOW TAX DOLLARS CAN UNDERCUT THE ENVIRONMENT AND THE ECONOMY* 65, 99-106 (Island Press 2001) (1997).

13. The estimate for the percentage depletion allowance was \$82 billion. The estimate for intangible drilling and development write-offs was between \$43 and \$55 billion. Letter from General Accounting Office to Sen. Tom Harkin 2 (Sept. 25, 2000) (RCED-00-301R), available at <http://www.gao.gov/new.items/rc00301r.pdf>. "The revenue loss to government from [these two tax benefits] has been estimated at \$400 million to \$2.5 billion annually over the fifty years they were in effect" roughly between 1920 and 1970. VIETOR, *supra* note 9, at 20. A 1980 Battell Laboratories study estimated

regulatory arena, for example, it was explicit White House policy for much of the twentieth century to subordinate antitrust enforcement against the oil industry to national security concerns—often over the objection of Justice Department lawyers.¹⁴

The regulatory subsidy that we discuss in this article has much to do with the nuances of the Clean Air Act. The oil industry's central product, gasoline, largely escaped air quality regulation for two decades after the enactment of the CAA in 1970. Things started to change in 1990, when President George H.W. Bush, a former oilman from Texas, signed a set of comprehensive amendments to the CAA. The new amendments required the reformulation of gasoline to reduce pollution and ordered EPA to pursue further pollution reduction from motor fuels. Yet gasoline—in particular, the aromatic fraction of gasoline—continues to enjoy special regulatory treatment even under the post-1990 legal regime. EPA has ample authority to reduce or eliminate aromatics from gasoline, but it has never exercised that authority with great vigor. At the same time, it has cracked down heavily on stationary sources of the same chemical compounds, even though the human exposure to stationary source air toxics emissions may be only a fraction of roadway exposures to gasoline emissions.

Given the apparent desirability of eliminating aromatics as an unnecessary source of octane, an obvious question comes quickly to mind: How is it that aromatics have been allowed to persist in gasoline—in even greater quantities now than in the 1970s—when they are apparently the source of so much economic and environmental damage? The story of how aromatics got into gasoline and stayed there, which we recount in brief below, is a fascinating one, involving fatal industrial accidents, inadequate public health measures, and half-

that the government had provided \$101 billion in 1977 dollars to the oil industry over a sixty year period through incentives, tax provisions, and direct subsidies, half of it through these two tax benefits. Michael W. Graine, *Recent Federal Energy Legislation: Toward a National Energy Policy at Last?*, 12 ENVTL. L. 29, 74–75 (Fall 1981).

14. See YERGIN, *supra* note 9, at 414–16, 472–75, 477–78; VIETOR, *supra* note 9, at 33–36. To be sure, it was a relationship of mutual benefit; in many respects, the oil companies served (not always entirely willingly) as an instrument of U.S. policy. See *id.* at 31–36, 43; YERGIN, *supra* note 9, at 414–16, 472–75, 477–78; S. COMM. ON FOREIGN RELATIONS, SUBCOMM. ON MULTINATIONAL CORPORATIONS, 93D CONG., MULTINATIONAL OIL CORPORATIONS AND U.S. FOREIGN POLICY 61–62 (Comm. Print 1975).

forgotten struggles between the oil and auto industries. The vision of the modern auto industry's founders, including Henry Ford and Charles Kettering of General Motors, was that cars would run on ethanol. The vision fell victim to Prohibition, the invention of leaded gasoline, and the discovery and development of gigantic oil fields in the Middle East.¹⁵ This history is well worth knowing, not least because it is possible that we have come full circle after 100 years of gasoline-powered motor transportation.

III. OCTANE, ETHANOL, AND "ETHYL": HOW LEAD GOT INTO GASOLINE

So why is benzene, along with other poisonous aromatics, in gasoline in the first place? The answer is that aromatics supply octane, which is another way of saying that they help prevent premature fuel detonation, a problem with which many young drivers are not even familiar.¹⁶ Nearly a century ago, premature detonation—known colloquially as engine knock—was the bane of motorists and engineers. A knocking engine made a metallic pinging noise that signaled that the engine was losing power. Climbing hills and hauling loads became difficult or impossible. Persistent knocking could destroy the engine.¹⁷

Auto buffs know that the knock problem was solved by General Motors. In the years following the First World War,

15. We make no claim to originality in telling the story, parts of which have emerged only recently. Academics, such as William Kovarik, and others deserve the credit for that. Their work has not received the attention that it merits.

16. SHARON BERTSCH MCGRAYNE, *PROMETHEANS IN THE LAB: CHEMISTRY AND THE MAKING OF THE MODERN WORLD* 82 (2001).

17. "Everyone who drove a car before World War I knew what knock was. It was the metal-on-metal ping that occurred whenever the pistons in an internal combustion engine strained at peak efficiency. Driving up a hill made valves rattle, cylinder heads knock, the gearbox vibrate, and the engine suddenly lose power. When a vehicle pulled slowly out of an intersection, it was often trailed by a long 'funeral procession' of other cars too underpowered to pass. If knocking continued long enough, it destroyed the engine." *Id.* See also KENNETH S. DEFFEYES, *HUBBERT'S PEAK: THE IMPENDING WORLD OIL SHORTAGE* 172–73 (Princeton Univ. Press 2001) ("The efficiency of an ordinary automobile engine increases with the compression ratio: how much the fuel-air mixture can be compressed before the spark plug initiates burning. However, burning can begin spontaneously and prematurely (called 'pinging') if chemical bonds between carbon atoms in the fuel start to break. The compression ratio that a fuel will tolerate is the 'octane' number displayed on a filling station pump. The scale is based on two standard molecules: isooctane taken as 100 on the scale and heptane taken as 0."); ED CRAY, *CHROME COLOSSUS: GENERAL MOTORS AND ITS TIMES* 240–41 (1980); Frank Ackerman et al., *Applying Cost-Benefit to Past Decisions: Was Environmental Protection Ever A Good Idea?*, 57 ADMIN. L. REV. 155, 161–62 (2005).

Charles Kettering, who headed GM's research operations, and Kettering's research star, Thomas Midgley, led a research effort to find an inexpensive compound that would solve the knock problem. The result was a spectacular, and a lucrative, success—for a time. What is less known is that even then, there were serious alternatives to the winning compound. Grain alcohol—our ethanol—could supply octane, as it does today.¹⁸ Efforts to derive ethanol from various kinds of vegetation were well known.¹⁹ And benzene, an aromatic hydrocarbon, could enhance octane, too.²⁰ But both ethanol and benzene were expensive.²¹

Kettering and Midgley—and Henry Ford, then the owner of the world's biggest automobile company—were strongly interested in the uses of alcohol as a fuel, whether alone or combined with gasoline.²² In the mid-nineteenth century,

18. See Thomas Midgley, Jr. & T.A. Boyd, *Detonation Characteristics of Some Blended Motor-Fuels*, 10 J. SOC'Y AUTOMOTIVE ENGINEERS 451, 451, 456 (June 1922); E.W. Dean & Clarence Netzen, *An Investigation of Airplane Fuels*, 5 J. SOC'Y AUTOMOTIVE ENGINEERS 126, 129-30 (Aug. 1919) (alcohol has antiknock properties and the same is true of alcohol-benzene-gasoline blend); Joseph E. Pogue, *Composite Fuels*, 15 J. SOC'Y AUTOMOTIVE ENGINEERS TRANSACTIONS pt. I, 339, 340-41, 343-44 (1920) (noting that composite fuels are not new and mentioning gasoline blended with benzol as well as with alcohol); William Kovarik, *Henry Ford, Charles F. Kettering and the "Fuel of the Future,"* 32 AUTOMOTIVE HISTORY REV. 7 (Spring 1998), available at <http://www.radford.edu/~wkovarik/papers/fuel.html>. Cf. Thomas Midgley, Jr. *High-Speed Indicators*, 15 J. SOC'Y AUTOMOTIVE ENGINEERS TRANSACTIONS pt. I, 317, 330 (1920) ("[A]lcohol . . . is the smoothest burning fuel of any we have. . . . The principal characteristic [of alcohol] is the smoothness of the combustion, the absolute lack of any indication of knock whatsoever.") (quoting from Midgley's statements during oral discussion).

19. See T.A. Boyd, *Motor Fuel From Vegetation*, 13 INDUS. & ENGINEERING CHEMISTRY 836-41 (Sept. 1921) (article by GM fuels researcher and engineer); Harold Hibbert, *The Role of the Chemist in Relation to the Future Supply of Liquid Fuel*, 13 INDUS. & ENGINEERING CHEMISTRY 841, 841-43 (Sept. 1921) (article by Yale chemistry professor on deriving fuel from cellulose).

20. See MCGRAYNE, *supra* note 16, at 82, 84.

21. See *id.* at 82; MARK Z. JACOBSON, *ATMOSPHERIC POLLUTION: HISTORY, SCIENCE, AND REGULATION* 110 (Cambridge Univ. Press 2002); Richard G. Newell & Kristian Rogers, *Leaded Gasoline in the United States: The Breakthrough of Permit Trading*, in CHOOSING ENVIRONMENTAL POLICY: COMPARING INSTRUMENTS AND OUTCOMES IN THE UNITED STATES AND EUROPE 175, 175 (Winston Harrington et al., eds., 2004).

22. On Kettering, see STUART W. LESLIE, *BOSS KETTERING* 155-56 (1983); *id.* at 156 ("[V]egetation offers a source of tremendous quantities of liquid fuel, the utilization of which awaits only a proper cheapening and simplification of the process of converting cellulose to a liquid suitable for motor fuel.") (quoting Kettering); *id.* ("Kettering spoke out against taxes on alcohol as an impediment to fuel research, talked with several dealers selling a mixture of alcohol and gasoline called Alcogas, and designed a special carburetor to accommodate the alcohol fuel."); *id.* at 179 ("Entirely aside from the question of how long petroleum will last, it seems assured that enough motor fuel could be gotten . . . from vegetation to last just as long as the sun shines.") (quoting Kettering). On Midgley, see Thomas Midgley, Jr. & T.A. Boyd, *The Application of Chemistry to the*

alcohol had been used as a source of illuminating oil. But in 1862, Congress slapped an excise tax of \$2 per gallon on alcohol—which helped to pay for the Civil War, but also destroyed the market for ethanol as an energy source.²³ The tax was not repealed until the early twentieth century.²⁴ Ford, who worried about the polluting effects of car exhaust, devoted sizeable resources to making his vehicles run on alcohol and acquiring the resources and knowledge to create the quantities of fuel that they would need. He designed the Model T to run on ethanol.²⁵ He visited Cuba in search of sugarcane fields and sugar mills. He started a program for distilling wood chips (which serendipitously resulted in the invention of charcoal briquettes). But Prohibition put a damper on Ford's experiments. The Internal Revenue Department told him that

Conservation of Motor Fuels, 14 J. INDUS. & ENGINEERING CHEMISTRY 849, 850 (Sept. 1922) (“vegetation offers a source of tremendous quantities . . .”) (statement attributed to Kettering by Leslie); William Kovarik, Ethyl: The 1920s Environmental Conflict Over Leaded Gasoline and Alternative Fuels (presented at American Society for Environmental History Conference, Mar. 26–30, 2003), available at <http://www.runet.edu/~wkovarik/papers/ethylconflict.html> ([hereinafter Kovarik Presentation]); William Kovarik, *Henry Ford, Charles F. Kettering and the “Fuel of the Future,”* 32 AUTOMOTIVE HISTORY REV. 7 (Spring 1998), available at <http://www.radford.edu/~wkovarik/papers/fuel.html>; Thomas Midgley, Jr., & T.A. Boyd, *Detonation Characteristics of Some Blended Motor-Fuels*, 10 J. SOC'Y AUTOMOTIVE ENGINEERS 451, 451 (June 1922); Discussion of Papers at Semi-Annual Meeting, Fred C. Ziesenheim, *Developing a High-Compression Automotive Engine*, 9 J. SOC'Y AUTOMOTIVE ENGINEERS 268, 269 (June 1922) (“The alcohol situation and its relation to the fuel of the future can be described by saying that from our cellulose waste products on the farm such as straw, corn-stalks, corn-cobs and all similar sorts of material that are virtually thrown away at present, we can get, by present known methods, enough alcohol to run our automotive equipment in the United States. . . . [I]t is not at all outside of the realm of possibility to increase the yields in commercial practice to such an extent that alcohol will compete with gasoline and we can leave some petroleum in the ground.”) (quoting Midgley). On Ford, see DOUGLAS BRINKLEY, *WHEELS FOR THE WORLD: HENRY FORD, HIS COMPANY, AND A CENTURY OF PROGRESS, 1903–2003*, at 219–20 (Penguin Group 2003); Remarks by Ashok Goyal, Director, Product Development, Ford Asia Pacific Hiroshima, at the Alternative Fuels Seminar, 26th Bangkok International Motor Show (Mar. 29, 2005) (transcript at http://media.ford.com/newsroom/release_display.cfm?release=20557). It was no secret that alcohol could be used as fuel. See, e.g., CARLETON ELLIS & JOSEPH V. MEIGS, *GASOLINE AND OTHER MOTOR FUELS* 564–66 (1921) (extensive bibliography of materials on alcohol as motor fuel dating back to 1902).

23. See AMORY B. LOVINS ET AL., *WINNING THE OIL ENDGAME: INNOVATION FOR PROFITS, JOBS, AND SECURITY* 4 n.33 (2005), available at http://www.rmi.org/images/other/WtOE/WtOEG_72dpi.pdf; Kovarik, *supra* note 18, at 7.

24. See, e.g., Kovarik, *supra* note 18, at 7.

25. TRANSPORTATION & REGIONAL PROGRAMS DIVISION, U.S. ENVTL. PROTECTION AGENCY, *CLEAN ALTERNATIVE FUELS: ETHANOL I* (2002), available at <http://www.epa.gov/otaq/consumer/fuels/altfuels/420f00035.pdf>; Ford Motor Company—Ethanol Vehicles, <http://www.ford.com/en/vehicles/specialtyVehicles/environmental/ethanol.htm> (last visited Dec. 2, 2005).

distilling alcohol, even to make alternative fuels, was illegal.²⁶ There is good evidence that both Kettering and Midgley thought that alcohol, over the long term, would become the substitute for petroleum fuels. But at the time, gasoline was cheap and plentiful, as it would be for decades to come.²⁷ There may have been other factors as well. The more or less official history of Standard Oil of New Jersey—later renamed Exxon—says that the company was “reluctant . . . to encourage the manufacture and sale of a competitive fuel produced by an industry in no way related to petroleum.”²⁸

Alcohol could conceivably have become the default octane enhancer for gasoline, but history did not work out that way. In 1921, Midgley and his staff discovered the tremendous anti-knock capabilities of tetraethyl lead (TEL), an additive that boosted octane ratings greatly when it was added in tiny quantities to ordinary gasoline.²⁹ TEL was inexpensive to make.

26. See BRINKLEY, *supra* note 22, at 219–20. Oil industry lobbying was another problem. *Id.* Cf. Ashok Goyal, Director of Product Development, Ford Motor Company, Remarks at the Alternative Fuels Seminar—26th Bangkok International Motor Show (Mar. 29, 2005), available at http://media.ford.com/newsroom/release_display.cfm?release=20557 (“Between 1916 and 1919, Henry Ford explored ethanol intensively. . . . What finally stopped his experiments? Well, for one thing . . . gasoline shortages eased after the war. But the real problem was that the U.S. brought in Prohibition—alcohol was completely banned for a decade. When that made his experimental motor fuel distillery illegal . . . Henry Ford threw up his hands and said, ‘Enough.’”).

27. See Kovarik, *supra* note 18, at 7; T.A. BOYD, GASOLINE: WHAT EVERYONE SHOULD KNOW ABOUT IT 133–34 (Frederick A. Stokes Co. 1925) (“[W]e will have to use gasoline for automobile fuel, at least for many years to come, because nothing else is available in anything like sufficient quantities.”); Thomas Midgley, Jr. & T.A. Boyd, *The Application of Chemistry to the Conservation of Motor Fuels*, 14 J. INDUS. & ENGINEERING CHEMISTRY 849, 850 (Sept. 1922) (“[W]hile [shale oil, oil from coal, and alcohol] offer a comforting reserve for the future, it will be many years before sufficient material can be obtained from these sources to supply any considerable percentage of the motor fuel requirements of the country.”).

28. 2 GEORGE SWEET GIBB ET AL., HISTORY OF STANDARD OIL COMPANY (NEW JERSEY) 494 (1956) (“As early as 1919 the Jersey Company had considered the possibility of bringing out a premium-quality, benzol-treated gasoline. It was decided, however, that there was no substantial demand for a better fuel than straight gasoline and that well-directed sales effort would soon drive out the competitive premium fuels. The company was reluctant, moreover, to encourage the manufacture and sale of a competitive fuel produced by an industry in no way related to petroleum, particularly since facilities for benzol production had been greatly expanded during the war years.”).

29. MCGRAYNE, *supra* note 16, at 87. “Within two decades of the introduction of tetraethyl lead, engine efficiency doubled, power per cylinder tripled, and the octane of regular gasoline rose from 55 to 75.” *Id.* at 94. Indeed, TEL’s power helped the Allies win the Second World War.

During World War II, Midgley was regarded as a national hero. Within a week of Pearl Harbor, the U.S. military began adding extra tetraethyl lead to make 100-octane fuel for vehicles and long-distance warplanes. Britain’s

And unlike alcohol, it could be patented.³⁰ To market the compound, GM and Standard Oil of New Jersey created the Ethyl Corporation. To avoid unpleasant associations with lead, it was called “Ethyl.” DuPont, which then owned much of GM, manufactured the compound, and Ethyl Corporation marketed it.³¹ There was a problem, though: Tetraethyl lead, like lead itself, is a deadly poison.³² In 1924, ten workers were killed, and many more hospitalized, from Ethyl poisoning at a Standard Oil facility in New Jersey. Other industrial accidents had also killed workers (Midgley himself had gotten lead poisoning from his work),³³ but these had been kept out of the news. This one made the newspapers.³⁴ As a direct result of the Standard Oil disaster, tetraethyl lead was taken off the market for months.³⁵ But thanks to adroit (and, it now seems, misleading) advocacy by Midgley and others, Ethyl was given a clean bill of health by a committee

petroleum secretary Geoffrey Lloyd said later, ‘We wouldn’t have won the Battle of Britain without 100-octane.’ The extra 13 octane points gave American and British planes one-third more power than German and Japanese planes. Allied pilots took off in one-fifth the space; climbed 40 percent faster out of anti-aircraft fire; flew higher; and could carry 20 to 30 percent more bombs, or fly 20 to 30 percent farther.

Id. at 103. Stalin once described the war as “a war of engines and octanes.” See YERGIN, *supra* note 9, at 382.

30. See Ackerman et al., *supra* note 17, at 161 (“Pursuing the enticing possibility of a substance one could patent (and thus corner the market in), Midgley shunted to the side another potential anti-knock compound, ethanol, in favor of TEL.”).

31. See MCGRAYNE, *supra* note 16, at 90; Ackerman et al., *supra* note 17, at 161–62; Jamie Lincoln Kitman, *The Secret History of Lead: Special Report*, THE NATION, Mar. 20, 2000, at 11, available at <http://www.globalleadnet.org/pdf/TheSecretHistoryofLead.pdf>.

32. At high enough exposures, its effects could include damage to the nervous system, convulsions, insanity, and death.

Lead is a neurotoxin and damages the central and peripheral nervous systems, the blood-forming organs, and the gastrointestinal tract and can cause convulsions, coma, insanity, and even death. Physicians have known for 2000 years about workers who were acutely poisoned by working around lead—the dropped wrist of the painter, for example. In the 1930s, health scientists understood that small amounts of lead accumulate in the body and can eventually reach dangerous amounts, but nothing was known about the long-term effects on the public health of low-level exposure to lead.

MCGRAYNE, *supra* note 16, at 88. See also *Ethyl Gasoline Corp. v. United States*, 309 U.S. 436, 446 (1940) (parties’ agreed statement of facts described tetraethyl lead as a poisonous substance).

33. MCGRAYNE, *supra* note 16, at 90.

34. *Id.* at 90–92.

35. See STUART W. LESLIE, *BOSS KETTERING* 166 (Columbia Univ. Press 1983); DAVID FARBER, *SLOAN RULES: ALFRED P. SLOAN AND THE TRIUMPH OF GENERAL MOTORS* 82–84 (The Univ. of Chicago Press 2002).

appointed by the Surgeon General.³⁶ Industry was left responsible for further research on Ethyl's health effects, including the effects of leaded gas exhaust.³⁷ This was an extraordinarily bad idea. Research work in the 1960s began to show that lead in exhaust is a poison for everyone who breathes the air that it contaminates, and particularly for children. But the research should have been done decades earlier.³⁸

Once the scare passed, tetraethyl lead became spectacularly successful. Leaded gasoline eventually became the dominant gasoline³⁹—so dominant, in fact, that the United States successfully took Ethyl Corporation to court for using its near-monopoly power to enforce gasoline prices set by the major oil companies.⁴⁰ In 1960, leaded gasoline amounted to almost

36. The committee concluded that the dangers of lead exhaust were unproven. See MCGRAYNE, *supra* note 16, at 92–94; FARBER, *supra* note 35, at 85–86; ED CRAY, CHROME COLOSSUS: GENERAL MOTORS AND ITS TIMES 242 (McGraw-Hill Book Co. 1980). The U.S. Bureau of Mines had been doing a study on the health effects of Ethyl, but the study was funded by GM and tightly controlled by the Ethyl Corporation. MCGRAYNE, *supra* note 16, at 91.

37. See MCGRAYNE, *supra* note 16, at 94; *id.* at 200 (“Midgley . . . invented hugely popular products . . . untrammled by public or scientific oversight. In the short run, taxpayers saved dollars by not funding lead research. In the long run, the imbalance between the underfinanced medical authorities who recognized the dangers of tetraethyl lead and the wealthy industry that conducted most of the lead research helped produce costly global pollution and widespread health problems.”); Ackerman et al., *supra* note 17, at 163–64. No one knew whether lead from auto exhaust could accumulate in the body to harm bystanders, but Kettering and Midgley were aware that it was a serious possibility. Midgley considered having Harvard Medical School and Columbia University perform an objective study of the toxicity of the exhaust from vehicles fueled by leaded gasoline. It never happened. MCGRAYNE, *supra* note 16, at 88.

38. See MCGRAYNE, *supra* note 16, at 168–97; *id.* at 200 (“[Clair] Patterson [the great Berkeley scientist] raised his alert even before the public was aware of the existence of lead pollution or its potential for great harm.”); FARBER, *supra* note 35, at 86; Joseph A. Pratt, *Letting the Grandchildren Do It: Environmental Planning During the Age of Oil as a Major Energy Source*, PUB. HISTORIAN 28, 51 (Summer 1980) (“The most striking result of the initial efforts to understand the possible effects of leaded gasoline on public health was the almost complete disregard of the question for several decades after 1931.”). The litany of pathologies caused by lead is sobering; it includes reproductive health problems, nerve disorders, loss of memory, loss of concentration, and, for children, damage to the brain and the nervous system, delayed growth, and hearing defects. EPA, Lead in Paint, Dust, and Soil: Basic Information, <http://www.epa.gov/lead/leadinfo.htm#health> (last visited Dec. 1, 2005).

39. See *Ethyl Gasoline Corp. v. United States*, 309 U.S. 436, 449 (1940) (refiners licensed by Ethyl Gasoline Corporation “refine 88% of all gasoline sold in the United States, and the gasoline processed by them under the license agreements is 70% of all the gasoline thus sold, and 85% of all gasoline processed to obtain a high octane rating”).

40. *Id.* at 453.

ninety percent of the U.S. market for automotive fuels.⁴¹ And even after lead was phased out in the United States beginning in the 1970s, leaded gasoline continued to be sold elsewhere. Venezuela stopped producing leaded gasoline only in August 2005. Twenty African countries are scheduled to finish phasing out lead in 2006.⁴²

Ethanol's fortunes, by contrast, declined sharply after the 1920s. At some point, the American Petroleum Institute (API) began lobbying and campaigning against measures to promote ethanol's use as a fuel or an additive—a campaign that continues today.⁴³ (Similarly, farm groups and Midwestern

41. "Ethyl Corporation swept the American market. By 1960, leaded gasoline accounted for nearly 90 percent of all automotive fuel sold and was one of the top 10 industrial chemical enterprises in the United States. Because Europe and Japan made smaller, more efficient engines, the United States used more than 80 percent of all leaded gasoline sold before 1970." MCGRAYNE, *supra* note 16, at 95.

42. See *Venezuela Oil Monopoly to Discontinue Leaded Fuels*, BNA DAILY ENV'T REP. (Aug. 9, 2005); U.S. ENVTL. PROTECTION AGENCY, FY 2006 ANNUAL PERFORMANCE PLAN AND CONGRESSIONAL JUSTIFICATION, at PPA-50 to -51, available at <http://www.epa.gov/ocfo/budget/2006/ppa.pdf>. When Venezuela stopped using TEL in gasoline in August 2005, ethanol was chosen as the replacement additive. See *Brazil's Petrobras Exports First Shipment of Ethanol* (July 30, 2005), in *Green Car Congress: Ethanol*, available at <http://www.greencarcongress.com/ethanol/>.

43. See COMM. ON MOTOR FUELS, AM. PETROLEUM INST., POWER ALCOHOL: HISTORY AND ANALYSIS 47–48 (1940); GENERAL MARKETING COUNSELORS, INC., ALCOHOL-GASOLINE MOTOR FUEL: A STUDY OF THE COMPARATIVE GAINS AND LOSSES TO THE VARIOUS INDUSTRIES AFFECTED BY THE PROPOSED LAW TO REQUIRE THE BLENDING OF ALCOHOL WITH GASOLINE (1933) (report by consultants retained by API); August W. Giebelhaus, *Resistance to Long-Term Energy Transition: The Case of Power Alcohol in the 1930s*, in *ENERGY TRANSITIONS: LONG-TERM PERSPECTIVES* 35, 39–43 (Lewis J. Perelman et al. eds., 1981) (describing API's campaign in the 1930s against legislation to require alcohol blending); Kathleen Braun, *Federal and State Legislative and Regulatory Fuels Issues*, Am. Petroleum Inst., http://api-ep.api.org/environment/index.cfm?objectid=655F4467-591C-44D1-BC2346720670DC39&method=display_body&er=1&bitmask=002008007002000000 (last visited Dec. 26, 2005) ("Ethanol blending in gasoline has costs and benefits and is used by oil companies where it makes economic sense. . . . Significantly expanding ethanol use beyond what the market can absorb will likely lead to unnecessary cost increases, gasoline supply constraints and losses to the highway trust fund. . . . API supports continued development and use of [renewable] fuels but believes lawmakers should avoid renewable fuel mandates as they are not in the best interest of the motoring public."); Juan R. Palomo, *Studies Document High Costs of Higher Ethanol Mandates*, Am. Petroleum Inst., http://api-ep.api.org/publications/index.cfm?objectid=C1BAF901-AA3C-4DD8-BF9874AE1AE45224&method=display_body&er=1&bitmask=002003002000000000 (last visited Dec. 26, 2005) ("Two studies released today by the American Petroleum Institute (API) find that higher ethanol mandates for gasoline produced in the United States—known as the Renewable Fuels Standard (RFS)—could hurt consumers and the nation's agricultural sector while yielding only small—and costly—reductions in U.S. petroleum use and imports. . . . API has supported an RFS that balances the industry's ability to provide consumers with reliable supplies of affordable gasoline with the need to diversify our energy supply. It joined with other stakeholders in support of a 5-bgy [billion gallons per year] RFS in the 108th Congress. However, it opposes a much larger RFS, which would force ethanol into markets outside the

politicians agitated for subsidies for ethanol that would support agricultural life.)⁴⁴ Yet ethanol had occasional successes up until the Second World War, particularly outside the United States.⁴⁵ In the 1930s, brands of gasoline (one of them partly owned by Standard Oil of New Jersey) containing thirty percent and sixteen percent ethanol were commercially successful in the United Kingdom.⁴⁶ And during the war itself, ethanol was used in the effort to defeat Germany and Japan.⁴⁷ But after peace was achieved, oil was inexpensive, and crop-based ethanol could not compete. Gasoline's dominance was assured. Almost no commercial fuel ethanol was available in the United States between the 1940s and the 1970s.⁴⁸

Midwest, where the majority of ethanol is produced, complicating logistics and increasing costs to pay for transporting the fuel.”). Cf. *Oversight to Examine Transportation Fuels of the Future: Hearing Before the S. Comm. on Env't & Pub. Works*, 109th Cong. (Nov. 16, 2005) (statement of Red Cavaney, President and CEO, American Petroleum Institute), http://epw.senate.gov/hearing_statements.cfm?id=248795 (“[P]etroleum-based fuels are likely to continue to be the dominant transportation fuels well into this century. It is critically important that government not attempt to force a transition away from these fuels until affordable, reliable substitutes are available in ample supply. . . . The reality is that gasoline, the time-tested champion fuel of motor vehicle transportation, is likely to remain the dominant fuel for many years to come. Its composition may change and its uses may be shaped by evolving technology, but gasoline, in fact, will be the fuel of the future—at least for the near-term.”); Kitman, *supra* note 31 (stating that oil companies “hated” ethanol).

44. See, e.g., AUGUST W. GIEBELHAUS, *BUSINESS AND GOVERNMENT IN THE OIL INDUSTRY: A CASE STUDY OF SUN OIL, 1876–1945*, at 176–77 (JAI Press 1980).

45. See JACOBSON, *supra* note 21, at 110 (“Since the 1920s, every industrialized country except the United States has marketed blends of ethyl alcohol with gasoline in greater than nontrivial quantities. . . . Nevertheless, alcohol may never have represented more than 5 percent of the total fuel use in Europe in the 1930s.”) (citation omitted). For discussion of ethanol in the U.S. in the pre-war period, see Joseph DiPardo, *Outlook for Biomass Ethanol Production and Demand*, <http://www.eia.doe.gov/oiaf/analysispaper/biomass.html> (last visited Dec. 1, 2005) (“Ford and others continued to promote the use of ethanol, and by 1938 an alcohol plant in Atchison, Kansas, was producing 18 million gallons of ethanol a year, supplying more than 2,000 service stations in the Midwest.”); GIEBELHAUS, *supra* note 44, at 176–77 (noting that Sun Oil, which resisted using TEL until after Ethyl Corporation’s patents on TEL expired, experimented with blending alcohol with its gasoline to boost octane, but ultimately decided against it, having already joined in the API’s lobbying campaign against the power alcohol movement); ARTHUR M. JOHNSON, *THE CHALLENGE OF CHANGE: THE SUN OIL COMPANY, 1945–1977*, at 66 (Ohio State Univ. Press 1983); Kovarik Presentation, *supra* note 22.

46. See Kovarik, *supra* note 18, at 7; Kitman, *supra* note 31.

47. See Valerie Thomas & Andrew Kwong, *Ethanol as a Lead Replacement: Phasing out Leaded Gasoline in Africa*, 29 ENERGY POL’Y 1133, 1135 (2000), available at <http://www.unep.org/PCFV/Documents/DataEthanolArticle.pdf>.

48. “By the 1940s, . . . efforts to sustain the U.S. ethanol program had failed. . . . Fuels from petroleum and natural gas became available in large quantities at low cost, eliminating the economic incentives for production of liquid fuels from crops. Federal officials quickly lost interest in alcohol fuel production, and many of the wartime distilleries were dismantled. Others were converted to beverage alcohol plants.” DiPardo,

IV. PHASING OUT LEAD—AND PHASING IN AIR TOXICS

The Clean Air Act of 1970 authorized the new Environmental Protection Agency, which President Nixon had just created,⁴⁹ to regulate fuel additives that endangered public health.⁵⁰ Soon after, EPA acted to begin phasing lead out of gasoline—first because lead disabled the catalytic converters used to reduce emissions of other air pollutants, and then because of the accumulating evidence that lead was dangerous to people.⁵¹

The episode was a striking example of the tension between the oil and automobile industries over who should be held responsible for cleaning up vehicle emissions.⁵² For the first twenty years after the CAA was enacted, the auto industry generally bore the brunt of the regulatory burden. The phase-out of leaded gasoline was the one major exception to the rule.⁵³

supra note 45. See JACOBSON, *supra* note 21, at 110 (“In the United States, gasoline prices have always been much lower than alcohol-fuel prices, inhibiting the popularity of alcohol as an alternative to gasoline.”).

49. GARY C. BRYNER, *BLUE SKIES, GREEN POLITICS: THE CLEAN AIR ACT OF 1990 AND ITS IMPLEMENTATION* 99, 136 n.11 (2d ed. 1995) (citing Reorganization Plan no. 3, 1970, 5 U.S.C.A. App. (Supp. 1992)).

50. See *Ethyl Corp. v. EPA*, 541 F.2d 1, 7 (D.C. Cir. 1976) (en banc) (1970 CAA “authorizes the Administrator of EPA to regulate gasoline additives whose emission products ‘will endanger the public health or welfare’”) (quoting CAA § 211(c)(1)(A), then codified at 42 U.S.C. § 1857f-6c(c)(1)(A) (and now codified, as amended, at 42 U.S.C. § 7545(c)(1))).

51. See *THE CLEAN AIR ACT HANDBOOK*, *supra* note 6, at 373–75; MCGRAYNE, *supra* note 16, at 95 (“[T]he petroleum industry did not solve the problem of cheap, lead-free, knock-free gasoline until the 1970s, after General Motors adopted the catalytic converter. Lead compounds inactivate the catalysts, and sophisticated catalytic cracking techniques had to be developed to replace the fuel additive.”); *id.* at 190; DANIEL SCHOENBROD, *SAVING OUR ENVIRONMENT FROM WASHINGTON* 29–35 (2005).

52. See, e.g., JACK DOYLE, *TAKEN FOR A RIDE: DETROIT’S BIG THREE AND THE POLITICS OF POLLUTION* 219 (2000) (noting that when the George H.W. Bush Administration called for 1 million alternative-fueled vehicles using 100% methanol, “[m]uch of the oil industry . . . viewed the proposal as a major threat to its preeminent position in gasoline” and that the automobile industry was cool to the idea but did not strongly oppose it); *id.* at 230 (describing “finger pointing” between industries “when their interests were threatened” in fights over alternative fuels in the run-up to the 1990 CAA Amendments); ENERGYWASHINGTON WK., *supra* note 5; Margaret E. Kriz, *Politics at the Pump*, 22 NAT’L J. 1328, June 2, 1990, at 1333 (describing the “breaking up” of “inter-industry alliance” between auto and oil companies during negotiations over the 1990 Clean Air Act amendments); James Mackintosh, *Biofuels Could Give Breathing Space to Carmakers*, FIN. TIMES (London), Dec. 6, 2005, at 37 (reporting that the European auto industry “appears to have succeeded in persuading the European Commission to shift at least some of the cost of reducing greenhouse gas emissions on to the oil industry,” and that “[t]he move is being fought by the oil majors”).

53. “With one notable exception—the phase-down of leaded gasoline—the federal motor vehicle control program has historically concentrated on establishing emission standards for new vehicles, such as tailpipe standards for hydrocarbons, nitrogen oxides, and CO. Motor vehicle *fuels* have been largely neglected. . . . For the first time, the 1990

The major oil refiners fiercely opposed phase-out, citing the prospect of massive costs.⁵⁴ Along with Ethyl Corporation, they sued EPA, arguing that EPA had not found that lead additives would endanger the public health. After two years of delay, phasedown was upheld.⁵⁵ The oil majors began to realize that the new requirements would give them an advantage over small refiners.⁵⁶ Even so, it was not until the middle of the 1980s that lead phasedown was largely complete.⁵⁷ As use of leaded gasoline plummeted in the United States, so did Americans' blood lead levels.⁵⁸

An unintended consequence of lead phase-out was a major increase in emissions of a second set of toxic pollutants.⁵⁹ In the

Amendments will reverse these trends." Henry A. Waxman et al., *Cars, Fuels, and Clean Air: A Review of Title II of the Clean Air Act Amendments of 1990*, 21 ENVTL. L. 1947, 1972-73 (1991) (emphasis in original). See also NAT'L RESEARCH COUNCIL, AIR QUALITY MANAGEMENT IN THE UNITED STATES 153-54 (2004), available at <http://www.nap.edu/books/0309089328/html> ("For most of the first 20 years of implementing the CAA, mobile-source emissions were controlled through technological changes to engines and exhaust systems. With the exception of lead, fuel was not regulated for emissions control. Beginning in the late 1980s, however, a more balanced strategy began to take shape that combined regulations on vehicle performance with regulations on the fuels used by those vehicles.") (citation omitted); DOYLE, *supra* note 52, at 236 ("With the exception of removing lead from gasoline in the 1970s, no regulatory action on the automobile's fuel had been taken [until 1990]. But that had changed.")

54. An executive of one of the Standard Oil companies, for example, claimed that making and distributing unleaded gasoline would require an investment of \$5 billion. Vivian E. Thomson, *Grab Bag Ethics and Policymaking for Leaded Gasoline: A Pragmatist's View*, in MORAL AND POLITICAL REASONING IN ENVIRONMENTAL PRACTICE 259, 262, 263 (Andrew Light & Avner de-Shalit, eds., 2003). See LAWRENCE E. SUSSKIND ET AL., BETTER ENVIRONMENTAL POLICY STUDIES: HOW TO DESIGN AND CONDUCT MORE EFFECTIVE ANALYSIS 32 (Island Press 2001).

General Motors, which wanted its catalytic converters to work, did not oppose phasedown. It (and Standard Oil of New Jersey) had sold Ethyl Corporation in 1962. MCGRAYNE, *supra* note 16, at 188; FARBER, *supra* note 35, at 86.

55. *Ethyl Corp. v. EPA*, 541 F.2d 1 (D.C. Cir. 1976) (en banc). See also Thomson, *supra* note 54, at 269.

56. See SCHOENBROD, *supra* note 51, at 214-15 (large firms use sophisticated lobbyists to seek laws that put competitors at a disadvantage; an example is that "big refiners pushed for a law requiring the elimination of all lead from gasoline in the early 1980s . . . in order to give themselves an edge over small refiners"). "With the demand for leaded gasoline dropping as old cars were junked, large refiners wanted to stop supplying it but feared losing market share to smaller competitors. The large refiners asked the EPA to use its mandate to protect health as a reason to ban leaded gasoline. . . . The EPA acted with resolution [by ruling in 1985 that almost all remaining lead must be removed from gasoline] only after the most powerful opposition had vanished." *Id.* at 35.

57. THE CLEAN AIR ACT HANDBOOK, *supra* note 6, at 374-75. Ten years later, lead was illegal for use in motor vehicles. *Id.* at 373.

58. See MCGRAYNE, *supra* note 16, at 191.

59. See NAT'L RESEARCH COUNCIL, *supra* note 53, at 155 ("There was also an unintended negative consequence of the lead phase-out. Tetraethyl lead was originally introduced into gasoline as an octane enhancer to improve vehicle performance. To

1970s, oil refiners had at least two basic substitutes for TEL as an octane enhancer, just as they had decades earlier—alcohols, such as ethanol and methanol, and related ethers; and aromatics, especially benzene, toluene, and xylene (BTX), which were already in gasoline to a significant extent.⁶⁰ Major refiners generally chose the latter, which would not compete with gasoline, were within their control, and were cheap.⁶¹ EPA knew that aromatics were toxic,⁶² but it appears that EPA did not believe that refiners had much of an alternative to aromatics.⁶³

maintain octane levels after the phase-out of lead, refiners blended higher amounts of light hydrocarbons and aromatics, such as benzene, into the fuel. The blending had the unintended consequence of increasing evaporative VOCs and air toxic emissions.”) (citations omitted); THE CLEAN AIR ACT HANDBOOK, *supra* note 6, at 358 (“[T]o replace the octane that lead additives provided and that MMT [methylcyclopentadienyl manganese tricarbonyl—another metal-based compound] was not allowed to provide, refiners used more volatile aromatic hydrocarbons and added to gasoline increased amounts of butane.”); *id.* at 378.

60. “Without antiknock additives, the only way to produce high-octane-number gasolines is to use inherently high-octane hydrocarbons or to use oxygenates [such as ethanol], which also have high-octane-number values.” Chevron, Gasoline Refining and Testing, http://www.chevron.com/products/PRODSERV/fuels/bulletin/motorgas/3_refining-testing/pg2.asp (last visited Dec. 28, 2005). For basic information on air toxics, see EPA Air Trends, Toxic Air Pollutants, <http://www.epa.gov/airtrends/toxic.html> (last visited Dec. 2, 2005). *Cf.* Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 65 Fed. Reg. 48,058, 48,061 (Aug. 4, 2000) (to be codified at 40 C.F.R. pts. 80 & 86) (“[T]oluene and xylene . . . are chemically very similar to benzene. Like benzene itself, these compounds occur naturally in petroleum and become more concentrated when petroleum is refined to produce high octane gasoline.”).

61. *See* The European Fuels Oxygenate Association: MTBE and Gasoline, <http://www.efoa.org/gasoline.html> (“When Europe started to phase down lead octane additives in petrol in the 1980s, many refiners usually replaced them with aromatics, which represented the lowest-cost alternative at the time.”); Joseph R. Dancy, *The Impact of the Clean Air Act’s Ozone Non-Attainment Areas on Texas: Major Problems And Suggested Solutions*, 47 SMU L. Rev. 451, 484 (1994) (“Gasoline naturally contains certain elements that contribute to air toxic emissions, including benzene, toluene, and xylenes. With the introduction of catalytic convertors and the phase out of octane boosting lead additives, carcinogenic aromatics have purposely been added to gasoline in the refining process to boost its octane rating.”); *id.* at 459 (“To replace the octane formerly contributed by lead additives, increased catalytic cracking was used to increase high octane hydrocarbons, and blending agents were added to the crude oil feedstock.”).

62. *See* EPA, Final Rule, Regulation of Fuels and Fuel Additives: Control of Lead Additives in Gasoline, 38 Fed. Reg. 33,733, 33,738 (Dec. 6, 1973) (concluding that current use of lead additives endangered public health to a greater degree than adding more aromatics to gasoline) (“Polynuclear aromatic hydrocarbons (PNA) are carcinogenic and are primarily caused by hydrocarbon emissions from stationary sources such as petroleum refineries and coke ovens. Currently automobile emissions account for less than 2 percent of total PNA emissions. . . . Although the indication is that the lead regulations will not produce an aromatics or a PNA emission problem, EPA nevertheless has the authority to regulate the aromatic content of gasoline should such action become necessary.”).

63. *See* Edwin S. Rothschild, *The Knock on High-Octane Gasoline*, WASH. POST, Feb. 18, 1990, at B3 (“Although ‘cleaner’ alternatives, namely alcohol and ethers (oxygenated hydrocarbons derived from alcohols) were available, the [major oil] companies in the

In addition, adding alcohol to gasoline triggered a Clean Air Act provision requiring specific approval of new fuels and additives that were not substantially similar to old ones.⁶⁴ Toxics, by contrast, were already in gasoline. Adding more of them did not implicate the new fuels and additives provision and thus required no EPA approval.

So the oil industry added aromatics to the gasoline pool in great quantities. To this end, the oil industry commenced a major refinery investment program to build more catalytic reformers and other so-called downstream refining units.⁶⁵ The industry sank billions of dollars into these and other refining investments.⁶⁶ As a result, the aromatics component of gasoline rose from about 22% of all gasoline sold in the early 1970s to about a third by 1990 (and 45% or even 50% of some premium grades).⁶⁷

early 1970s told the EPA they wanted to use aromatics because it was more 'practical' to do so. The EPA acquiesced despite the fact that as early as December 1973, when it issued its initial lead phase-down regulations, the agency recognized the harmful consequences of increasing aromatics."). Indeed, in 1973, at the time it announced its first major regulation requiring lead phasedown for public health reasons, EPA said that "[m]anganese is the only fuel additive besides lead which is now recognized as being a cost effective octane booster." Regulation of Fuels and Fuel Additives: Control of Lead Additives in Gasoline, 38 Fed. Reg. at 33,738. Manganese, it turned out, has its own problems; it has never become a significant gasoline additive in the United States. See Chevron, Gasoline Refining and Testing, http://www.chevron.com/products/prodserv/fuels/bulletin/motorgas/3_refining-testing/pg4.asp (last visited Dec. 2, 2005) ("MMT [methylcyclopentadienyl manganese tricarbonyl] was commercialized in 1959 and was used in gasoline alone or in combination with the lead alkyls. . . . MMT's future in the U.S. is clouded: Its use in gasoline is opposed by environmental groups and the automobile manufacturers.").

64. See Clean Air Act, 42 U.S.C. § 7545(f) (2000); EPA, Fuels and Fuel Additives: Gasohol; Marketability, 44 Fed. Reg. 20,777 (Apr. 6, 1979) (giving notice of waiver of "substantially similar" requirement for blends of gasoline with 10% alcohol).

65. See Energy Info. Administration, U.S. Dep't of Energy, Petroleum Chronology of Events 1970–2000, http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/chronology/petroleumchronology2000.htm (last visited Dec. 2, 2005); Chevron, Gasoline Refining and Testing, http://www.chevron.com/products/PRODSERV/fuels/bulletin/motorgas/3_refining-testing/pg3.asp (last visited Dec. 2, 2005); Francesca Lyman, *The Gassing Of America: A High-Octane Campaign Against Toxic Fuel Additives*, WASH. POST, Apr. 13, 1990, at C5.

66. Between 1977 and 1982, refiners invested over \$28 billion—in 1995 dollars—in refining capital expenditures. See ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, PUBL'N NO. DOE/EIA-0615, PETROLEUM 1996: ISSUES AND TRENDS 146 (Sept. 1997), available at http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/petroleum_issu es_trends_1996/ENTIRE.PDF. See *id.* at 62, 145, 146.

67. See Waxman et al., *supra* note 53, at 1972; Lyman, *supra* note 65 ("Some premium, high-octane blends have been found to contain more than 50 percent aromatic hydrocarbons."); Chevron, RFG Characteristics, <http://www.chevron.com/products/prodserv/fuels/bulletin/fed-refm/rfg-char.shtml> (last visited Dec. 2, 2005) ("The total aromatics content of 1990 U.S. industry average gasoline ranged from 26% by volume in

V. AIR TOXICS AFTER LEAD: THE 1990 CLEAN AIR ACT
AMENDMENTS

Around 1990, the trend began to turn. That year, President George H. W. Bush signed a comprehensive set of amendments to the Clean Air Act. A key component of the overhaul was an entirely new regulatory scheme that focused on the composition of automobile fuel itself, including the air toxic components.⁶⁸

It was about time for this shift to occur. Any scheme of regulation that tries to reduce hazardous-air-pollutant (HAP) levels without focusing on mobile-source pollution is doomed to failure. Automobiles and other mobile sources account for about half of the HAPs that are released in the United States each year.⁶⁹ And fuels must be regulated—not just vehicles—if the most reductions are to be achieved at the lowest cost.⁷⁰

The new statute's biggest initiative to lower toxics in fuels was a program that applied to certain urban areas with serious ozone problems. The 1990 amendments required fuel marketers to supply all customers in these areas with reformulated gasoline (RFG), which has lower levels of benzene and other toxics than conventional gasoline. RFG had to contain a set percentage of oxygenates such as ethanol (which has no toxic content) and had to abide by limits on volatility and toxics levels.⁷¹ The statute

the winter to 32% by volume in the summer.”); Gary Yepsen & Tony Witoshkin, *Refiners Have Options to Deal With Reformulated Gasoline*, OIL & GAS J. 68 (Apr. 8, 1991) (aromatics are 32.0% of current gasoline pool). Cf. *Ethyl Corp. v. EPA*, 541 F.2d 1, 33 n.68 (D.C. Cir. 1976) (en banc) (predicting that “the average aromatic content of gasoline will rise from 22% to 29%” as a result of new lead regulations).

68. See DOYLE, *supra* note 52, at 236 (CAA of 1990, which “was the beginning of a whole new regulatory matrix devoted exclusively to gasoline and other automotive fuels,” “identified automobile fuels as a key source” of HAPs).

69. See EPA, Air Trends, Toxic Air Pollutants, <http://www.epa.gov/airtrends/toxic.html> (last visited Nov. 30, 2005).

70. As the D.C. Circuit has said, “[h]igh pollutant levels in fuel make it impossible or at least far more difficult to achieve low emissions.” *Nat’l Petrochemical & Refiners Ass’n v. EPA*, 287 F.3d 1130, 1134 (D.C. Cir. 2002).

71. See Waxman et al., *supra* note 53, at 1972–91 (discussing the fuels provisions). See *id.* at 1974–87 (describing details of volatility and RFG regulations). See also BRYNER, *supra* note 49, at 124–25, 168–69; Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 65 Fed. Reg. 48,058, 48,076 (Aug. 4, 2000) (to be codified at 40 C.F.R. pts. 80 & 86) (“[T]he RFG program (covering about one-third of the gasoline sold in the country) includes standards on the benzene content of fuel as well as standards governing the overall toxics emissions associated with evaporation and combustion of the fuel.”); *id.* at 48,077; Michael Walsh, *Motor Vehicles*, in THE CLEAN AIR ACT AMENDMENTS: BNA’S COMPREHENSIVE ANALYSIS OF THE NEW LAW 53, 70–73 (1991); Theodore L. Garrett & Sonya D. Winner, *A Clean Air Act Primer*, in CLEAN AIR DESKBOOK, AN ELI DESKBOOK 3, 62–63 (1992).

also put limits on toxics in conventional gasoline. This was to prevent refiners from larding it with toxics that could not be used in RFG.⁷² Similarly, gasoline in cities with carbon monoxide (CO) problems had to contain a set percentage of oxygenates in the winter, when CO pollution is worst.⁷³ Political motives, unsurprisingly, were highly relevant to decisions of this kind; Senators and Congressmen from farm states naturally took opportunities to promote corn-based ethanol.⁷⁴ But mixed motives can have good policy results: By 2002, gasoline aromatics levels had declined to about 20% for reformulated gasoline and 25% to 28% (depending on the season) for conventional gasoline.⁷⁵ The RFG program, along with other Clean Air Act initiatives, had cut mobile-source toxics emissions by about a million tons per year between 1990 and 1996.⁷⁶

72. See Waxman et al., *supra* note 53, at 1986–87.

73. See DOYLE, *supra* note 52, at 236; Walsh, *supra* note 64, at 71.

74. See BRYNER, *supra* note 49, at 124–25, 168–69, 197–204, 228 n.33; *id.* at 202–03 (describing ethanol provisions of implementation regulations). “Environmentalists were strong supporters of reformulated gas, but the key political support came from Midwestern agricultural interests . . .” *Id.* at 168. See also DOYLE, *supra* note 52, at 229–30 (account of how the Senate amended RFG provisions to require more RFG use); NAT’L RESEARCH COUNCIL, *supra* note 53, at 160.

75. In 2002, average RFG aromatics levels were 20.4% in the summertime and 19.4% in the wintertime. Aromatics levels in conventional gasoline were 28.0% in the summertime and 25.0% in the wintertime. See EPA, Reformulated Gasoline Parameters by Reporting Year, <http://www.epa.gov/otaq/regs/fuels/rfg/properf/rfg-params97-02.htm> (last visited Dec. 2, 2005). See also EPA, RFG Properties Survey Data, <http://www.epa.gov/otaq/regs/fuels/rfg/properf/rfgperf.htm> (last visited Dec. 2, 2005); EPA, Conventional Gasoline Parameters by Reporting Year, <http://www.epa.gov/otaq/regs/fuels/rfg/properf/cg-params97-02.htm> (last visited Dec. 2, 2005); EPA, RFG Properties Survey Data, <http://www.epa.gov/otaq/regs/fuels/rfg/properf/rfgperf.htm> (last updated Dec. 2, 2005); Maureen Lorenzetti, *Ex-presidential Aide Seeks Clean Fuels Policy Reform*, OIL & GAS J. 25, 28 (July 15, 2002) (“The aromatics level in today’s reformulated gasolines (RFG) is generally 25 vol%, according to EPA, but those amounts can vary. Conventional gasolines often contain higher levels.”); ASSESSMENT & STANDARDS DIVISION, U.S. ENVTL. PROTECTION AGENCY, PUBL’N NO. EPA420-R-00-023, TECHNICAL SUPPORT DOCUMENT: CONTROL OF EMISSIONS OF HAZARDOUS AIR POLLUTANTS FROM MOTOR VEHICLES AND MOTOR VEHICLE FUELS 159 (Dec. 2000), available at <http://www.epa.gov/otaq/regs/toxics/r00023.pdf> [hereinafter FINAL MSATS TSD] (stating that in 1998, aromatics were 27.30% of conventional gasoline (CG) in the summer, 24.49% of CG in the winter, 22.58% of reformulated gasoline (RFG) in the summer, and 19.58% of RFG in the winter).

76. See MADELEINE STRUM ET AL., PROJECTION OF HAZARDOUS AIR POLLUTANT EMISSIONS TO FUTURE YEARS 7 (Apr. 2005), available at <http://www.epa.gov/ttn/chief/conference/ei14/session10/strum.pdf>. See also NAT’L RESEARCH COUNCIL, *supra* note 53, at 172 (crediting RFG for “reductions in population exposure to benzene”); *id.* at 169. See also EPA, Reformulated Gasoline, <http://www.epa.gov/otaq/f99040.htm> (last visited Dec. 28, 2005) (citing study “show[ing] that Phase I RFG reduced cancer risk from gasoline by about 12 percent, and Phase II RFG is expected to reduce cancer risk by 19 percent”); FINAL MSATS TSD, *supra* note 75, at 164 (“RFG has significantly reduced toxic

To clean up automobile fuels, the 1990 amendments directed EPA to go beyond the reformulated-gasoline requirements, which apply only in areas with ozone problems.⁷⁷ Section 202(l) of the amended statute required EPA to finish a study by May 1992 on “the need for, and feasibility of,” controls on air toxics from mobile sources (MSATs).⁷⁸ Section 202(l) then required EPA to issue—and periodically revise—regulations controlling mobile-source toxics that would “reflect the greatest degree of emission reduction achievable through the application of technology which will be available,” considering the availability and costs of the technology and other factors.⁷⁹ This “technology-forcing” language made feasibility depend on foreseeable future innovations, rather than simply on the state of current technology.⁸⁰ The deadline for issuing regulations

emissions, including benzene. . . . [E]mission reductions from the RFG program have been more than the program requires each year since the program’s introduction in 1995.”); *id.* at 158; OFFICE OF AIR QUALITY, U.S. ENVTL. PROTECTION AGENCY, PUBL’N NO. EPA-453/R-99-007, REPORT TO CONGRESS, NATIONAL AIR TOXICS PROGRAM: THE INTEGRATED URBAN STRATEGY 4–10 (July 2000), *available at* <http://www.epa.gov/ttn/atw/urban/natprpt.pdf>; Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 65 Fed. Reg. at 48,071, 48,077 (Aug. 4, 2000) (to be codified at 40 C.F.R. pts. 80 & 86).

77. RFG “is currently used in 17 states and the District of Columbia. About 30 percent of gasoline sold in the U.S. is reformulated.” EPA, Reformulated Gasoline: Basic Information, <http://www.epa.gov/otaq/rfg/information.htm> (last visited Dec. 26, 2005). This means that a significant minority of Americans live in RFG areas, but a minority nonetheless. *See id.* (“About 75 million people are breathing cleaner air because of RFG.”).

78. 42 U.S.C. § 7521(l)(1) (2000).

79. “The regulations shall contain standards for such fuels or vehicles, or both, which the Administrator determines reflect the greatest degree of emission reduction achievable through the application of technology which will be available, taking into consideration the standards established under subsection (a), the availability and costs of the technology, and noise, energy, and safety factors, and lead time. . . . The regulations shall, at a minimum, apply to emissions of benzene and formaldehyde.” § 7521(l)(2). *See also* DAVID WOOLEY & ELIZABETH MORSS, CLEAN AIR ACT HANDBOOK § 2:33 (current through May 2005). Section 202(l) supplements subsection (a) of CAA § 202, which is a more general grant of authority to EPA to issue emissions standards. Section 202(a) provides that EPA’s Administrator “shall by regulation prescribe (and from time to time revise) . . . standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles or new motor vehicle engines, which in his judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare.” § 7521(a)(1).

80. *See* Sierra Club v. EPA, 325 F.3d 374, 378 (D.C. Cir. 2003) (noting that “§ 202(l)(2) is ‘technology-forcing,’ so that the agency must consider future advances in pollution control capability”) (citing *Husqvarna AB v. EPA*, 254 F.3d 195, 201 (D.C. Cir. 2001)); *Husqvarna AB*, 254 F.3d at 201 (“CAA section 213 is a technology-forcing standard. In construing similar language included in CAA section 202, we explained . . . that the mere fact that the provisions ‘seek to promote technological advances while also accounting for cost does not detract from their categorization as technology-forcing standards.’ The ‘Congress intended the agency to project future advances in pollution

under section 202(1) was May 1995.⁸¹ This provision pertains both to fuel controls and to controls on vehicle systems, but we concentrate on fuel controls here.

EPA finished the study in April 1993.⁸² But EPA did not issue MSAT regulations until early 2001.⁸³ Its new rules did not require any new reductions.⁸⁴ For the near term, the rules capped aggregate emissions of five toxics, including benzene, at recent levels, with separate “anti-backsliding” requirements for reformulated gasoline and dirtier conventional gasoline.⁸⁵ Recent emissions levels were lower than had been expected because refiners had overcomplied with the 1990 RFG standards in order to extract benzene from gasoline and sell it at a profit in other markets.⁸⁶ Accordingly, EPA said, its new rule “[wa]s not

control capability. It was “expected to press for development and application of improved technology rather than be limited by that which exists today.”” (citations omitted).

81. See § 7521(1)(2).

82. See EPA, Motor Vehicle-Related Air Toxics Study, http://www.epa.gov/OTAQ/reg/toxics/tox_archive.htm (last visited Dec. 28, 2005).

83. See *Sierra Club v. Leavitt*, 355 F. Supp. 2d 544, 545–46 (D.D.C. 2005) (noting that after EPA “fail[ed] to meet the[] statutory deadlines, various groups brought suit against the EPA to compel it to comply with the 1990 Amendments,” and that shortly thereafter, “the EPA entered into a consent decree setting a schedule for agency action”) (citation omitted). The 2001 final rule for MSATs was issued “[c]onsistent with the consent decree.” *Id.* at 546.

84. “The mobile source air toxics rule does not require additional sampling or measurement, or[,] in general, effort beyond what the refiner did during the baseline period (1998–2000) with respect to gasoline production.” OFFICE OF MGMT. & BUDGET, PROGRAM ASSESSMENT RATING TOOL (PART), at Section III, available at <http://www.whitehouse.gov/omb/budget/fy2004/pma/airtoxics.xls> [hereinafter PART] (last visited Dec. 28, 2005).

85. Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 66 Fed. Reg. 17,230, 17,247 (Mar. 29, 2001) (to be codified at 40 C.F.R. pts. 80 & 86). Refiners had overperformed in seeking to obey the law. The new rule locked in the resulting extra reductions by forbidding refiners to backslide from an average of the annual levels achieved from 1998 to 2000. *Id.* at 17,245. Congress revised the anti-backsliding limits slightly in 2005. See Energy Policy Act of 2005, Pub. L. No. 109-58, § 1504(b) (2005) (amending CAA § 211(k)(1), 42 U.S.C. § 7545(k)(1), to require use of 2001 and 2002 data to set backsliding baseline).

86. EPA believed that the refineries had overcomplied “because it was economically advantageous. In most cases, the financial incentive to overcomply is due to proximity to a market for chemical benzene.” Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 66 Fed. Reg. at 17,245. As EPA had said in the proposed rule, “[f]or certain refineries geographically located near petrochemical plants, it is profitable to remove benzene from reformat, a gasoline blending component, and sell it for petrochemical uses.” Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 65 Fed. Reg. 48,058, 48,077 (Aug. 4, 2000) (to be codified at 40 C.F.R. pts. 80 & 86). The United States was a net importer of benzene, and demand was expected to increase. See FINAL MSATs TSD, *supra* note 75, at 155. It has in fact increased since the MSATs rule was issued. See *Benzene Markets to Remain Tight Through 2007*, OIL & GAS J. 50 (Mar. 21, 2005); UHDE GMBH, AROMATICS 7 (Mar. 2003), available at <http://www.ohiostate.edu/~chem/ohio/ohio.htm>

expected to impose any costs on industry”; the new regulations “[we]re not technology-forcing.”⁸⁷

For the longer term, EPA said that it needed more time to consider suitable control options, as well as to allow refiners to comply with other regulatory requirements, including its “Tier 2” program for both vehicles and fuels. Tier 2, which requires automakers to make better catalytic converters, also requires refiners to make lower-sulfur fuel (sulfur impedes the operation of catalytic converters).⁸⁸ So EPA promised to gather information and undertake a second rulemaking, with final action by July 1, 2004.⁸⁹

Section 202(1) does not mandate the least costly degree of emission reduction. To the contrary, it mandates the greatest degree of reduction possible, taking costs (and other factors) into account. This, presumably, is why EPA said that the anti-backsliding program was “the most stringent program” that EPA could “justify in the near term.”⁹⁰ Yet it appears that stricter mobile-source air toxics controls would have been achievable in 2001 without imposing much expense on the industry. As EPA said, its final rule imposed at most “negligible” costs on refiners.⁹¹ And EPA had already proposed a slightly stricter low-cost alternative.

www.uhde.biz/cgi-bin/byteserver.pl/pdf/broschueren/Oil_Gas_Refinery/Aromatics.pdf#search=history%20catalytic%20reformers%20aromatics%20octane. Two other reasons that EPA cited for refiners’ overcompliance were “[r]eduction in overall aromatics due to use of oxygenates [such as ethanol] for octane” and “[d]ilution with oxygenates.” U.S. ENVTL. PROTECTION AGENCY, PUBL’N NO. EPA420-D-00-003, DRAFT TECHNICAL SUPPORT DOCUMENT: CONTROL OF EMISSIONS OF HAZARDOUS AIR POLLUTANTS FROM MOTOR VEHICLES AND MOTOR VEHICLE FUELS 3, 141 (July 2000), *available at* <http://www.epa.gov/otaq/regs/toxics/d00003.pdf> [hereinafter DRAFT MSATs TSD].

87. OFFICE OF TRANSPORTATION & AIR QUALITY, U.S. ENVTL. PROTECTION AGENCY, PUBL’N NO. EPA420-F-00-055, REGULATORY ANNOUNCEMENT: CONTROL OF EMISSIONS OF HAZARDOUS AIR POLLUTANTS FROM MOBILE SOURCES 3 (Dec. 2000), *available at* <http://www.epa.gov/otaq/regs/toxics/f00055.pdf>.

88. *See* EPA, Tier 2 Vehicle & Gasoline Sulfur Program, Basic Information, <http://www.epa.gov/tier2/basicinfo.htm> (last visited Dec. 1, 2005) (“Compared to Model Year 2003 and earlier, vehicles meeting the Tier 2 emission standards are much cleaner—77% to 95% cleaner, depending on the size of the vehicle. . . . Average national gasoline sulfur levels are already declining, and by 2006 will be 90% lower than before the program.”).

89. *See* Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 66 Fed. Reg. at 17,247; *id.* at 17,253; *id.* at 17,257–58; *id.* at 17,259 (final action).

90. *Id.* at 17,245.

91. *Id.* at 17,245. “The current rule is designed to avoid increases in toxic emissions from gasoline while imposing the least cost on the refining industry.” *Id.*

In its 2000 Notice of Proposed Rulemaking, EPA had announced that it was planning to impose an anti-backsliding limit (at “negligible” expense)⁹² on the benzene content of gasoline.⁹³ This limit would not have been costly; it was estimated in the final rule at 0.0702 cents per gallon—an annual aggregate cost of about \$81 million for the nation.⁹⁴ That is a very small sum of money compared with the sums that EPA has imposed on other industries to extract smaller pollution control benefits. Tier 2, after all, had an estimated cost of a little less than 2 cents per gallon—about \$12 per year per car, as the Clinton Administration noted in 1999.⁹⁵ By the same reckoning, the benzene limit would have cost 36 cents per car annually. Yet EPA did not explain why it could not have combined the benzene cap with the aggregate toxics cap.⁹⁶

Indeed, it seems that the benzene limit could have been ratcheted down further. In its technical analysis for the final rule, EPA said, quoting a consultant, that “[t]he incremental cost to extract more benzene in a refinery is insignificant compared to the base cost to extract benzene down to the RFG limit.”⁹⁷ Perhaps it was for this reason that the American Petroleum Institute and the National Petrochemical and Refiners Association, when commenting on the proposed rule, said that if they had to choose, they would take a standard for

92. DRAFT MSATS TSD, *supra* note 86, at 147.

93. “Emissions from gasoline-powered vehicles and engines contain several different toxic pollutants, including the following MSATs: benzene, 1,3-butadiene, acetaldehyde, formaldehyde, polycyclic organic matter (POM), and MTBE. However, on a mass basis, benzene makes up about 70 percent of the total amount of these gaseous toxics.” Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 65 Fed. Reg. 48,058, 48,077 (Aug. 4, 2000) (to be codified at 40 C.F.R. pts. 80 & 86). “Because refiners are able to directly control fuel benzene levels, benzene offers refiners the greatest degree of control over a specific toxic fuel component that is also present in emissions at substantial levels.” *Id.*

94. Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 66 Fed. Reg. at 17,246. California gasoline would not have been affected. *Id.*

95. See Press Release, EPA, Tier II—Cleaner Cars and Cleaner Fuels for the 21st Century (Dec. 21, 1999) (transcript available at <http://yosemite1.epa.gov/opa/admpress.nsf/b1ab9f485b098972852562e7004dc686/0b8d5154df6d30a18525684e0077437d?OpenDocument>). The estimate has not changed since then. See EPA, Frequent Questions—Tier 2 Vehicle & Gasoline Sulfur Program, <http://www.epa.gov/tier2/faqs.htm> (last visited Dec. 1, 2005).

96. The final rule seems to suggest that a benzene cap was unnecessary because other regulations would keep benzene emissions down. See Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 66 Fed. Reg. at 17,246. But if that is so, one wonders why it would have been too expensive to impose a benzene cap.

97. FINAL MSATS TSD, *supra* note 75, at 155.

benzene content rather than an overall toxics performance standard.⁹⁸ Yet EPA does not seem to have seriously considered this possibility in the rulemaking.⁹⁹

Indeed, in its technical analysis for the proposed rule, EPA had devoted only one paragraph to the topic of “more stringent control programs,” principally to say that it did not know enough to adequately assess the costs and benefits of *any* such controls. EPA would “conduct further evaluations . . . over the next few years.”¹⁰⁰ This claim of ignorance is puzzling.¹⁰¹ Congress, after all, had instructed EPA in 1990 to study the feasibility of controls by 1992, and to promulgate a rule based on that study by 1995. And EPA had already spent years developing air toxics control technology standards for scores of categories of stationary pollution sources. As we’ll see, some of these stationary-source reductions have been very costly.

Environmental groups and other parties sought review of EPA’s decision in the D.C. Circuit. The court of appeals upheld EPA’s fuel control decision.¹⁰² Without parsing the details, suffice it to say that our own analysis, which focuses on matters

98. See U.S. ENVTL. PROTECTION AGENCY, PUBL’N NO. EPA420-R-00-024, CONTROL OF EMISSIONS OF HAZARDOUS AIR POLLUTANTS FROM MOBILE SOURCES: RESPONSE TO COMMENTS 58–59 (Dec. 20, 2000), available at <http://www.epa.gov/OTAQ/regs/toxics/r00024.pdf> [hereinafter MSATS RESPONSE TO COMMENTS]. Cf. *id.* at 3 (noting that API and NPRA had argued that the rulemaking was “without merit”).

99. As for the benefits of a benzene cap, EPA said nothing to suggest that they would not be substantial, but we cannot be entirely sure what they would have been. In its analysis justifying the final decision that it took, EPA did not say how many tons of benzene would have been taken (or kept) out of the air if the benzene limit had been promulgated. It did say that the standard that it ultimately promulgated would result in “preserved overcompliance” that would “amount to approximately 40,000 tons of toxics emissions in the year 2007.” *Id.* at 111.

100. “There are a wide variety of programs more stringent than the anti-backsliding program we are proposing today which may yield additional toxics emissions reductions beyond the reductions we expect under existing programs. These include further fuel benzene controls, controls on other fuel properties which affect toxics emissions, or emission performance standards directed at one or multiple toxic compounds. Because we do not have sufficient information to adequately evaluate the costs and benefits of such additional programs at this time, we are not proposing any such [] additional program [sic] in today’s action. Instead, we will conduct further evaluations of the costs and benefits of more stringent toxics controls through fuels in our Technical Analysis Plan over the next few years.” DRAFT MSATS TSD, *supra* note 86, at 149.

101. See also MSATS RESPONSE TO COMMENTS, *supra* note 98, at 116 (“Currently we do not have any precise means for evaluating the impact of fuel properties on emissions of aromatic compounds, so we cannot place controls on aromatic compounds specifically at this time.”).

102. *Sierra Club v. EPA*, 325 F.3d 374 (D.C. Cir. 2003). The court remanded one aspect of the Agency’s vehicle controls decision for further explanation. See *id.* at 382–83.

of policy, does not rest on any disagreement with the court's legal conclusions.¹⁰³

When EPA missed its promised deadline for starting the second MSATs rulemaking, EPA was again sued by environmental groups, this time in federal district court. After the court held that the promised deadlines were legally binding on EPA,¹⁰⁴ the parties reached a tentative settlement. Under its terms, the court would enter a consent decree that would require EPA to issue a final rule by February 2007.¹⁰⁵ As of December 2005, the terms had not received final approval.

103. The court's review was limited to whether EPA's actions violated the terms of the CAA or were otherwise "arbitrary and capricious"—a deferential standard. *See id.* at 378 (noting that "[e]xcept for certain explicit statutory questions, . . . our review will be under the familiar [Administrative Procedure Act] standard of 'arbitrary and capricious'"); *id.* at 379 ("Nor does the agency interpretation appear unreasonable on the facts. . . . [W]e see neither statutory violation nor capriciousness in the agency's decision to allow companies to trade benzene or formaldehyde increases against less costly reductions in other toxics."); *id.* at 380 (EPA's "temporary rejection of regulations with long or intermediate lead times was not arbitrary"). The court later said that it had upheld the anti-backsliding rule "because the provision was to be in effect for a short period of time only and because it allowed the EPA to 'assess achievability on a longer term basis' where 'the agency didn't know what technological fixes . . . manufacturers would use to' best reduce emissions." *Bluewater Network v. EPA*, 372 F.3d 404, 412 (D.C. Cir. 2004) (quoting *Sierra Club*, 325 F.3d at 378–80); *see also Sierra Club*, 325 F.3d at 380 (stating that in MSATs rule, EPA "focused on the short term because it found itself confronting a situation where—for a brief time—it wouldn't be able to realistically assess achievability on a longer term basis"); *id.* ("With relatively mild action now, [EPA] would be able later to assess, in a rulemaking actually scheduled for 2003-04, the impact of the earlier rules and the benefits and costs of further controls.") (citation omitted).

We do think it fair to say that the court had to strain somewhat to uphold the Agency's action:

As for the agency's choice of a mere anti-backsliding rule rather than a more aggressive emissions cap, petitioners argue first that the rule achieves no actual "reduction" in emissions, and so cannot be considered the statutorily required "greatest possible reduction achievable." But this errs at the outset by assuming that the emissions level prevailing at some historic point of time is the only permissible baseline against which "reductions" might be measured. The statute does not state any such baseline.

Id. at 379. With respect to whether the agency actually violated the law, this reasoning might well be right. *See Chevron U.S.A., Inc. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837 (1984). But it does seem to be in tension with the policy goals of the statutory language.

104. *See Sierra Club v. Leavitt*, 355 F. Supp. 2d 544, 551 (D.D.C. 2005).

105. *See* Plaintiffs and Defendant, Consent Decree at 3, *Sierra Club v. Leavitt*, 355 F. Supp. 2d 544 (D.D.C. 2005) (No. 04-CV-00094-RBW); Defendant, Motion on Consent to Enter Consent Decree at 2, *Sierra Club v. Johnson*, 355 F. Supp. 2d 544 (D.D.C. 2005) (No. 04-CV-00094). (Stephen Johnson became the named defendant in the case after he replaced Michael Leavitt as EPA Administrator.) As the CAA requires, 42 U.S.C. § 7413(g) (2000), the terms of the settlement were published in the Federal Register in August 2005 to allow persons not involved in the case to submit comments. *See* Proposed Consent Decree, Clean Air Act Citizen Suit, 70 Fed. Reg. 46,168 (Aug. 9, 2005). After the comment period closed, EPA moved to enter the decree. Defendant, Motion on Consent

EPA now has an opportunity to go far beyond what it did five years ago. The magnitude of the opportunity, when one considers it, is surprising.

VI. GASOLINE AIR TOXICS AND FINE-PARTICLE POLLUTION

The Clean Air Act lists 188 hazardous air pollutants.¹⁰⁶ All of them “are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects.”¹⁰⁷ EPA says that there are no risk levels that represent acceptable or unacceptable regulatory thresholds for air toxics.¹⁰⁸ But the “residual risk” provisions of the 1990 CAA amendments give us some idea of what kind of risk might be acceptable. Under the residual risk provisions, the ultimate goal, for any given category of stationary HAP sources, is to reduce the lifetime cancer risk to below one in a million.¹⁰⁹ Before reducing residual risks, though, EPA is required first to develop “technology-based” standards mandating emissions reductions to the lowest levels already achieved in each

to Enter Consent Decree at 2, *Sierra Club v. Johnson*, 355 F. Supp. 2d 544 (D.D.C. 2005) (No. 04-CV-00094).

Section 1504 of the Energy Policy Act of 2005, which was signed into law on August 8, 2005, sets a July 2007 deadline for the MSATs rulemaking. This provision does not make the settlement agreement irrelevant. A consent decree directly enforceable by the court is far more potent as a spur to EPA action than a statutory provision that would require the plaintiffs to sue EPA all over again before they could force EPA to act by the new statutory deadline.

In the one public comment that was filed in the case docket concerning the proposed consent decree, the American Petroleum Institute suggested that EPA consider putting off the rulemaking until the deadline set by the 2005 Act. *See* Letter from Alfonse Mannato, Fuels Manager, American Petroleum Institute, to EPA Docket Center 2 (Sept. 8, 2005) (EPA Dkt. No. OGC-2005-0010) (letter on file with author).

106. *See* Clean Air Act § 112(b), 42 U.S.C. § 7412(b).

107. EPA, About Air Toxics, <http://www.epa.gov/ttn/atw/allabout.html> (last visited Dec. 1, 2005).

108. *See* EPA, Technology Transfer Network National Air Toxics Assessment, Frequently Asked Questions, <http://www.epa.gov/ttn/atw/nata/natsafaq.html> (last visited Dec. 1, 2005).

109. *See* 42 U.S.C. § 7412(f) (requiring EPA to set risk-based standards if needed to provide ample margin of safety); *id.* § 7412(c)(9)(B)(i), (f)(2)(A) (referring to one-in-one-million goal); THE CLEAN AIR ACT HANDBOOK, *supra* note 6, at 272 (discussing CAA section 112(f)); National Emission Standards for Coke Oven Batteries, 70 Fed. Reg. 19,992, 20,001 (Apr. 15, 2005) (to be codified at 40 C.F.R. pt. 63) (referring to “our general goal of protecting the greatest number of people possible to risks no higher than 1 in a million”); Hazardous Air Pollutants: Proposed Regulations Governing Constructed, Reconstructed or Modified Major Sources, 59 Fed. Reg. 15,504, 15,525 (Apr. 1, 1994) (to be codified at 40 C.F.R. pts. 63 & 70) (“The EPA has traditionally believed that exposures that cause a risk above one in one million are considered important.”).

industry—rather like the standards that EPA is required to set for mobile-source air toxics under section 202(1).¹¹⁰ The technology-based stationary-source standards, which EPA finished issuing in early 2004, have achieved annual reductions of 1.7 million tons of toxic air emissions from stationary pollution sources.¹¹¹

Although EPA's air toxics program "has focused primarily on reducing emissions from large industrial sources through technology-based standards,"¹¹² mobile-source air toxics emissions have also declined significantly since 1990 and are expected to continue to decline. This is because of programs that directly regulate these emissions, but also because of programs that were meant for other purposes.¹¹³ A classic

110. See EPA, Air Quality Planning & Standards, <http://www.epa.gov/oar/oaqps/takingtoxics/p1.html> (last visited Dec. 2, 2005).

111. See U.S. ENVTL. PROTECTION AGENCY, PERFORMANCE AND ACCOUNTABILITY REPORT, FISCAL YEAR 2005, at III-16 (Nov. 15, 2005), available at <http://www.epa.gov/ocfo/finstatement/2005par/par05.pdf> ("As of March 2004, toxic emissions from large industrial facilities have decreased by 1.7 million tons per year, a 35 percent reduction since 1990."). See also EPA, Air Trends, Toxic Air Pollutants, <http://www.epa.gov/airtrends/toxic.html> (last visited Dec. 3, 2005); EPA, Technology Transfer Network National Air Toxics Assessment, Air Toxics Reduction, <http://www.epa.gov/ttn/atw/nata/natsatr.html> (last visited Dec. 3, 2005); U.S. ENVTL. PROTECTION AGENCY, FY 2004 ANNUAL REPORT, SECTION I: OVERVIEW AND ANALYSIS 3, available at http://www.epa.gov/ocfo/finstatement/2004ar/aro4_overview2.pdf.

The original 1970 CAA, which required EPA to develop standards to reduce HAP risks, achieved only about 125,000 tons per year of reductions between 1970 and 1990. See EPA, Air Quality Planning & Standards, Introduction, <http://www.epa.gov/oar/oaqps/takingtoxics/p1.html> (last visited Dec. 3, 2005). Hence the 1990 shift to doing technology-based standards first.

112. The Introduction to the Fall 2002 Regulation Plan, 67 Fed. Reg. 74,057, 74,210 (Dec. 9, 2002). In the short discussion from which the quote is taken, there is one reference to mobile sources: "Through other efforts such as phasing lead out of gasoline, EPA also has significantly reduced air toxics from cars and trucks." *Id.* The reference to lead phase-out, which began thirty years ago, is some indication of how much emphasis EPA has put in recent years on toxics reductions from mobile sources. In a recent version of the same document, EPA did not even mention mobile source emissions when it discussed its air toxics reduction efforts. Statement of Regulatory Priorities, 69 Fed. Reg. 72,663, 72,820 (Dec. 13, 2004).

113. EPA says that by 2020, it expects that onroad motor vehicle emissions of some air toxics will be about 75% lower than 1990 levels. See EPA, Air Trends, Toxic Air Pollutants, <http://www.epa.gov/airtrends/toxic.html> (last visited Dec. 3, 2005); Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 66 Fed. Reg. 17,230, 17,237 (Mar. 29, 2001) (to be codified at 40 C.F.R. pts. 80 & 86) (projecting that on-highway emission control programs will reduce emissions of benzene by 73%, formaldehyde by 76%, 1,3-butadiene by 72%, and acetaldehyde by 67% from 1990 levels). But 1990 levels were high, so this means rather less than one might expect. And it doesn't include off-highway mobile source emissions. See *id.* Emissions of the main MSATs were projected to decline by about half between 1996 and 2007, but only by about twenty or thirty percent between 2007 and 2020 (except for diesel PM emissions, which were projected to decline from 85,000 to 15,000 tons during the same period). *Id.*

example of the former is the reformulated gasoline program. A classic example of the latter is the Tier 2 program, which reduces toxics emissions as a byproduct of its main goals of reducing ozone and particulate matter.¹¹⁴ Thus EPA has projected that by 2007, U.S. mobile sources will be emitting 1.34 million tons of air toxics, about forty percent lower than the 2.25 million tons emitted in 1996.¹¹⁵ There is some evidence that this estimate is overly optimistic.¹¹⁶ Either way, 1.34 million tons is

at 17,241. Cf. U.S. ENVTL. PROTECTION AGENCY, PUBL'N NO. EPA420-R-99-023, REGULATORY IMPACT ANALYSIS—CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES: TIER 2 MOTOR VEHICLE EMISSIONS STANDARDS AND GASOLINE SULFUR CONTROL REQUIREMENTS, at III-96 to -102 (Dec. 1999), available at <http://www.epa.gov/otaq/regs/ld-hwy/tier-2/frm/ria/r99023.pdf> [hereinafter TIER 2 RIA] (projecting toxics levels using various assumptions based on different regulatory scenarios).

114. See Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 66 Fed. Reg. at 17,242; PART, *supra* note 84, at Section IV (“For mobile sources, the substantial [toxics] reductions already being achieved and the large reductions projected are resulting from emission and fuel controls designed primarily to reduce criteria pollutant emissions, and impose little additional societal cost.”); Michael P. Vandenbergh, *From Smokestack To SUV: The Individual as Regulated Entity in the New Era of Environmental Law*, 57 VAND. L. REV. 515, 572 n.217 (2004). Two caveats should be stated here. First, Tier 2 did set formaldehyde standards. Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 66 Fed. Reg. at 17,243. Second, EPA’s regulatory impact analysis for Tier 2 did discuss the health effects of some toxics emissions and the program’s predicted impacts on toxics emissions. TIER 2 RIA, *supra* note 113, at III-82 to -102. But EPA’s cost-benefit analysis for Tier 2 did not quantify any of the effects of the predicted air toxics impacts, including formaldehyde reductions. See *id.* at VII-2, VII-5.

115. See WILLIAM BATTYE, U.S. ENVTL. PROTECTION AGENCY, PUBL'N NO. EPA420-R-01-038, THE PROJECTION OF MOBILE SOURCE AIR TOXICS FROM 1996 TO 2007: EMISSIONS AND CONCENTRATIONS (DRAFT) 22 (Aug. 2001), available at <http://www.epa.gov/otaq/regs/toxics/r01038.pdf> [hereinafter BATTYE PROJECTIONS]; EPA, Technology Transfer Network National Air Toxics Assessment, Air Toxics Reduction, <http://www.epa.gov/ttn/atw/nata/natsatr.html> (last visited Dec. 3, 2005) (citing Battye). Cf. EPA, Technology Transfer Network National Air Toxics Assessment, Summary of Results, <http://www.epa.gov/ttn/atw/nata/risksum.html> (last visited Dec. 3, 2005). The Battye projections take into account the effects of the RFG program, Tier 2, and other “regulatory programs which are projected to impact on HAP emissions in 2007,” but not regulations that will reduce diesel emissions beginning in 2007. See BATTYE PROJECTIONS, *supra* at 3. The diesel regulations will not have a major effect on HAP emissions levels (except, of course, for emissions of diesel PM (which is classified as a HAP)). See, e.g., *id.* at 23 (in 1996, onroad benzene emissions from diesel vehicles were about two percent of total onroad benzene emissions; in 2007, diesel share is expected to be under four percent); *id.* at 26 (1996 nonroad diesel emissions were about ten percent of total; in 2007, diesel share is expected to be about eight percent); Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 65 Fed. Reg. 48,058, 48,077 (Aug. 4, 2000) (to be codified at 40 C.F.R. pts. 80 & 86) (“Benzene is also emitted from diesel engines, but at levels approximately one-fortieth of that coming from gasoline vehicles.”).

116. According to EPA’s 1999 emissions inventory, mobile sources now account for 2.23 million tons of U.S. air toxics emissions, or about 44% of the total. See EPA, AirData, County Emissions Report—Hazardous Air Pollutants, <http://oaspub.epa.gov/airsdata/adnti.summary?geotype=us&geocode=USA&geoinfo=%3Fus%7EUSA%7EUnited+States&pol=Hall&year=&emis=a&fld=state&fld=county&fld=urb&fld=area&fld=onr>

still quite a lot¹¹⁷—particularly when many of those tons are emitted in densely populated urban locations.¹¹⁸

What matters most is the risk caused by toxics exposures, not aggregate emissions numbers.¹¹⁹ And in the urban areas inhabited by many of the Americans with the highest exposure risks, motor vehicles are the largest single source of air pollution¹²⁰ and mobile-source contributions to cancer risk levels

oad&fld=nonroad&fld=percent&rpp=25 (last visited Dec. 3, 2005) [hereinafter AirData Table]. (The table shows a total of 4.454 billion pounds of HAPs emitted by mobile sources; we divided this number by 2000 to get the number of tons emitted.) This number seems very close to Battye's 1996 estimate, suggesting that the real 2007 number will be higher than what Battye predicted.

In addition, EPA's most recent performance report shows that overall air toxics emissions decreased in fiscal year 2000 and 2001 at much slower rates than it had projected. See PERFORMANCE AND ACCOUNTABILITY REPORT, FISCAL YEAR 2005, *supra* note 111, at Administrator's Message (in fiscal year 2000, a 1.7% reduction from 1993 levels fell short of EPA's goal for that year of a 3.0% reduction; in FY 2001, a second 1.7% reduction from 1993 levels fell short of EPA's goal of a 5.0% reduction). "Although there are annual slippages, projections developed through 2010 show that EPA will still achieve the estimated cumulative reductions in 2010." *Id.* at GOAL 1-20. But EPA says that toxics emissions data for fiscal year 2005 will be available only in 2015 (apparently because it takes a long time to compile data; see *id.* at GOAL 1-19 n.1). See *id.* at GOAL 1-19. So it may be long after 2010 before we know whether these projections are right.

117. 2020 emissions are also expected to be considerable. A seemingly unofficial EPA estimate projects a further, smaller decline of about half a million tons between 2007 and 2020. See MADELEINE STRUM ET AL., PROJECTION OF HAZARDOUS AIR POLLUTANT EMISSIONS TO FUTURE YEARS 7 (Apr. 2005), available at <http://www.epa.gov/ttn/chief/conference/ei14/session10/strum.pdf>. Cf. Vandenberg, *supra* note 114, at 572-73 ("[I]ncreases in the number of vehicles and the [vehicle miles traveled] per vehicle will undercut much of the gains from the Tier II tailpipe reductions imposed on auto manufacturers.").

118. According to the 1999 National Emissions Inventory, all of the 100 U.S. counties with the highest onroad hazardous air pollutant (HAP) emissions levels were urban counties. See AirData Table, *supra* note 108, at 1-4 (sorted by descending "onroad emissions." Eighty-nine of the 100 U.S. counties with the highest offroad HAP emissions levels were urban counties. See AirData Table, *supra* note 116, at 1-4 (data sorted by descending "nonroad emissions"). For more on the NEI database, see EPA, AirData, About the National Emission Inventory Database, <http://www.epa.gov/air/data/neidb.html> (last visited Dec. 3, 2005); EPA, AirData, Generating Reports and Maps, <http://www.epa.gov/air/data/reports.html> (last visited Dec. 3, 2005); and EPA, AirData, Select Geographic Area, <http://www.epa.gov/air/data/geosel.html> (last visited Dec. 3, 2005).

119. Because of "the uncertainties associated with characterizing air toxics emissions, ambient concentrations, human exposure, and health effects," EPA "relies on emissions data for gauging its progress in reducing health risks from airborne toxics." U.S. ENVTL. PROTECTION AGENCY, SUPPLEMENTAL INFORMATION FOR SUSTAINED PROGRESS IN ADDRESSING MANAGEMENT ISSUES 30, available at http://www.epa.gov/ocfo/finstatement/2004ar/ar04_supplementalchallenges.pdf. Yet "there are concerns with the accuracy of this data." *Id.*

120. See André Nel, *Air Pollution-Related Illness: Effects of Particles*, 308 SCI. 804, 804 (May 6, 2005) (vehicle emissions are "the largest source of air pollution in urban areas"); American Academy of Pediatrics, Committee on Environmental Health, *Policy Statement, Ambient Air Pollution: Health Hazards to Children*, 114 AM. ACAD. PEDIATRICS 1699, 1703 (Dec. 2004) ("In numerous cities in the United States, the personal automobile is the

may be especially significant.¹²¹ In its comprehensive 1996 air toxics assessment, EPA estimated that for mobile-source pollution alone, “more than 100 million people live in areas of the United States where the combined upper-bound lifetime cancer risk from all air toxics compounds exceeds 10 in a million”—over ten times the residual-risk threshold for categories of stationary pollution sources.¹²² A few years ago, EPA expected that exposures from onroad mobile sources would

single greatest polluter, because emissions from millions of vehicles on the road add up.”); *id.* at 1701. *See generally* SIERRA CLUB, HIGHWAY HEALTH HAZARDS (2004), *available at* http://www.sierraclub.org/sprawl/report04_highwayhealth/report.pdf; ADRIANNA QUINTERO-SOMAINI ET AL., NATURAL RESOURCES DEFENSE COUNCIL, HIDDEN DANGER: ENVIRONMENTAL HEALTH THREATS IN THE LATINO COMMUNITY 13 (Oct. 2004), *available at* http://www.nrdc.org/health/effects/latino/english/latino_en.pdf (“Engine exhaust from cars, trucks, and other vehicles is the leading source of pollution in most U.S. cities, including those where the vast majority of Latinos live and work.”); *id.* at 16 (“Transportation accounts for most urban air pollution, and that pollution causes serious health problems[.]”); AM. ACAD. PEDIATRICS, *supra*, at 1702 (noting links between proximity to traffic and childhood respiratory tract complications and cancers); *id.* at 1703; AM. LUNG ASS’N, STATE OF THE AIR 2005, PROTECT THE AIR YOU BREATHE 59, 60, *available at* http://www.lungusa2.org/embargo/sota05/SOTA05_final.pdf; U.S. ENVTL. PROTECTION AGENCY, FY 2004 ANNUAL REPORT, SECTION II: PERFORMANCE RESULTS 47, *available at* http://www.epa.gov/ocfopage/finstatement/2004ar/aro4_section2.pdf (discussing preliminary findings from El Paso Children’s Health Study).

121. “[A]mbient HAP concentrations are considerably higher in urban areas than in rural areas, because of the increased density of both mobile and stationary emission sources in an urban setting.” BATTYE PROJECTIONS, *supra* note 115, at 37. *See id.* at 38 (showing persistence of projected gap between urban and rural counties); *id.* at 39. *Cf. id.* at 45 (showing projected ambient impacts for benzene in 2007 of between 1.2 and 3 micrograms per cubic meter [$\mu\text{g}/\text{m}^3$] in many urban areas, including some in northeastern United States and southern California). A presentation given by a Federal Highway Administration employee at a Transportation Research Board conference on air toxics in January 2005 contains pie charts for twenty-eight major urban counties showing source sector contributions to cancer risk from HAPs, including background contributions. In twelve or thirteen of the counties, the mobile-source contribution appears to account for about half or more of the total risk. It appears that the data may be from EPA’s Office of Air Quality Planning and Standards. *See* KEVIN N. BLACK, AIR TOXICS, CRITERIA POLLUTANTS, AND THE CLEAN AIR ACT 25 (Jan. 9, 2005) (from presentation at TRB Air Toxics Workshop), *available at* [http://www.trbairquality.com/miscdocs/wi2005/A\)%20Air%20Toxics%20Criteria%20Pollutants%20and%20The%20CAA%206a.pdf](http://www.trbairquality.com/miscdocs/wi2005/A)%20Air%20Toxics%20Criteria%20Pollutants%20and%20The%20CAA%206a.pdf).

122. EPA, Technology Transfer Network National Air Toxics Assessment, Summary of Results, <http://www.epa.gov/ttn/atw/nata/risksum.html> (last visited Dec. 3, 2005). *See also* EPA, 1996 Risk Characterization, <http://www.epa.gov/ttn/atw/nata/rcharts/figure15.pdf> (last visited Dec. 3, 2005) (depicting numbers of Americans with various levels of cancer risk from mobile sources). The 1999 assessment has not been released, but a preliminary report suggests that the picture may not have improved very much: The average cancer risk in 1999 for Americans was forty-eight in a million, and 29% of this risk was attributable to mobile sources—which works out to a mobile-source cancer risk for the average American of about fourteen in a million. *See* ANNE POPE & MADELEINE STRUM, EMISSIONS INVENTORY PREPARATION FOR AIR TOXICS AND FOR MODELING AIR TOXICS POLLUTANTS 283, 286 (Apr. 2005), *available at* <http://www.epa.gov/ttn/chief/conference/ei14/training/eitraining.pdf> (last visited Dec. 27, 2005).

decline by half by 2007.¹²³ Granting certain assumptions,¹²⁴ this would get 100-million-plus Americans closer to the one-in-a-million residual risk target, but still at average risk levels at least over five times that target level.¹²⁵ Moreover, average risk numbers may be misleadingly low. As the director of EPA's Air Toxics Center for transportation and air quality has said, "[c]oncentrations of air toxics in commuter vehicles can be substantially higher than average concentrations."¹²⁶ More and faster reductions are needed.¹²⁷

Aside from their direct effect, air toxics in gasoline also exacerbate other air quality problems, especially in cities. For instance, benzene and other aromatic mobile-source air toxics

123. EPA, Technology Transfer Network National Air Toxics Assessment, Summary of Results, <http://www.epa.gov/ttn/atw/nata/risksum.html> (last visited Dec. 3, 2005).

124. We would have to (1) assume similar reductions for nonroad sources; (2) assume that the reduction in exposures is distributed more or less evenly among most or all Americans; and (3) assume that there is a linear relationship between exposure and risk. For now, EPA typically takes at least the third assumption as true. See EPA, Technology Transfer Network Air Toxics Assessment, Background on Risk Characterization, <http://www.epa.gov/ttn/atw/nata/riskbg.html> (last visited Dec. 3, 2005).

125. Aggregate toxics exposure risks—in other words, risks from mobile and non-mobile sources combined—are of course much higher. According to a preliminary report from EPA's 1999 national toxics assessment, most urban locations have an aggregate cancer risk greater than twenty-five in a million; transportation corridors have a risk greater than fifty in a million; and several counties have a risk of greater than 100 in a million. See POPE & STRUM, *supra* note 122, at 297.

126. Kathryn A. Sergeant, *Reducing Air Toxics From Transportation Sources: Standards and Strategies to Protect the Public Health*, 227 TR NEWS 18, 19 (2003), available at <http://gulliver.trb.org/publications/trnews/trnews227.pdf>. See *id.* at 19 ("Recent studies show elevated concentrations of mobile source toxics near roadways."); U.S. ENVTL. PROTECTION AGENCY, PUBL'N NO. EPA420-R-04-007, FINAL REGULATORY ANALYSIS: CONTROL OF EMISSIONS FROM NONROAD DIESEL ENGINES 2-59 (May 2004), available at <http://www.epa.gov/nonroad-diesel/2004fr/420r04007.pdf>; *id.* at 2-13 to -15.

127. See Sergeant, *supra* note 120, at 20–21 ("Although more research is needed to improve assessments and to quantify the risks of mobile-source air toxics, reducing exposure to air toxics is desirable now."). See also Stefan Bruehlmann et al., *Benzene: A Secondary Pollutant Formed in the Three-Way Catalyst*, 39 ENVTL. SCI. & TECH. 331 (2005), available at <http://pubs.acs.org/cgi-bin/sample.cgi/esthag/2005/39/i01/pdf/es049755m.pdf> (noting that 2001 U.S. urban average benzene concentration was about 25% higher than 2001 weighted concentration for Switzerland and that "[t]he risk to the Swiss population based on the current lifetime exposure to benzene is an order of magnitude higher than the accepted risk of one in a million") (citations omitted). Cf. OFFICE OF MGMT. & BUDGET, ENVIRONMENTAL PROTECTION AGENCY PART ASSESSMENTS 16, 17 (Fiscal Year 2006), available at <http://www.whitehouse.gov/omb/budget/fy2006/pma/epa.pdf>. See also *id.* at 17 ("The [EPA's] program has targets for reducing toxicity-weighted air toxics emissions. These targets are achievable, as the reduction will result from rules that have already been promul[gat]ed, but the program has not demonstrated that they are ambitious. In fact, according to performance data, these targets have already been achieved.")

are important, photochemically reactive ozone precursors.¹²⁸ Replacing them with cleaner renewable octane components such as ethanol, if it is done right, would help put U.S. counties into compliance with national ozone air quality standards. Similarly, replacing aromatics with less carbon-intensive alternatives would reduce CO₂ emissions.¹²⁹ But the biggest of the air quality problems exacerbated by air toxics emissions—indeed, the most pressing air quality problem that EPA says it faces¹³⁰—is the problem of fine particulate matter (PM) with an aerodynamic diameter of 2.5 microns or less (hence the term PM_{2.5}).¹³¹

Fine particles are predominantly derived from fossil fuel combustion and its products, including sulfates, nitrates, and

128. Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 65 Fed. Reg. 48,057, 48,061 n.4 (Aug. 4, 2000) (to be codified at 40 C.F.R. pts. 80 & 86) (noting that “several gaseous toxics (e.g., benzene, formaldehyde, 1,3-butadiene, and acetaldehyde)” are volatile organic compounds (VOCs)); U.S. ENVTL. PROTECTION AGENCY, EVALUATING OZONE CONTROL PROGRAMS IN THE EASTERN UNITED STATES: FOCUS ON THE NOX BUDGET TRADING PROGRAM, 2004, at 2 (Aug. 2005), available at <http://www.epa.gov/airtrends/2005/ozonenbp.pdf> (stating that in 2004, 43% of VOC emissions in the eastern United States were from mobile onroad and nonroad sources); JACOBSON, *supra* note 21, at 112 (“The most important reactive organic gases in urban air are aromatics, alkenes, and aldehydes.”).

129. See Greenhouse Gases 1987–1994, Appendix A, <http://www.eia.doe.gov/oiaf/1605/95report/appa.html> (“Because carbon is more dense than hydrogen, aromatics drive up the density of unleaded gasoline. Further, the increased ratio of carbon to hydrogen in aromatics also drives up the carbon share. . . . After density, the percentage of carbon in motor gasoline is the most important determinant of its carbon emissions coefficient.”); ENERGY INFO. ADMIN., PUBL’N NO. DOE/EIA-0638 (2003), DOCUMENTATION FOR EMISSIONS OF GREENHOUSE GASES IN THE UNITED STATES 2003, at 198–99, 201–02 (May 2005), available at [http://www.eia.doe.gov/oiaf/1605/ggrpt/documentation/pdf/0638\(2003\).pdf](http://www.eia.doe.gov/oiaf/1605/ggrpt/documentation/pdf/0638(2003).pdf). “At present, corn-based ethanol reduces full fuel-cycle GHG [greenhouse gas] emissions by slightly more than 30 percent in comparison with gasoline.” PEW CENTER ON GLOBAL CLIMATE CHANGE, TAKING CLIMATE CHANGE INTO ACCOUNT IN U.S. TRANSPORTATION 5, available at <http://www.pewclimate.org/docUploads/ustransp%5Fbrief%2Epdf> (last visited Dec. 28, 2005).

130. U.S. ENVTL. PROTECTION AGENCY, PUBL’N NO. EPA 454-R-04-002, THE PARTICLE POLLUTION REPORT: CURRENT UNDERSTANDING OF AIR QUALITY AND EMISSIONS THROUGH 2003, at ii (Dec. 2004), available at http://www.epa.gov/airtrends/pmreport03/report_2405.pdf.

131. See THE PARTICLE POLLUTION REPORT, *supra* note 130, at 2 (“[F]ine particles, also known as known as PM_{2.5}, include particles with diameters equal to or smaller than 2.5 μm.”). A particle’s aerodynamic diameter is not a measure of its physical diameter. Particles that are not perfect spheres do not have diameters in the strict sense of the word; and “particles of identical shape can be composed of quite different chemical compounds and, therefore, have different densities.” EPA, Basic Concepts in Environmental Sciences, Module 3: Characteristics of Particles, Aerodynamic Diameter, <http://www.epa.gov/eogapt1/module3/diameter/diameter.htm> (last visited Nov. 25, 2005). Aerodynamic diameters, accordingly, are used “to provide a simple means of categorizing the sizes of particles having different shapes and densities with a single dimension.” *Id.*

organic carbon from vehicle exhaust.¹³² There is strong (and accumulating) evidence that high fine-particle concentrations lead to chronic respiratory disease, hospitalizations, and premature deaths.¹³³ Roughly ninety million people—about thirty percent of the U.S. population—reside in so-called “nonattainment” counties that have fine-PM levels above national maximum limits.¹³⁴ In December 2005, EPA proposed to tighten the national fine-PM limits further; this could significantly increase the number of counties in nonattainment.¹³⁵

Like diesel-fueled vehicles, gasoline-fueled vehicles contribute significantly to fine-PM levels, both directly (from “primary” emissions of PM_{2.5} itself) and indirectly (from “secondary” emissions of gaseous precursors that react in the atmosphere to form PM_{2.5}). This is particularly true in urban areas,¹³⁶ where carbon-based particles, many of them from motor vehicles, can amount to fifty percent of the fine particles in the ambient air—

132. Nel, *supra* note 120, at 804.

133. See AM. LUNG ASS'N, *supra* note 120, at 55 (“Studies showing the dangers of particle pollution are pouring in by the thousands.”); Jocelyn Kaiser, *Mounting Evidence Indicts Fine-Particle Pollution*, 307 SCI. 1858, 1859 (Mar. 25, 2005) (“[T]he list of health effects linked to fine particles keeps growing.”); PERFORMANCE AND ACCOUNTABILITY REPORT, FISCAL YEAR 2005, *supra* note 111, at GOAL 1-4; PARTICULATE MATTER SCIENCE FOR POLICY MAKERS: A NARSTO ASSESSMENT 17–18 (Peter H. McMurry et al., eds., 2004) [hereinafter NARSTO ASSESSMENT]; *Fine Particulate Air Pollution and Mortality in Nine California Counties: Results from CALFINE*, ENVTL. HEALTH PERSP. 4, available at <http://ehp.niehs.nih.gov/members/2005/8335/8335.pdf> (last visited Nov. 25, 2005); Krupnick, *supra* note 6, at 69.

134. See Proposed Rule To Implement the Fine Particle National Ambient Air Quality Standards, 70 Fed. Reg. 65,984, 65,990 (proposed Nov. 1, 2005) (to be codified at 40 C.F.R. pts. 51 & 52). For more on national air quality standards for PM_{2.5} and other pollutants, see *id.* at 34; 42 U.S.C. §§ 7408–09; Robert J. Martineau, Jr., & David P. Novello, eds., THE CLEAN AIR ACT HANDBOOK, *supra* note 6, at 13–14; EPA, Six Common Air Pollutants, What Are the Six Common Air Pollutants?, <http://www.epa.gov/air/urbanair/6poll.html> (last visited Nov. 25, 2005).

135. See, e.g., Steven Cook, *Tighter Daily Emissions Standard Proposed for Fine Particles to Protect Public Health*, BNA DAILY ENV'T REP. (Dec. 21, 2005). Both EPA's Clean Air Scientific Advisory Committee (CASAC) and outside environmental groups have recommended stricter limits than the ones that EPA proposed; and EPA is “encouraging a robust public comment period on the proposal.” *Id.* A court order obliges EPA to reach a final decision on the matter by September 27, 2006. See *id.*

136. Studies for particular urban locations have found gas-to-diesel PM_{2.5} source contribution ratios ranging from 9:1 to 1:4. See BASIL W. COUTANT ET AL., SECOND DRAFT TECHNICAL REPORT (REVISION 1), COMPILATION OF EXISTING STUDIES ON SOURCE APPORTIONMENT FOR PM_{2.5}, at A-63 to -64 (Aug. 22, 2003), available at <http://www.epa.gov/oar/oaqps/pm25/docs/compsareports.pdf>; Rule to Reduce Interstate Transport of Fine Particulate Matter and Ozone (Interstate Air Quality Rule), 69 Fed. Reg. 4,566, 4,605 (Jan. 30, 2004) (to be codified at 40 C.F.R. pts. 51, 72, 75, 96).

or even more.¹³⁷ Recent EPA monitoring data showed carbonaceous matter at between 35% and 59% of fine-particle mass at urban sites and between 26% and 57% in rural sites.¹³⁸ As EPA has said, “[m]obile sources are much more concentrated in urban areas and may explain much of the elevated urban carbon concentrations.”¹³⁹

Many carbon-based fine particles contain, or are coated with, aromatic air toxics,¹⁴⁰ which could go a long way toward explaining the health effects of fine PM. In addition, many carbonaceous particles from vehicles are ultrafine particles, a subgroup of fine particles that may be the most dangerous of all.¹⁴¹ A recent southern California study found that the concentration of ultrafines near two major freeways was twenty-five times higher than background levels.¹⁴²

It would seem that EPA may be preparing to regulate gasoline’s contribution to fine particles with some aggressiveness—and more aggressively than EPA’s historic record with respect to gasoline regulation would suggest. Only a few months ago, EPA announced that aromatics are considered to be the most significant gaseous precursors of carbon-based PM_{2.5} that are attributable to human activity.¹⁴³ And in recent

137. In North America, “[s]ulfate and organic [i.e., carbon-based] compounds can each account for 20 to 50 percent of PM_{2.5} mass.” NARSTO ASSESSMENT, *supra* note 133, at 19. *See id.* at 206, 211, 370, 381, 382, 387–88, 390, 400, 406, 419 (pertinent maps and charts).

138. Proposed Rule To Implement the Fine Particle National Ambient Air Quality Standards, 70 Fed. Reg. at 65,993. The component of urban fine particulate mass that comes from urban rather than regional sources—the so-called “urban increment”—is predominantly carbon. *See id.* at 51 (“Carbonaceous mass is the largest contributor to urban increments in all regions of the country. In east coast and midwestern urban areas, carbon can account for as much as 70–90 percent of the total urban increment.”). “The urban increment for sulfate, on the other hand, appears to be fairly low in most locations.” *Id.* at 52.

139. *Id.* at 71.

140. *See* NARSTO ASSESSMENT, *supra* note 133, at 25.

141. *See* Nel, *supra* note 120, at 804 (ultrafines are “potentially the most dangerous” of all fine particles and are “the major component in vehicle emissions”). Ultrafines “have the largest surface area and highest content of potentially toxic hydrocarbons among all PM sources. They can also penetrate deeper into lung tissue than fine or coarse particles.” *See also* U.S. ENVTL. PROTECTION AGENCY, FY 2004 ANNUAL REPORT: SECTION II. PERFORMANCE RESULTS 46–47, available at http://www.epa.gov/ocfopage/finstatement/2004ar/aro4_section2.pdf.

142. *See* SIERRA CLUB, *supra* note 120, at 8.

143. Secondary organic aerosols (SOAs) are the secondary precursors of carbon-based PM_{2.5}. *See* Proposed Rule To Implement the Fine Particle National Ambient Air Quality Standards, 70 Fed. Reg. at 65,995, 65,996. What EPA said was that “[a]romatic compounds such as toluene, xylene, and trimethyl benzene are considered to be the

years, EPA has undertaken a campaign to reduce PM_{2.5} pollution from a wide range of sources.¹⁴⁴ There is no particular reason to think that gasoline may not be next.

EPA's fine-PM initiative is driven at least partly by its conclusion that the benefits are immense and the costs small. Two recent EPA rules prove the point. Each rule aims to sharply reduce emissions of both PM_{2.5} and two of its main precursors, nitrogen oxides (NO_x) and sulfur dioxide (SO₂), and each is expected to prevent over 12,000 premature deaths per year by the time it is fully implemented.¹⁴⁵

The first rule will reduce emissions from off-road diesel engines. EPA estimates that by 2020, these nonroad diesel regulations will result in net health and welfare benefits valued at \$41 billion or \$42 billion per year in 2000 dollars, depending on which discount rate is assumed. By 2030, the net annual benefits are estimated at \$78 or \$81 billion in 2000 dollars, again depending on the choice of discount rate.¹⁴⁶ These estimates are

most significant anthropogenic SOA precursors" *Id.* at 64 (citing D. Grosjean & J.H. Seinfeld, *Parameterization of the Formation Potential of Secondary Organic Aerosols*, 23 *ATMOSPHERIC ENV'T* 1733 (1989)). See NARSTO ASSESSMENT, *supra* note 133, at 25. Indeed, EPA said, aromatic compounds "have been estimated to be responsible for 50 to 70 percent of total SOA in some airsheds." Proposed Rule To Implement the Fine Particle National Ambient Air Quality Standards, 70 Fed. Reg. at 65,996. "The experimental work of Odum and others showed that the secondary organic aerosol formation potential of gasoline could be accounted for solely in terms of its aromatic fraction." *Id.* (citation omitted).

144. Citing a lack of clear consensus on the mechanisms by which fine PM harms human beings, see Control of Emissions of Air Pollution From Nonroad Diesel Engines and Fuel, 69 Fed. Reg. 38,958, 39,138 (Jun. 29, 2004) (to be codified at 40 C.F.R. pts. 9, 69, 80, 86, 89, 94, 1039, 1048, 1051, 1065, 1068). EPA has thus far assumed for regulatory purposes that all fine PM is equally bad for human health, regardless of its source. See U.S. ENVTL. PROTECTION AGENCY, PUBL'N NO. 6560-50-P, RULE TO REDUCE INTERSTATE TRANSPORT OF FINE PARTICULATE MATTER AND OZONE (CLEAN AIR INTERSTATE RULE); REVISIONS TO ACID RAIN PROGRAM; REVISIONS TO THE NOX SIP CALL 100 (Mar. 10, 2005) (citation omitted), available at http://www.epa.gov/cair/pdfs/cair_final_preamble.pdf. See also EPA, Clean Air Interstate Rule, Regulatory Actions, <http://www.epa.gov/cair/rule.html>; NARSTO ASSESSMENT, *supra* note 133, at 2, 25, 31, 390, 415, 419; Transportation Conformity Rule Amendments for the New PM_{2.5} National Ambient Air Quality Standard: PM_{2.5} Precursors, 70 Fed. Reg. 24,280, 24,284 (May 6, 2005) (to be codified at 40 C.F.R. pt. 93); Kaiser, *supra* note 133, at 1860; Krupnick, *supra* note 6, at 69, 71.

145. Proposed Rule To Implement the Fine Particle National Ambient Air Quality Standards, 70 Fed. Reg. at 65,991.

146. Control of Emissions of Air Pollution From Nonroad Diesel Engines and Fuel, 69 Fed. Reg. at 39,135 (for 2020, \$42 billion quantified net benefits assuming a three percent discount rate and \$41 billion assuming a seven percent discount rate; for 2030, \$78 billion assuming the lower rate and \$81 billion assuming the higher rate). Most of the \$40-billion-plus in estimated health and welfare benefits comprises so-called statistical life values.

based solely on benefits from reduced $\text{PM}_{2.5}$ levels. Strikingly, they imply that every microgram-per-cubic-meter [$\mu\text{g}/\text{m}^3$] reduction in population-weighted levels of fine particulate matter nationwide means roughly \$100 billion of annual health benefits.¹⁴⁷

The second rule is the newly promulgated Clean Air Interstate Rule (CAIR), which was made final in March 2005.¹⁴⁸ The rule will sharply reduce fine particles attributable to power plants in the eastern U.S. by capping emissions of nitrogen oxides and sulfur dioxide in 28 states, most of them east of the Mississippi, and the District of Columbia.¹⁴⁹ As Tables 1 and 2¹⁵⁰ and the graph in Figure 1¹⁵¹ show, SO_2 and NO_x emissions in the East in 2015 will be about half what they would be without this new power plant rule.

147. For the nonroad diesel rule, EPA reported that “[o]n a population-weighted basis, the average modeled change in future-year $\text{PM}_{2.5}$ annual averages is projected to decrease by $0.42 \mu\text{g}/\text{m}^3$ (3.3%) in 2020, and $0.59 \mu\text{g}/\text{m}^3$ (0.6%) in 2030.” Control of Emissions of Air Pollution From Nonroad Diesel Engines and Fuel, 69 Fed. Reg. at 38,967. \$42 billion divided by $0.42 \mu\text{g}/\text{m}^3$, of course, is exactly \$100 billion per $\mu\text{g}/\text{m}^3$. \$81 billion divided by $0.59 \mu\text{g}/\text{m}^3$ is \$137.3 billion per $\mu\text{g}/\text{m}^3$. If one uses the \$41 billion and \$78 billion estimates instead, the results are \$97.6 billion per $\mu\text{g}/\text{m}^3$ and \$132.2 billion per $\mu\text{g}/\text{m}^3$, respectively. See also Krupnick, *supra* note 6, at 69 (“EPA studies of the costs and benefits of reducing particulates . . . show a cost-benefit ratio in the range of ten or twenty to one, roughly \$100 billion of benefits for every one microgram-per-cubic-meter reduction in fine-particulate concentrations.”); *id.* (“In contrast, the benefits and costs of reducing ozone are about equal; net benefits are zero for reductions in ozone beyond the baseline of the old standard.”).

148. RULE TO REDUCE INTERSTATE TRANSPORT OF FINE PARTICULATE MATTER AND OZONE (CLEAN AIR INTERSTATE RULE); REVISIONS TO ACID RAIN PROGRAM; REVISIONS TO THE NO_x SIP CALL, *supra* note 144.

149. See U.S. ENVTL. PROTECTION AGENCY, PUBL’N NO. EPA-452/R-05-002, REGULATORY IMPACT ANALYSIS FOR THE FINAL CLEAN AIR INTERSTATE RULE, at 2-1 to -2 (Mar. 2005), available at <http://www.epa.gov/airprog/oar/interstateairquality/pdfs/finaltech08.pdf>.

150. Tables 1 and 2 can be found at, and are reproduced from, EPA, Projected Annual SO_2 and NO_x Emissions and Seasonal NO_x Emissions from Power Plants with the Final Clean Air Interstate Rule and Projected Cost of the Final Clean Air Interstate Rule 1, 4, http://www.epa.gov/airprog/oar/interstateairquality/charts_files/cair_emissions_costs.pdf (last visited Dec. 3, 2005).

151. Figure 1 can be found at, and is reproduced from, EPA, CAIR Accelerates 35 Years of Clean Air Progress: Nationwide SO_2 and NO_x Emissions from the Power Sector, http://www.epa.gov/airprog/oar/interstateairquality/charts_files/power_sector.pdf (last visited Dec. 3, 2005).

TABLE 1

Projected Annual SO ₂ Emissions from Power Plants with the Final Clean Air Interstate Rule		Annual SO ₂ (Million Tons)				
		2003	2010	2015	2020	Full Implementation of CAIR
Emissions without CAIR	CAIR Region	9.4	8.7	7.9	7.7	N/A
	Nationwide	10.6	9.7	8.9	8.6	N/A
CAIR Caps	CAIR Region	N/A	3.6	2.5	2.5	2.5
Emissions with CAIR	CAIR Region	N/A	5.1	4.0	3.3	2.5
	Nationwide	N/A	6.1	5.0	4.3	3.5
Percent Reduction with CAIR (Relative to 2003)	CAIR Region	N/A	44%	56%	64%	73%
	Nationwide	N/A	42%	53%	60%	67%

**As further explained in the note below, the region covering annual SO₂ and NO_x varies slightly from the ozone season NO_x region.
**See additional notes below.*

TABLE 2

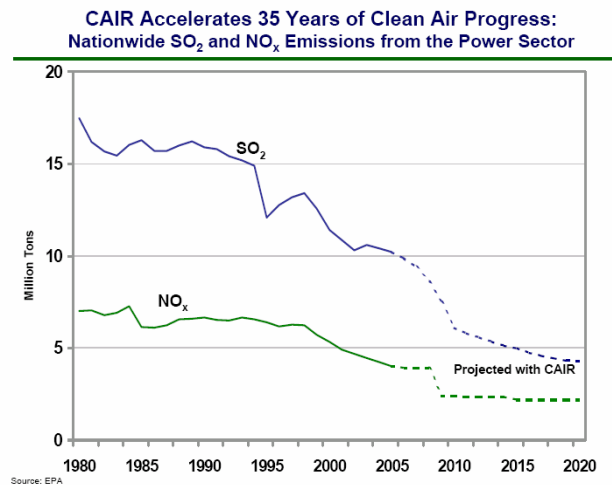
Projected Annual NO _x Emissions from Power Plants with the Final Clean Air Interstate Rule		Annual NO _x (Million Tons)				
		2003	2009	2015	2020	Full Implementation of CAIR
Emissions without CAIR	CAIR Region	3.2	2.7	2.8	2.8	N/A
	Nationwide	4.2	3.6	3.7	3.7	N/A
CAIR Caps	CAIR Region	N/A	1.5	1.3	1.3	1.3
Emissions with CAIR	CAIR Region	N/A	1.5	1.3	1.3	1.3
	Nationwide	N/A	2.4	2.2	2.2	2.2
Percent Reduction with CAIR (Relative to 2003)	CAIR Region	N/A	52%	61%	61%	61%
	Nationwide	N/A	42%	48%	48%	48%

**As further explained in the note below, the region covering annual SO₂ and NO_x varies slightly from the ozone season NO_x region.
**The final CAIR includes a compliance supplement pool of NO_x allowances (roughly 200,00 allowances) for the annual program, which could lead to slightly higher annual NO_x emissions than are stated here.
* See additional notes below*

Just a few weeks ago, EPA issued its “performance and accountability” report for the 2005 fiscal year. In his introduction to the report, EPA’s administrator, Stephen Johnson, stated that the Clean Air Interstate Rule “will result in the greatest health benefits of *any* rule [issued by] EPA since the phase-out of lead in gasoline.”¹⁵²

152. PERFORMANCE AND ACCOUNTABILITY REPORT, FISCAL YEAR 2005, *supra* note 111, at Administrator’s Message.

FIGURE 1



In its Regulatory Impact Analysis for the Clean Air Interstate Rule, EPA predicts that in the eastern United States, population-weighted fine-PM annual averages will have “declined by 8.1 percent (or 0.96 $\mu\text{g}/\text{m}^3$) in 2010 and 9.8 percent (or 1.15 $\mu\text{g}/\text{m}^3$) in 2015.”¹⁵³ The net annual monetized benefits (almost all of them from particulate matter reductions)¹⁵⁴ are estimated at \$60.4 billion or \$71.4 billion in 2010, and \$83.2 billion or \$98.5 billion in 2015, in 1999 dollars, depending on the discount rate.¹⁵⁵ Here we would expect a figure lower than \$100 billion per population-weighted $\mu\text{g}/\text{m}^3$, because the expected declines will occur only in part of the continental United States.¹⁵⁶ Even so, the benefit per population-weighted $\mu\text{g}/\text{m}^3$ reduction works out to \$62.9 billion or \$74.4 billion for 2010 and to \$72.3 billion or \$85.7 billion for 2020.

Even after the Clean Air Interstate Rule is implemented, fine-particle levels will remain significantly higher in densely

153. REGULATORY IMPACT ANALYSIS FOR THE FINAL CLEAN AIR INTERSTATE RULE, *supra* note 149, at 3-14 n.2. The eastern U.S., here, means anywhere east of the 100th meridian. *Id.*

154. *Id.* at 1-5.

155. *Id.* at 1-1, 1-2. See also EPA, Clean Air Interstate Rule, Basic Information, <http://www.epa.gov/airprog/oar/interstateairquality/basic.html> (last visited Dec. 3, 2005) (by 2015, CAIR will result in “\$85 to \$100 billion in annual health benefits”).

156. EPA separately calculated PM_{2.5} declines for the western part of the continental U.S. The projected declines are minimal. REGULATORY IMPACT ANALYSIS FOR THE FINAL CLEAN AIR INTERSTATE RULE, *supra* note 149, at 3-15.

populated areas than in rural areas. We know this because, as Table 3 shows, EPA has projected that population-weighted PM_{2.5} levels will be significantly higher than non-weighted levels in 2010 and 2015.¹⁵⁷ In the West (which is barely affected by CAIR), in fact, the projected population-weighted averages are over twice the non-weighted averages.

TABLE 3

Table 3-6. Summary of Base Case PM Air Quality and Changes Due to Clean Air Interstate Rule: 2010 and 2015

Region	PM _{2.5} (µg/m ³)	2010			2015		
		Base Case	Change ^a	Percent Change	Base Case	Change ^a	Percent Change
	Average ^b Annual Mean	10.36	-0.73	-7.1	10.28	-0.89	-8.7
East	Population-Weighted Average Annual Mean	11.91	-0.96	-8.1	11.79	-1.15	-9.8
	Average Annual Mean	6.04	-0.02	-0.3	6.07	-0.03	-0.5
West	Population-Weighted Average Annual Mean ^c	12.38	-0.01	-0.1	12.50	-0.01	-0.1

^a The change is defined as the control case value minus the base case value.

^b Calculated as the average across all grid cells in the U.S. portion of the region.

^c Calculated by summing the product of the population and the projected annual mean PM concentration for each grid cell then dividing this sum by the total population.

The discrepancy between weighted and non-weighted levels may help explain how EPA’s regulatory agenda could now be shifting toward closer scrutiny of the toxics (and other) pollution caused by gasoline-fueled vehicles. Even assuming the elimination of all remaining power-sector emissions, the result, at best, would be population-weighted reductions about as big as those that the Clean Air Interstate Rule is projected to achieve. These reductions would be significant, but they would still leave the population-weighted average for the East at about 10.0 µg/m³ in 2010 and about 9.5 µg/m³ in 2015—and eastern urban

157. Table 3 can be found at, and is reproduced from, *id.* at 3-15. *Cf. id.* at 3-14 (discrepancy between higher population-weighted and lower “spatial,” or non-weighted, levels of projected air quality improvements “indicates the rule generates greater absolute air quality improvements in more populated urban areas”). The non-weighted average is derived by placing a grid over a map of the continental United States and by dividing the sum of the concentrations per grid cell by the total number of cells. The population-weighted average gives more weight to cells that have more people—and thus is a rough surrogate for the average individual American’s exposure to PM_{2.5}.

areas would face significantly higher levels. In the West, of course, power-sector reductions would be even less efficacious.

VII. QUANTIFYING THE BENEFITS OF REDUCING AROMATICS IN GASOLINE

The benefits of major gasoline aromatics reductions are difficult to quantify, but we can make broad estimates.¹⁵⁸ First, we

158. Careful attention to the benefits as well as the costs of aromatics reductions will likely be required by Executive Order No. 12,866 of Sept. 30, 1993, 58 Fed. Reg. 51,735, as well as by Executive Order No. 13,211 of May 18, 2001, 66 Fed. Reg. 28,355.

Executive Order No. 12,866 requires that agencies submit to OMB (acting through the Administrator of its Office of Information and Regulatory Affairs (OIRA)), among other things, a cost-benefit assessment for each “significant regulatory action.” Exec. Order No. 12,866 of Sept. 30, 1993, 58 Fed. Reg. 51,735, 51,741 (§ 6(a)(3)(B)(ii)). “Significant regulatory actions” include, among other things, actions that would likely have an annual effect on the economy of at least \$100 million or would “[r]aise novel legal or policy issues arising out of legal mandates, the President’s priorities, or the principles set forth in this Executive order.” *Id.* at 51,738 (§ 3(f)). OMB reviews the action and has the power to return it to the pertinent agency for further consideration. *Id.* at 51,742 (§ 6(b)(3)). While the action is under review, the agency ordinarily cannot publish it or release it to the public in any other way. *Id.* at 51,743–44 (§ 8). Disagreements between agencies and OMB, or between one agency and another, are to be resolved by the President when OMB cannot resolve them. *Id.* at 51,743 (§ 7). After the review ends, if the agency proceeds to publish the action in the Federal Register (or otherwise announces it to the public), the agency must publish its OMB submission as well. *Id.* at 51,741 (§ 6(a)(3)(E)(i)).

For a subclass of significant regulatory actions, including actions with an annual effect of at least \$100 million, a more detailed assessment is required. For these actions, the agency must (1) submit assessments, “including the underlying analys[is],” of expected benefits and costs (defined broadly to include economic, health and safety, environmental, and other considerations) “together with, to the extent feasible, a quantification of those benefits . . . [and] costs.” *Id.* (§ 6(a)(3)(C)(i)–(ii)). The agency must, moreover, (2) submit “[a]n assessment, including the underlying analysis, of costs and benefits of potentially effective and reasonably feasible alternatives . . . and an explanation why the planned regulatory action is preferable to the identified potential alternatives.” *Id.* (§ 6(a)(3)(C)(iii)). This information, too, must be released to the public after the agency announces its action. *Id.* (§ 6(a)(3)(E)(i)).

Executive Order No. 13,211 requires agencies to submit a detailed “Statement of Energy Effects” to OMB, and publish them (or a summary thereof) in each related Notice of Proposed Rulemaking and final rule, for all “significant energy actions.” Exec. Order No. 13,211 of May 18, 2001, 66 Fed. Reg. 28,355, 28,355 (§ 2(a)). The Executive Order defines “significant energy action” as agency rulemaking action “(1)(i) that is a significant regulatory action under Executive Order 12866 or any successor order, and (ii) is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (2) that is designated by [OMB] as a significant energy action.” *Id.* at 28,355–56 (§ 4(b)). The statement must discuss “(i) any adverse effects on energy supply, distribution, or use (including a shortfall in supply, price increases, and increased use of foreign supplies) should the proposal be implemented, and (ii) reasonable alternatives to the action with adverse energy effects and the expected effects of such alternatives on energy supply, distribution, and use.” *Id.* at 28,355 (§ 2(b)).

The 2001 MSATs rule was deemed a “significant regulatory action” under Executive Order No. 12,866 because it raised novel legal or policy issues. *See* Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 66 Fed. Reg. 17,230, 17,260 (Mar. 29,

assess the health effects of exposures to air toxics themselves. EPA is generally loath to quantify the benefits of reductions in ambient toxics concentrations.¹⁵⁹ But we can get some rough sense of the benefits by looking at the dollar costs imposed by past industrial air toxics regulations, on the theory that, as EPA says, it concluded that those benefits, though unquantified, are great enough to justify the costs.¹⁶⁰ The costs per ton of reductions predicted to result from these regulations vary by industry, but the upper limit is high. For example, EPA issued a regulation for rubber tire manufacturers in 2002. The rule is expected to cut hazardous-air-pollutant emissions in half, principally emissions of hexane and toluene, which also come from mobile sources.¹⁶¹ The annual cost (to simplify somewhat) is about \$24,000 per ton of HAP reductions.¹⁶² An apparent outlier is a rule issued in March 2004 for new stationary combustion turbines, which will reduce HAP emissions by ninety percent.¹⁶³ The estimated annual cost (again, simplifying

2001) (to be codified at 40 C.F.R. pts. 80 & 86). The rule was made final before Executive Order No. 13,211 was issued. Given the economic significance of the 2006–2007 MSATs rulemaking and its possible impacts on energy supply, distribution, or use, it is highly probable that the rulemaking will be subject to review under Executive Order No. 12,866—and quite possible that it will be subject to review under Executive Order No. 13,211, as well.

159. See U.S. ENVTL. PROTECTION AGENCY, PUBL'N NO. 452/R-04-002, REGULATORY IMPACT ANALYSIS FOR THE INDUSTRIAL BOILERS AND PROCESS HEATERS NESHAP [NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS], FINAL REPORT 9-3 to 9-4 (Feb. 2004), available at <http://www.epa.gov/ttn/atw/boiler/ria-final.pdf>. Cf. FINAL REGULATORY ANALYSIS: CONTROL OF EMISSIONS FROM NONROAD DIESEL ENGINES, *supra* note 126, at 9-2 (“EPA currently does not have appropriate tools for modeling changes in ambient concentrations of CO or air toxics input into a national benefits analysis.”); Science Advisory Board, Office of Air and Radiation, Office of Research and Development Notification of Public Workshop, 65 Fed. Reg. 37,544, 37,544–45 (June 15, 2000).

160. National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters, 69 Fed. Reg. 55,218, 55,246–47 (Sept. 13, 2004) (to be codified at 40 C.F.R. pt. 63) (“Although the available science does not support quantification of [HAP exposure reduction] benefits at this time, the Agency believes the qualitative benefits are large enough to justify substantial investment in these emission reductions.”).

161. National Emission Standards for Hazardous Air Pollutants: Rubber Tire Manufacturing, 67 Fed. Reg. 45,588, 45,588, 45,595 (July 9, 2002) (to be codified at 40 C.F.R. pt. 63).

162. *Id.* at 45,595. The rule also lowers emissions of volatile organic compounds (VOCs), which are ozone precursors, so the actual cost per ton of HAP reductions must be somewhat lower than \$24,000. The VOC and HAP categories overlap to a significant degree, but not completely.

163. U.S. ENVTL. PROTECTION AGENCY, PUBL'N NO. EPA-452/R-03-014, ECONOMIC IMPACT ANALYSIS OF THE FINAL STATIONARY COMBUSTION TURBINES NESHAP: FINAL REPORT 3-2 (Aug. 2003), available at <http://www.epa.gov/ttn/atw/turbine/>

slightly) is about \$440,000 per ton of reductions—again, mostly reductions of pollutants also emitted by mobile sources.¹⁶⁴ EPA imposed this cost even though it said explicitly that it did not know what the exposure or health effects would be.¹⁶⁵

Because mobile-source emissions are likely to expose more people to higher concentrations of pollutants, we need to make adjustments before extrapolating from industrial-source figures. The White House Office of Management and Budget (OMB), which is known to be conservative about such matters, values mobile-source emissions of nitrogen-oxide precursors to PM_{2.5} at twice the value of stationary-source emissions.¹⁶⁶ Using this as a rule of thumb, and assuming (if that is possible) that one could eliminate all mobile-source air toxics emissions, one might value the ensuing effects on air toxics exposures at \$64 billion per year as of 2007: \$24,000 (say) per ton, multiplied by 1.34 million tons (EPA's prediction for 2007), multiplied by two to account for the exposure differential.

Second, we attempt a rough quantification of the benefits of reductions in exposures to fine particles traceable to aromatics. Relying on recent EPA monitoring data, we estimate that about

turbines_eia_final.pdf; National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines, 69 Fed. Reg. 10,512, 10,533 (Mar. 5, 2004) (to be codified at 40 C.F.R. pt. 63).

164. This figure does not take into account some reductions of carbon monoxide and some other pollutants. If it did, the \$440,000 per ton figure would be lowered somewhat. See National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines, 69 Fed. Reg. at 10,533. See also ECONOMIC IMPACT ANALYSIS OF THE FINAL STATIONARY COMBUSTION TURBINES NESHAP: FINAL REPORT, *supra* note 159, at 7-1 to 7-2, tbl. 7-1.

165. "We do not have the type of current detailed data on each of the facilities covered by the final rule and the people living around the facilities that would be necessary to conduct an analysis to determine the actual population exposures to the HAP emitted from these facilities and potential for resultant health effects. Therefore, we do not know the extent to which the adverse health effects described above occur in the populations surrounding these facilities. However, to the extent the adverse effects do occur, the final rule will reduce emissions and subsequent exposures." National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines, 69 Fed. Reg. at 10,514.

166. See OFFICE OF MGMT. & BUDGET, DRAFT 2005 REPORT TO CONGRESS ON THE COSTS AND BENEFITS OF FEDERAL REGULATIONS 62 app. B (Mar. 9, 2005), *available at* http://www.whitehouse.gov/omb/infoeg/2005_cb/draft_2005_cb_report.pdf; OFFICE OF MGMT. & BUDGET, INFORMING REGULATORY DECISIONS: 2003 REPORT TO CONGRESS ON THE COSTS AND BENEFITS OF FEDERAL REGULATIONS AND UNFUNDED MANDATES ON STATE, LOCAL, AND TRIBAL ENTITIES 92 (Sept. 2003), *available at* http://www.whitehouse.gov/omb/infoeg/2003_cost-ben_final_rpt.pdf (noting that "mobile source tailpipe emissions are located in urban areas at ground level (with limited dispersal) while electric utilities emit NOx from 'tall stacks' located in rural (remote) locations with substantial geographic dispersal").

forty percent of fine-PM mass is carbon-based.¹⁶⁷ We then posit, for the sake of illustration, that half of this mass, when adjusted for population exposures—in other words, twenty percent of all population-weighted PM_{2.5} nationwide—could be attributable to gasoline vehicles.¹⁶⁸ Twenty percent would account for more than 2 µg/m³ of population-weighted PM_{2.5} nationwide (see Table 3, above), which the nonroad diesel rule and the Clean Air Interstate Rule suggest should be valued at over \$200 billion per year or more. When this is added to the estimate for air toxics, the total is in the neighborhood of \$250 billion annually, well over the annual value for CAIR and the nonroad diesel rule combined.

We emphasize that these are, necessarily, speculative estimates, based on various heuristic assumptions that cannot easily be proven (or refuted, given basic uncertainties). The fine-PM number might be much higher if PM_{2.5} from gasoline is in fact particularly toxic, or lower if gasoline aromatics' contribution to population-weighted PM_{2.5} levels is in fact much smaller than twenty percent. Furthermore, our numbers are based on a completely hypothetical case—the elimination of all (not some) air toxics emissions from gasoline vehicles. The crucial point is that the benefits of reducing aromatics levels in gasoline could be very great.¹⁶⁹

As for the costs, what we know suggests that refiners can greatly reduce gasoline aromatic components using existing technology, and at a low cost, by replacing them with ethanol. As they did in the 1990s, it seems, refiners would make a profit today from taking toxics out of gasoline—or from simply leaving them out—and selling them in other markets.¹⁷⁰ Demand for

167. See Proposed Rule To Implement the Fine Particle National Ambient Air Quality Standards, 70 Fed. Reg. 65,984, 65,993 (proposed Nov. 1, 2005) (to be codified at 40 C.F.R. pts. 51 & 52).

168. Cf. COUTANT ET AL., *supra* note 136, at A-63 to -64 (summarizing various studies estimating apparently non-weighted gasoline contribution to PM_{2.5} at between about 4% and about 33% of total PM_{2.5} mass).

169. It is worth mentioning that the health benefits of getting lead out of gasoline were decisively validated and quantified only in the mid-1980s, several years after lead phase-out had begun. See Ackerman et al., *supra* note 17, at 171, 192.

170. Prices on the octane market can fluctuate greatly, but ethanol is generally quite competitive with aromatics. Earlier in 2005, the price ratio of benzene and ethanol was four to one: The March 21, 2005, issue of OCTANE WEEK reported that benzene (with an octane rating of 101) was selling at \$3.94 per gallon and ethanol (113 octane) at \$.85 per gallon on the spot market. *Octane Week Price Report*, OCTANE WEEK, Mar. 21, 2005. The current tax credit for ethanol is 51 cents per gallon; that means the unsubsidized price

benzene in the chemicals market is expected to continue to increase, as it has done for some years.¹⁷¹ Of course, it will be EPA's task to perform a careful assessment of these matters when it moves in 2006 to consider imposing stricter fuel content controls to limit mobile-source emissions further.

There are recent indications that EPA is considering proposing a limit on the benzene content of gasoline when it begins the 2006 mobile-source air toxics rulemaking.¹⁷² This would be highly desirable: Private motor vehicles release almost ten times the benzene emitted by large industrial facilities.¹⁷³ Yet EPA should also seriously consider action that would cut the aromatic content of gasoline and reduce emissions of a broader range of hazardous air pollutants. Toluene and xylene are prime candidates for this treatment. They account for over half of all Hazardous Air Pollutant emissions from all mobile sources¹⁷⁴ and, through engine combustion, are themselves a significant

was \$1.36 per gallon. Toluene (103 octane) was \$2.30 per gallon; xylene (106 octane) was \$2.25 per gallon. *Id.* Six months later—several weeks after the spike in demand for ethanol that followed Hurricanes Katrina and Rita, and at a time when gasoline prices had begun to fall steadily—the November 21, 2005, issue reported that benzene was \$2.15 per gallon and ethanol \$1.59 per gallon. *Octane Week Price Report*, OCTANE WEEK, Nov. 21, 2005, at 11. Toluene was \$1.90 per gallon. *Id.* Xylene was \$1.95 per gallon. *Id.* About a month after Katrina, and a few days after Rita, the October 3, 2005, issue reported that benzene was \$3.05 per gallon and ethanol \$2.04 per gallon. *Octane Week Price Report*, OCTANE WEEK, Oct. 3, 2005, at 10. Toluene was \$3.70 per gallon. *Id.* Xylene was \$3.65 per gallon. *Id.*

171. See *Benzene Markets to Remain Tight Through 2007*, *supra* note 86; Uhde GmbH, Aromatics 7 (Mar. 2003), http://www.uhde.biz/cgi-bin/byteserver.pl/pdf/broschueren/Oil_Gas_Refinery/Aromatics.pdf#search=history%20catalytic%20reformers%20aromatics%20octane (last visited Dec. 3, 2005).

172. See, e.g., Carol Cole, *MSAT Benzene Level May Be Proposed Early in 2005*, OCTANE WEEK, Oct. 24, 2005, at 1 (“The limit may be in the range of 0.6–0.65% vol% in gasoline.”); ENERGYWASHINGTON WK., *supra* note 5. A 2001 EPA memo indicates that it would cost, on average, 0.42 cents per gallon to reduce conventional gasoline benzene content to 0.7% by volume. Driving down benzene content in RFG to 0.3% by volume would cost 0.69 cents per gallon. See Memorandum from Lester Wynborny on Cost Estimates of Long-Term Options for Addressing Boutique Fuels 31–33 (Oct. 22, 2001) available at <http://www.epa.gov/oms/regs/fuels/ii-b-3.pdf>.

173. See Michael P. Vanderbergh, *Taking Individual Behavior Seriously*, 31 ADMIN. & REG. NEWS 2 (Fall 2005). See also ENERGYWASHINGTON WK., *supra* note 5 (“EPA’s upcoming National Air Toxics Assessment based on air toxics data from 1999 will show that benzene is seen as the most significant toxic contributor to cancer risks, and that mobile sources make up almost 70 percent of benzene emissions.”).

174. See BATTYE PROJECTIONS, *supra* note 115, at 22. In 1996, total mobile-source HAPs emissions were 2,248,000 tons, including 775,000 tons of toluene, 543,000 tons of xylene, and 259,000 tons of benzene. Total projected 2007 emissions are 1,341,000 tons, including 466,000 tons of toluene, 341,000 tons of xylene, and 147,000 tons of benzene. *Id.*

source of benzene tailpipe emissions.¹⁷⁵ Moreover, EPA made specific reference to toluene and xylene in September 2005 when it pointed to evidence that aromatics are the most significant human-caused gaseous precursors of carbon-based fine particles.¹⁷⁶

VIII. NOT YOUR FATHER'S ETHANOL

Ethanol has had a bad name in some quarters, in large part because of a tax credit and other government subsidies that have heavily benefited the domestic corn industry. According to the Congressional Budget Office, the tax credit will cost the country \$1.4 billion in 2006.¹⁷⁷ This is very little compared with the subsidies that petroleum has received and continues to receive.¹⁷⁸ At the same time, it is not pocket change.

175. See Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 65 Fed. Reg. 48,058, 48,061 (Aug. 4, 2000) (to be codified at 40 C.F.R. pts 80 & 86) ("A significant amount of automotive benzene comes from the incomplete combustion of compounds in gasoline such as toluene and xylene that are chemically very similar to benzene. Like benzene itself, these compounds occur naturally in petroleum and become more concentrated when petroleum is refined to produce high octane gasoline.").

176. Proposed Rule To Implement the Fine Particle National Ambient Air Quality Standards, 70 Fed. Reg. 65,984, 65,996 (proposed Nov. 1, 2005) (to be codified at 40 C.F.R. pts. 51 & 52).

177. CONG. BUDGET OFFICE, BUDGET OPTIONS 303 (Revenue Option 29) (Feb. 2005), available at <http://www.cbo.gov/ftpdocs/60xx/doc6075/02-15-BudgetOptions.pdf>. For more on the tax credit, see Dep't of Energy, Energy Efficiency and Renewable Energy, Federal Biomass Policy: Tax Incentives for Alcohol Fuels, http://www.eere.energy.gov/biomass/federal_biomass.html#alcoholfuels (last visited Nov. 26, 2005).

178. See, e.g., MYERS & KENT, *supra* note 12, at 90 (describing "the problem of the playing field tilted by subsidies in favor of fossil fuels" and estimating that in the United States "the ratio of subsidies between conventional sources, being largely fossil fuels, and renewable sources of energy is at least 10:1"); *id.* at 70, 87-88, 90-92. For this reason, we think that complaints about subsidies to ethanol, while well taken, must be properly viewed in the context of the much more substantial subsidies that have contributed to petroleum dependence. See *supra* section II. Similarly, we think that concerns about the "energy balance" of ethanol and other biofuels must be considered in light of similar concerns about the energy costs of petroleum extraction and use. For an introduction to the energy balance dispute, which we do not explore in any depth here, see, e.g., David Pimentel & Tad W. Patzek, *Ethanol Production Using Corn, Switchgrass, and Wood; Biodiesel Production Using Corn and Sunflower*, 14 NAT. RESOURCES RES. 65 (Mar. 2005) (concluding that energy outputs from ethanol and biodiesel from various sources are exceeded by the respective fossil energy inputs); Hosein Shapouri et al., AGRIC. ECON. REP. NO. 813, THE ENERGY BALANCE OF CORN ETHANOL: AN UPDATE at Abstract (July 2002), available at <http://www.usda.gov/oc/eoepnu/aer-813.pdf> (concluding that "corn ethanol is energy efficient as indicated by an energy output:input ratio of 1.34").

Happily, today's ethanol doesn't have to be made just from corn. Brazilian sugar-based ethanol is cheaper,¹⁷⁹ but a U.S. tariff offsets the value of the tax credit, distorting competition and raising ethanol prices for U.S. consumers.¹⁸⁰ Eventually, cellulose—plant fiber—and other kinds of biomass may replace sugar as the cheapest source of ethanol.¹⁸¹ Although the production costs are still relatively high, progress is being made. The Battelle Memorial Institute recently concluded that using biomass to make 50 billion gallons of ethanol a year—over a quarter of the energy content of the 130 billion gallons of gasoline that Americans consume for ground transportation each year¹⁸²—would require “a large increase over current biomass use, but would not result in large impacts on the agricultural system.”¹⁸³ By the end of the 1990s, according to the Department of Energy, the cost of cellulosic ethanol was \$2.30 per gallon.¹⁸⁴ Because of the energy content difference between ethanol and gasoline, that would be competitive only if the comparable cost for gasoline were about \$3.30 per gallon—no longer an implausible scenario in light of recent events. Yet the

179. See Stefan Theil, *The Next Petroleum*, NEWSWEEK (Aug. 8, 2005) (“Super-efficient Brazil now sells ethanol at the equivalent of \$25 dollars a barrel, less than half the cost of crude. What's more, . . . Brazil uses much less fossil fuel to produce alcohol than Europe and America. In those places, by contrast, ethanol and biodiesel cost \$50 and up.”).

180. See, e.g., *Global Energy: Stirring in the Corn Fields*, ECONOMIST (May 16, 2005), available at http://www.ebusinessforum.com/index.asp?doc_id=7262&layout=rich_story; U.S. Dep't of Agric., *Agriculture Marketing Service*, GRAIN TRANSP. REP. (Oct. 9, 2001), available at http://www.ams.usda.gov/tmd/grain/2001/10_9_01.pdf.

181. See Dep't of Energy, Energy Efficiency and Renewable Energy, Biomass Program, Biomass FAQs, http://www.eere.energy.gov/biomass/biomass_basics_faqs.html (last visited Dec. 3, 2005). See also Dep't of Energy, Energy Efficiency and Renewable Energy, Biomass Program, <http://eeredev.nrel.gov/biomass> (last visited Dec. 3, 2005).

182. STEVEN J. SMITH ET AL., BATTELLE MEMORIAL INSTITUTE, PUBL'N NO. PNWD-3285, NEAR-TERM U.S. BIOMASS POTENTIAL: ECONOMICS, LAND-USE, AND RESEARCH OPPORTUNITIES 4 (Jan. 2004), available at <http://www.energyfuturecoalition.org/pubs/Battelle%20study%20v4.pdf> [hereinafter BMI STUDY].

183. *Id.* at 3. Fifty billion gallons would require about a quarter of the cropland in the United States, but would require less if pasture lands were also used. *Id.* at 7. See also R. James Woolsey, *Defeating the Oil Weapon: Reducing U.S. Dependence on Middle East Oil*, 114 COMMENTARY 29 (Sept. 2002) (“Lee Lynd of the Thayer School of Engineering at Dartmouth estimates that, by using a little over half of the prairie grass growing naturally on cropland now idled by federal conservation programs, we could produce enough biomass-derived ethanol to fill a quarter of our annual gasoline needs, even at present vehicle mileages.”).

184. Dep't of Energy, State, Biofuels, Technology Overview, http://www.eere.energy.gov/state_energy/technology_overview.cfm?techid=8#40 (last visited Nov. 28, 2005).

costs of making cellulosic ethanol have fallen since then.¹⁸⁵ For instance, a Danish company, Novozymes, announced in April 2005 that it had managed to cut thirty-fold the cost of enzymes used to convert corn cellulose biomass to ethanol, from over \$5 per gallon in 2001 to 18 cents in 2005.¹⁸⁶ Ironically, Henry Ford, Charles Kettering of General Motors, and others predicted eighty years ago that alcohol derived from cellulose would eventually replace gasoline.

As the costs of making ethanol continue to fall, it bears noting that ethanol can be used as a fuel, not just as a fuel additive. At a minimal extra cost, flexible-fuel vehicles (FFVs) can now be made that can run either on gasoline or on E85, a blend of eighty-five percent ethanol and fifteen percent gasoline.¹⁸⁷ Take a hybrid-electric car that normally goes forty miles for every gallon of gasoline in its tank. If the car were an FFV, it would run about two hundred miles on E85—mostly burning ethanol, except for the fifteen percent gasoline component—before it had burned a gallon of gasoline.¹⁸⁸ About five million FFVs are

185. "Once cellulosic biofuel technology lowers the cost of ethanol below the equivalent crude oil price benchmark of \$26/bbl, as has already occurred for sugarcane ethanol in Brazil, the game changes fundamentally." LOVINS ET AL., *supra* note 23, at 163 (citations omitted).

186. Press Release, Novozymes, Novozymes and NREL Reduce Enzyme Cost (Apr. 14, 2005), available at <http://www.novozymes.com/cgi-bin/bvisapi.dll/press/press.jsp?id=32730&from=staf>. *Wired*, the magazine, reported earlier this year that both Novozymes and Iogen Energy Corp., a company based in Ottawa that gets some support from the Canadian government and is partly owned by Shell, are close to commercializing their biomass technologies. John Gartner, *Biomass Adds to Ethanol Debate*, WIRED NEWS (June 2, 2005), available at <http://www.wired.com/news/avantgo/story/0,2278,67691-,00.html>. Royal Dutch/Shell invested \$46 million to acquire a 22.5% equity stake in Iogen. See LOVINS ET AL., *supra* note 23, at 254. See also Lee Dye, *Nobel Prize-Winning Scientist Sees Potential in Creating Fuel-Producing Microbes*, ABC NEWS (May 25, 2005), <http://abcnews.go.com/Technology/DyeHard/story?id=786146&page=1> (last visited Nov. 28, 2005).

187. See DEP'T OF ENERGY, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, ALTERNATIVE FUEL FACT SHEET (Apr. 2003), available at <http://www.nrel.gov/docs/fy03osti/33058.pdf> (cost is minimal); Automotive Fuel Economy Manufacturing Incentives for Alternative Fueled Vehicles, 69 Fed. Reg. 7,689, 7,696 (Feb. 19, 2004) (to be codified at 49 C.F.R. pt. 538).

188. Ethanol has an energy content of about 76,000 Btus, which is about seventy percent that of gasoline (110,000 Btus). See Dep't of Energy, Energy Efficiency and Renewable Energy, Biomass Program, Policy Questions, http://www.eere.energy.gov/biomass/policy_questions.html (last visited Nov. 28, 2005). See also R. James Woolsey, *Reshaping the Energy and Security Debate*, 15 OUR PLANET 14–15 (2005), available at http://www.ourplanet.com/imgversn/154/images/Our_Planet_15.4_english.pdf; George P. Shultz & R. James Woolsey, *Oil and Security*, THE COMMITTEE ON THE PRESENT DANGER (Aug. 5, 2005, draft), available at <http://www.fightingterror.org/pdfs/O&S8-5-05.pdf>. Assume that a gallon of E85 has about 73.7% of the energy content of a gallon of gasoline ($0.85 * 76,000 \text{ Btu} + 0.15 * 110,000 \text{ Btu} = 64,600 \text{ Btu} + 16,500 \text{ Btu} = 81,100 \text{ Btu}$).

on the road today in the United States; many of their owners do not know it.¹⁸⁹ If one of the Big Three U.S. automakers chose to sell all its models as FFVs, it might quickly gain a competitive advantage with consumers—and perhaps outrun pressures for a government FFV mandate.¹⁹⁰

For FFVs to have a significant effect on U.S. fuel-use patterns, it will be essential to ensure the growth of a fueling infrastructure. A Department of Energy official said in July 2005 that there are over 225 public E85 stations nationwide (up from fifty-two in 2000), almost half of them in Minnesota.¹⁹¹ But in September 2005, the *New York Times* reported that the number of stations selling E85 had “nearly doubled since January, to more than 460.”¹⁹² There are about 180,000 gasoline stations in the United States.¹⁹³ So ethanol has a way to go.

A word about ethanol infrastructure should be added here. It might be argued that the major oil companies make little or no effort to put E85 in their pumps because they do not want it to get a foothold in competing with their main product.¹⁹⁴ The major companies, after all, are vertically integrated, with major resources devoted to exploration, production, refining, transportation, and marketing.¹⁹⁵ Without access to the needed infrastructure, ethanol and other renewable fuels could not

An automobile that got forty miles per gallon (mpg) of gasoline would therefore get 29.5 mpg of E85. Twenty-nine and one-half miles per 0.15 gallons of gasoline is equivalent to 196.67 mpg of gasoline. For a vehicle that ran on fifty mpg of gasoline, the comparable figures would be thirty-five mpg of E85 and 233.33 mpg of gasoline.

189. See KEVIN O’CONNOR, NATIONAL RENEWABLE ENERGY LABORATORY, PETROLEUM REDUCTION IN PUBLIC AND PRIVATE FLEETS THROUGH ADVANCED TECHNOLOGIES AND ALTERNATIVE FUELS 15, <http://www.eesi.org/briefings/2005/Transportation%20&%20Smart%20Growth/7.18.05PublicHealthandTransportation/OConnorPresentation.pdf> (about five million FFVs); *Senators to Push Legislation in Early 2006 to Boost Alternative Fuels, Reduce Oil Use*, BNA DAILY ENV’T REP. (Dec. 1, 2005).

190. See, e.g., ANN BORDETSKY ET AL., SECURING AMERICA: SOLVING OUR OIL DEPENDENCE THROUGH INNOVATION 19 (Feb. 2005), available at <http://www.nrdc.org/air/transportation/oilsecurity/plan.pdf> (calling for mandate that all new cars be FFVs from 2012 on); *Senators to Push Legislation in Early 2006 to Boost Alternative Fuels, Reduce Oil Use*, *supra* note 189.

191. See O’CONNOR, *supra* note 189, at 17; NAT’L RENEWABLE ENERGY LABORATORY, BIOETHANOL: FUELING SUSTAINABLE TRANSPORTATION 2, http://www.eere.energy.gov/biomass/pdfs/bioethanol_fueling_sustainable_transportation.pdf.

192. Danny Hakim, *The New Prize: Alternative Fuels*, N.Y. TIMES, Sept. 10, 2005, at C1.

193. See *id.*

194. See, e.g., *id.* (E85 “remains hard to find, to say the least, in part because many oil companies have no desire to put a competing product in stations that carry their banner”).

195. See, e.g., DEFFEYES, *supra* note 17, at 166.

make headway against an established competitor.¹⁹⁶ Yet we assume that one or more of the majors, or at the very least owners of independent service stations, would aggressively sell ethanol at their stations given the right economic incentives. Minnesota, where a concentration of E85 stations is developing,¹⁹⁷ will be an interesting test case for our assumption. In Thailand, where an explosion of demand for ethanol-blended gasoline has occurred in 2005 (a six-fold increase in the first five months over the same period in 2004), ExxonMobil's Thai unit has made plans to install ten percent-ethanol (E10) pumps in all 650 of its Thai stations by 2006.¹⁹⁸

In the meantime, much can be done with gasoline blends containing relatively small amounts of ethanol. E10 gasoline contains the maximum ethanol allowed for U.S. automobiles that are not FFVs. But Minnesota recently passed a law that would require all gasoline sold in the state to contain twenty percent ethanol (E20) if certain conditions are met. EPA approval, which is one of the conditions, would likely mean that E20 could be sold nationwide.¹⁹⁹ In Brazil, conventional gasoline has been over twenty percent ethanol for years.²⁰⁰

Blending ethanol in small amounts with gasoline does present some environmental challenges. But as the Natural Resources Defense Council has explained, they are not insurmountable.²⁰¹ For example, E10 and other low-ethanol blends are more

196. See ALLIANCE OF AUTOMOBILE MANUFACTURERS, ADVANCED TECHNOLOGY VEHICLES: DRIVING INNOVATION 17, available at <http://autoalliance.org/archives/ATV%20REV15.pdf>.

197. See Minn. Dep't of Commerce, Minnesota Gas Stations With E85, http://www.bmp.state.mn.us/mn/externalDocs/Commerce/State-wide_E-85_station_map_121302123133_MinnesotaE85StationsMap.pdf (last visited Nov. 29, 2005); Minn. Dep't of Commerce, Metro Area Gas Stations with E85, http://www.state.mn.us/mn/externalDocs/Commerce/Twin_Cities_area_E85_stations_080304013200_MetroE85StationsMap704.pdf (last visited Nov. 29, 2005).

198. See Patrick Barta, *Thai "Biofuel" Sector Takes Off as Asia Seeks Alternative to Oil*, WALL ST. J., Sept. 22, 2005, at C14.

199. See Dep't of Energy, Energy Efficiency and Renewable Energy, Clean Cities Program, Minnesota Passes E20 Law (Sept. 9, 2005), http://www.eere.energy.gov/cleancities/progs/afdc/ddown.cgi?/WHATS_NEW/480/1/0 (last visited Nov. 29, 2005).

200. See São Paulo Sugarcane Agroindustry Union—Fuel Alcohol (Ethanol), http://www.unica.com.br/i_pages/alcool_alcoolcombustivel.asp (last visited Nov. 29, 2005); *id.* at A Clean And Renewable Fuel, http://www.unica.com.br/i_pages/alcool_combustivel.asp (last visited Nov. 29, 2005).

201. See NATHANAEL GREENE ET AL., GROWING ENERGY: HOW BIOFUELS CAN HELP END AMERICA'S OIL DEPENDENCE 50–55 (Dec. 2004), available at <http://www.bio.org/ind/GrowingEnergy.pdf>.

volatile than ordinary gasoline—or straight ethanol. This can result in higher summer ozone levels.²⁰² Over time, the problem will diminish, as cleaner, newer vehicles replace older ones. Even now, it can be addressed by tightening volatility requirements for gasoline itself, which has been done before and can be done again.²⁰³ That, of course, would not be costless. Yet the added costs would be more than offset by ethanol's cost advantage over aromatic octane enhancers and by the net air toxics reductions caused by using ethanol.²⁰⁴ In short, no additive is perfect, but ethanol is considerably better than what it would replace.²⁰⁵ That there are (as always) tradeoffs should not blind us to the overall picture.

The United States should certainly consider renewable options other than ethanol. For example, we should consider the use of an ether derived from ethanol, ethyl tertiary butyl ether (ETBE), that is less volatile than ethanol and is widely used in the European Union.²⁰⁶ The energy legislation recently

202. See C. HAMMEL-SMITH ET AL., NAT'L RENEWABLE ENERGY LABORATORY, PUBL'N NO. NREL/TP-510-32206, ISSUES ASSOCIATED WITH THE USE OF HIGHER ETHANOL BLENDS (E17-E24), TECHNICAL REPORT 11-13 (Oct. 2002), available at <http://www.nrel.gov/docs/fy03osti/32206.pdf>.

203. See NATHANAEL GREENE & YERINA MUGICA, NATURAL RESOURCES DEFENSE COUNCIL, BRINGING BIOFUELS TO THE PUMP: AN AGGRESSIVE PLAN FOR ENDING AMERICA'S OIL DEPENDENCE 15-17 (July 2005), available at <http://www.bio.org/ind/background/NRDC.pdf>; HAMMEL-SMITH ET AL., *supra* note 202, at 13-15; Natural Resources Canada, Office of Energy Efficiency, Ethanol[:] The Road to a Greener Future, http://oee.nrcan.gc.ca/publications/infosource/pub/vehiclefuels/ethanol/M92_257_2003.cfm (last visited Nov. 29, 2005); EPA, Volatility (RVP), <http://www.epa.gov/omswww/volatility.htm> (last visited Nov. 29, 2005).

204. More blending of ethanol would lead to higher acetaldehyde emissions, but because they are a small fraction of overall HAP emissions, "even a relatively large increase in acetaldehyde emissions [caused by more use of E10] should be offset by a ten percent decrease in more than 90 percent of the remainder of toxic emissions." Control of Emissions of Hazardous Air Pollutants from Mobile Sources, 66 Fed. Reg. 17,230, 17,249 (Mar. 29, 2001) (to be codified at 40 C.F.R. pts. 80 & 86). See also EPA, EPA Air Trends, Toxic Air Pollutants, <http://www.epa.gov/airtrends/toxic.html> (last visited Nov. 29, 2005); HAMMEL-SMITH ET AL., *supra* note 202, at 16-19.

205. See Energy Info. Admin., Timing of Startups of the Low-Sulfur and RFS Programs, App. C (Oct. 2002), <http://www.eia.doe.gov/oiaf/servicerpt/fuel/appenc.html> (last visited Nov. 30, 2005) (discussing some of the tradeoffs). See also Energy Info. Admin., Timing of Startups of the Low-Sulfur and RFS Programs, <http://www.eia.doe.gov/oiaf/servicerpt/fuel/lows.html> (last visited Nov. 30, 2005); Energy Info. Admin., Analysis of Selected Transportation Fuel Issues—Summary, <http://www.eia.doe.gov/oiaf/servicerpt/fuel/index.html> (last visited Nov. 30, 2005).

206. See INT'L PETROLEUM INDUS. ENVTL. CONSERVATION ASS'N, GETTING THE LEAD OUT: DOWNSTREAM STRATEGIES AND RESOURCES FOR PHASING OUT LEADED GASOLINE 32 (2003), available at http://www.ipieca.org/downloads/fuels/Lead_-_WEBSITE_revised.pdf; HART DOWNSTREAM ENERGY SERVICES, ETHANOL MARKET FUNDAMENTALS 4 (stating that "ETBE use is on the rise and widely used in several European gasolines"),

signed by President Bush requires EPA to conduct a study on the public health, air quality, and water resources effects of using ETBE, ethanol, and other compounds in gasoline.²⁰⁷ The study should provide policymakers with guidance on the issue.²⁰⁸

IX. SOME IMPORTANT SIDE BENEFITS

EPA may indeed use the mobile-source air toxics rulemaking—and its responsibility to lower ambient fine-particle levels—as an opportunity to mandate a sharp reduction in the aromatics content of gasoline. If EPA does this, it could be much easier for the country to reach a goal set by the comprehensive energy legislation that the President signed in August 2005. In that enactment, Congress eliminated the oxygenate requirement for reformulated gasoline²⁰⁹ and, in essence, replaced it with a Renewable Fuels Standard (RFS). The RFS mandates the use of 7.5 billion gallons of renewable fuels and blending components per year by 2012, but allows refiners flexibility as to how and when to use those renewable products.²¹⁰ (Like the original decision to impose the oxygenate requirement, this, too, was a highly political decision.) Depending on the results of the rulemaking, the oil companies might exceed the requirements of the RFS mandate in order to comply with their obligation to reduce MSAT levels.²¹¹

But the mobile-source air toxics rulemaking could leave a far greater legacy than that of merely making the Renewable Fuels Standard moot. Let us assume that EPA decides to do to the

available at <http://www.nyce.com>; Steve Krupa & Jill Meister, *Hüls Ethers Processes*, in HANDBOOK OF PETROLEUM REFINING PROCESSES 13.3–13.4 (Robert A. Meyers ed., 3d ed. 2004). See also DAVID L. GREENE & ANDREAS SCHAFER, REDUCING GREENHOUSE GAS EMISSIONS FROM U.S. TRANSPORTATION 31 (May 2003) (prepared for Pew Center on Global Climate Change), available at <http://www.pewclimate.org/docUploads/ustransp%2Epdf> (“Greenhouse gas emission reductions of up to 15 percent compared to gasoline might be possible by blending gasoline with ethyl tertiary butyl ether (ETBE) from cellulosic ethanol (up to 17 percent ethanol, by volume). Such blends can be used in conventional vehicles with no performance problems, meeting all requirements for clean gasoline under the Clean Air Act.”).

207. Energy Policy Act of 2005, Pub. L. No. 109-58, § 1505 (2005).

208. We should note that at least one of the clients whom we have been representing in Clean Air Act matters would benefit from the increased use of ETBE.

209. Pub. L. No. 109-58, § 1504.

210. See *id.* § 1501.

211. See Press Release, Renewable Fuels Association, U.S. Ethanol Industry Surpasses First Year Goal of RFS: September Production Sets New Record, Soars Over 4 Billion Gallons Annually (Nov. 25, 2005), available at <http://www.ethanolrfa.org/media/press/rfa/view.php?id=450>.

makers of gasoline fuels, with respect to air toxics, as EPA has historically done to other big industries when it comes to reducing pollution levels. In other words, assume that EPA requires fuel quality improvements that result in mobile-source emissions reductions of fifty percent, sixty percent, or eighty percent, or even more.²¹² An eighty percent reduction of aromatics in gasoline would replace roughly twenty-five percent of the content of today's conventional gasoline. The result would be a market for over thirty-seven billion gallons of ethanol per year, or about five times the size of the RFS.²¹³

Just as importantly, a major implicit subsidy to fuel producers would be significantly reduced. It cannot be emphasized enough that the current regulatory scheme imposes great costs on the American people. To be sure, these include the dollar costs resulting from the inefficiencies of the scheme, but more important are the direct effects on human health and quality of life that wiser regulation would have prevented. In this very real sense, the unrealized benefit of air toxics reduction (very roughly calculated above as \$250 billion per year, with all the caveats stated above) is an annual tax on Americans that results in a subsidy to fuel producers. Worse, a significant chunk of that subsidy is transferred to oil-producing countries—with deleterious consequences for U.S. interests, as we know all too well.

Unwinding this and other deleterious energy subsidies would seem to be an essential step toward unwinding petroleum

212. See, e.g., Press Release, EPA, Tier II—President Clinton and Vice President Gore—Clean Air: A Record of Accomplishment (Dec. 21, 1999), available at <http://yosemite1.epa.gov/opa/admpress.nsf/b1ab9f485b098972852562e7004dc686/b5eadba968474788525684e007755e8?OpenDocument> (“[The Clinton Administration] took the strongest action ever to reduce air toxics by requiring massive reductions in pollution from a variety of industrial sources including chemical plants and petroleum refineries. This action alone called for 90 percent reductions in major air toxics and was the equivalent of taking 38 million cars off the road.”). Cf. PERFORMANCE AND ACCOUNTABILITY REPORT, FISCAL YEAR 2005, *supra* note 111, at MD&A-4 to -5 (CAIR “is expected to dramatically reduce pollution in the eastern United States by cutting power plant emissions of sulfur dioxide by more than 70 percent and nitrogen oxides by more than 60 percent,” and the second phase of EPA’s Clean Air Mercury Rule “is expected to achieve a reduction of 70 percent from current levels”).

213. If aromatics is twenty-five percent of the volume of gasoline, an eighty percent reduction means twenty percent of the volume of gasoline is reduced, or 26 billion gallons if we assume that the total volume is 130 billion gallons. To replace the energy content of 26 billion gallons, we divide 26 billion by 0.7 on the crude assumption that 1.0:0.7 is the ratio between the energy content of a gallon of gasoline and that of a gallon of ethanol. Twenty-six billion divided by 0.7 is about 37.1 billion.

dependency and providing a level playing field for energy markets.²¹⁴ As the current President (like his father, a former Texas oilman) has observed, the oil industry needs no subsidies to survive and flourish.²¹⁵ After the subsidies are gone, it can be determined whether national security now demands a temporary tilt toward subsidies for alternatives to plain old gasoline.²¹⁶ In the meantime, it is enough to know that our security is threatened, not enhanced, by our continuing to subsidize oil dependence.

As in decades past, the problem of octane is more significant, and less abstruse, than it may seem at first glance. Removing the disadvantages for alternative sources of octane—and harmonizing mobile-source toxics and fine-particle regulations with air pollution controls that already apply to other sectors of the U.S. economy—could provide the basis for the shift to a transportation system that uses ethanol as a fuel, not just as a tagalong additive to gasoline. As we have emphasized, a shift of this kind could have historic implications for our economic and military security in ways that could also be of great benefit to our global neighbors. For all the right reasons, the hour of alternative fuels may finally have arrived.

214. The same principle, of course, has applicability in other contexts. See *BP Chief Executive Outlines \$8 Billion Investment Plan for Green Energy Projects*, BNA DAILY ENV'T REP. (Nov. 30, 2005) (Lord John Browne “supports the idea of placing a fee on the burning of coal [for power generation,] to offset the impact of releasing more carbon dioxide in the atmosphere . . . [and] to level the playing field for alternative fuels, which are overpriced unless ‘externalities’ such as air pollution are considered, Browne said”). Cf. MYERS & KENT, *supra* note 12, at 191 (“Hidden subsidies for oil serve to create an energy policy by default—a policy that is actually the reverse of the government’s stated priorities.”); *id.* at 85–86, 92.

215. See Justin Blum, *House Energy Bill Increases Tax Breaks for Energy Industry; Legislation at Odds with Bush Proposal*, WASH. POST, Apr. 19, 2005, at A4 (“‘I will tell you with \$55 oil we don’t need incentives to oil and gas companies to explore,’ Bush said in a speech to newspaper editors in Washington. ‘There are plenty of incentives. What we need is to put a strategy in place that will help this country over time become less dependent.’”). See also William Neikirk, *Energy Secretary Rebuts Study on Ethanol’s Value*, CHI. TRIB. (July 21, 2005), at C10 (stating that Energy Secretary Samuel Bodman “add[ed] that he and the president ‘don’t think that the oil and gas industry needs incentives to develop oil and gas with prices where they are today’”).

216. For discussion of some of the pros and cons of environmental subsidies, see MYERS & KENT, *supra* note 12, at 116, 204. Cf. *id.* at 92 (“Consider what could be accomplished on a level playing field. Were the U.S. Congress to fund renewable energy with the same amount in tax credits, financial incentives, and other subsidies that it provides for coal and oil, renewables would readily become competitive with fossil fuels.”).