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Of Fables and Federalism: A Re-Examination of the Historical Rationale for Federal Environmental Regulation

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ARTICLES

OF FABLES AND FEDERALISM: A RE-EXAMINATION OF THE HISTORICAL RATIONALE FOR FEDERAL ENVIRONMENTAL REGULATION

BY

WILLIAM L. ANDREEN*

This Article responds to recent scholarship questioning the need for environmental statutes that place primary responsibility for regulation in the hands of the federal government. These claims are based, in part, upon assertions that state and local governments had made great progress on a number of pollution fronts before the major federal environmental statutes were passed in the 1970s. Earlier scholarly work demonstrates that these claims lack credible empirical and historical support with respect to water pollution. This Article will focus on similar arguments with respect to air pollution, the area where critics contend the most extensive data exists supporting their assertions. As this Article will demonstrate, the data upon which these critics have relied is seriously flawed and cannot be relied upon to support the contention that sulfur dioxide and particulate matter pollution were declining in the years before substantial federal regulatory involvement. In fact, additional empirical data reveals that sulfur dioxide pollution was growing much worse during these years. While this additional evidence shows that particulate matter pollution was improving, this Article reveals that most of this improvement can be attributed to a variety of nonregulatory technical and economic developments. This conclusion is buttressed by an exploration of state and local regulatory efforts during this time period that confirms the view that these efforts were

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fragmentary and, on the whole, ineffective. The lack of broad progress prior to 1970 is then contrasted with the remarkable progress that has been achieved through the Clean Air Act of 1970. The empirical and historical record thus casts serious doubt on the claim that federal authority could be reduced today without producing adverse environmental impacts.

I. INTRODUCTION

The decade of the 1970s witnessed a veritable explosion of environmental law. Frustrated by the nation's seeming inability to control the fouling of our water, air, and land, Congress cast aside prior, less ambitious regulatory approaches and passed a series of pollution statutes that were sweeping in their scope and uncompromising in their rigor.[1] In doing so, Congress vastly expanded the federal government's role in pollution control.[2] Programs that had relied primarily on state initiative, like both the clean air and clean water programs, were now largely federally driven, with the new U.S. Environmental Protection Agency (EPA) responsible for setting most pollution standards and the states generally responsible for implementing those requirements,[3] although the states were free, in most instances, to establish more stringent standards.[4] The political structure of

[1] *See* RICHARD J. LAZARUS, THE MAKING OF ENVIRONMENTAL LAW 67–71 (2004) (noting that "[t]he substantive terms of many of these laws were unprecedented in their reach").

[2] *Id.* at 69–70 ("A listing of the federal environmental laws enacted in the 1970s illustrates the dramatic nature of the virtual revolution in law that occurred.").

[3] *See* Robert V. Percival, *Environmental Federalism: Historical Roots and Contemporary Models*, 54 MD. L. REV. 1141, 1155–63 (1995) ("Congress recognized that a high level of state involvement was a practical necessity for effective implementation . . . .").

[4] *See, e.g.*, Federal Water Pollution Control Act, 33 U.S.C. § 1370 (2006); Clean Air Act, 42 U.S.C. § 7416 (2006); Resource Conservation and Recovery Act of 1976, 42 U.S.C. § 6926 (2006).

environmental law had thus changed in a fundamental way. Although the states still had a significant role to play under this "cooperative" approach to federalism, the EPA was clearly the senior partner in the relationship. The states had lost their predominant position.

This new approach to environmental protection produced tremendous progress. The air is markedly cleaner today,[5] water pollution has declined,[6] and the problem posed by hazardous waste has been reduced dramatically.[7] Controversy, however, still surrounds Congress's decision to give the federal government the leading role in environmental regulation. The critics of this approach, including some prominent legal scholars, would like to return regulatory primacy to the states, although most would accept the need for a continuing, albeit more modest, federal presence in the field.

Many critics would concede that some federal involvement is necessary in cases involving interstate pollution, since states have little incentive to deal effectively with the spillover effect, for example, of air or water pollution generated within their own borders and discharged into an adjoining state.[8] In addition, few would question the fact that the federal government enjoys economies of scale when it comes to producing and analyzing scientific and technical data.[9] This role could, however, be detached from primary regulatory authority with the federal government returning to the informational and support role that it had played prior to the 1970s.[10] On the other hand, these economies of scale clearly extend beyond the

5 *See* Craig N. Oren, *Is the Clean Air Act at a Crossroads?*, 40 ENVTL. L. 1231, 1235–37 (2010) ("[T]he Act has been quite successful in reducing air pollution."); *see infra* Part V.

6 *See* William L. Andreen, *Water Quality Today—Has the Clean Water Act Been a Success?*, 55 ALA. L. REV. 537, 569–73 (2004) [hereinafter Andreen, *Water Quality Today*] ("'[T]he evidence is overwhelming' that the regulatory and policy design of the CWA has 'achieved significant successes in many waterways'") (quoting U.S. ENVTL. PROT. AGENCY, PROGRESS IN WATER QUALITY: AN AVALUATION OF THE NATIONAL INVESTMENT IN MUNICIPAL WASTEWATER TREATMENT 4–11 (2000); ANDREW STOODARDETAL, MUNICIPAL WASTEWATER TREATMENT: EVALUATING IMPROVEMENTS IN NATIONAL WATER QUALITY 195 (2002)).

7 *See* Adam Babich, *Our Federalism, Our Hazardous Waste, and Our Good Fortune*, 54 MD. L. REV. 1516, 1521–22 (1995) (noting that it is difficult to know how we far we have come unless we look back at history).

8 *See* Richard L. Revesz, *Rehabilitating Interstate Competition: Rethinking the "Race-to-the-Bottom" Rationale for Federal Environmental Regulation*, 67 N.Y.U. L. REV. 1210, 1222–23 (1992) [hereinafter Revesz, *Rethinking the "Race-to-the-Bottom"*] (arguing that "states would have the incentive to underregulate because part of the benefits of regulation would accrue to other states"); Richard B. Stewart, *Pyramids of Sacrifice? Problems of Federalism in Mandating State Implementation of National Environmental Policy*, 86 YALE L.J. 1196, 1215–16 (1977) ("[S]tates are likely to favor federal intervention to eliminate the more damaging forms of spillover."); *see also* Henry N. Butler & Jonathan R. Macey, *Externalities and the Matching Principle: The Case for Reallocating Environmental Regulatory Authority*, 14 YALE L. & POL'Y REV. (SYMPOSIUM ISSUE) 23, 33 (1996) (stressing that the problem could be addressed by "fairly minimal" federal regulation, or by some other response).

9 *See* ROBERT L. GLICKSMAN ET AL., ENVIRONMENTAL PROTECTION: LAW AND POLICY 86 (5th ed. 2007) ("Seldom, if ever, does one encounter calls for the federal government's surrender of these informational roles, due to the widely shared view that federal action benefits from economies of scale.").

10 *See* Butler & Macey, *supra* note 8, at 48–50 (suggesting that the economies of scale offered by centralized research and data collection could be realized by the federal government, even while most policymaking and implementation are conducted by the states).

mere generation of environmental information and would logically include the sometimes enormous task of setting standards based upon that information. It would be difficult to imagine any single state or even a group of states having either the resources or inclination to develop the kind of technology-based effluent limitations that EPA promulgated under the Clean Water Act. The same would likely be true for any number of programs under the Clean Air Act including ambient air quality standards, new source performance standards, and standards for hazardous air pollutants.

Those who favor decentralization often contend that state primacy would better reflect the fact that certain regions in the country place a higher value on environmental quality than others and that state primacy would promote experimentation with different governmental policies.[11] The states, however, seldom utilize their power to set higher standards.[12] In a decentralized system, of course, they could set less protective standards, but that ability would run counter to the argument that all Americans are entitled to enjoy a certain level of environmental protection regardless of where they choose to live or travel in the nation.[13] A centralized system, moreover, reduces the number of political arenas in which significant policy and legal questions are addressed, thus, empowering citizens and environmental groups to compete on a more level playing field with large business and industrial interests.[14]

11 Stewart, *supra* note 8, at 1210; *see also* Peter H. Schuck, *Some Reflections of the Federalism Debate*, 14 YALE L. & POL'Y REV. (SPECIAL ISSUE) 1, 11–16 (1996) (arguing that "each state possesses a distinctive social character and political culture"). It is also said that state primacy is desirable in order to take into account unique local environmental and geographical conditions. Butler & Macey, *supra* note 8, at 53–54. Such conditions, however, are not normally confined within the borders of one state but are normally found in other states in the same region. *Id.* at 53–56. In addition, there are many ways in which the cooperative approach found in the current pollution control framework permits states, within certain limits, to take such conditions into account. The water quality standards program in the Clean Water Act is one such example. *See* Andreen, *Water Quality Today*, *supra* note 6, at 548–49.

12 DANIEL P. SELMI & KENNETH A. MANASTER, 1 STATE ENVIRONMENTAL LAW §§ 10:5, 11:3 (2011).

13 Rena I. Steinzor, *Devolution and the Public Health*, 24 HARV. ENVTL. L. REV. 351, 370 (2000).

14 *See* Daniel C. Esty, *Revitalizing Environmental Federalism*, 95 MICH. L. REV. 570, 650 (1996) (suggesting that centralization will create more equal footing for conflicting interests); Stewart, *supra* note 8, at 1213 (stating that environmental groups have a greater impact and more leverage when policy decisions are made at a centralized level rather than on a state or local level because of the strong industrial and union pressures faced by the local and state governments). Centralization, therefore, would tend to better recognize the diversity of attitudes and policy preferences that actually exist in the nation. *See* GLICKSMAN ET AL., *supra* note 9, at 90–91 (noting that centralization allows for more attention to issues, more press coverage, and greater awareness of the views of citizens). However it is certainly true that concentrated industrial interests may be able in many instances to overwhelm the views of citizens and environmental groups at the national level. *See* Richard L. Revesz, *The Race to the Bottom and Federal Environmental Regulation: A Response to Critics*, 82 MINN. L. REV. 535, 542 (1997) [hereinafter Revesz, *A Response to Critics*] (arguing that an unfair playing field "could occur at the federal level as well as at the state level"); *see also* Wendy Wagner, Katherine Barnes, & Lisa Peters, *Rulemaking in the Shade: An Empirical Study of EPA's Toxic Emission Standards*, 63 ADMIN. L. REV. 99, 103–04 (2011) (tracing imbalanced interest group engagement favoring industry in the federal environmental rulemaking life cycle).

The justification for federalized environmental regulation that is most commonly challenged is the belief that states in a decentralized system will be tempted to engage in a race to the bottom in order to attract and retain industry through lax environmental standards, weak implementation, and lethargic enforcement.[15] The fact that so many states have enacted statutes either forbidding or restricting the ability of state regulators to exceed federal standards[16] suggests that the fear of competitive disadvantage, so basic to the notion of a race to the bottom, remains pervasive in state capitals.[17] While one might offer occasions on which individual states have set stricter requirements in an effort to cast some doubt

15 *See* Stewart, *supra* note 8, at 1211–12 (discussing the tendency of states to reject higher environmental standards and adopt lower standards without nationwide environmental standards). It is not altogether relevant whether a particular industry will actually leave a particular state in pursuit of a more relaxed regulatory environment. William L. Andreen, *The Evolution of Water Pollution Control in the United States—State, Local and Federal Efforts, 1789–1972: Part I*, 22 STAN. ENVTL. L.J. 145, 155 (2003) [hereinafter Andreen, *Evolution of Water Pollution Control: State and Local Efforts*]. What is relevant are the perceptions and fears of state politicians who "have relatively little 'bacon'" to dispense other than economic development. *Id.*

16 With regard to water pollution, at least 18 states have acted to constrain the ability of their state pollution agencies from promulgating standards that are tougher than federal minimum requirements. *See* Andrew Hecht, *Obstacles to the Devolution of Environmental Protection: States' Self-Imposed Limitations on Rulemaking*, 15 DUKE ENVTL. L. & POL'Y F. 105, 116 (2004) (identifying 17 states with "no more stringent" rules that prevent state agencies from imposing environmental regulations that are more stringent than federal regulations); *N.C. Law Restricts Environmental Rulemaking*, 80 U.S.L.W. 143, 143 (2011) [hereinafter *N.C. Restricts Envtl. Rulemaking*] (adding North Carolina to the states that prohibit the enactment of more stringent environmental regulations, apart from some "serious and unforeseen threat" to public welfare). And at least 27 state agencies are wholly or partially forbidden, either by state law or policy, from setting stricter air quality regulations. STATE & TERRITORIAL AIR POLLUTION PROGRAM ADM'RS & ASS'N OF LOCAL AIR POLLUTION CONTROL OFFICIALS, RESTRICTIONS ON THE STRINGENCY OF STATE AND LOCAL AIR QUALITY PROGRAMS 1 (2002), *available at* http://www.4cleanair.org/stringency-report.pdf; *N.C. Restricts Envtl. Rulemaking.*, *supra*, at 143 (adding North Carolina to the states that are wholly or partially forbidden from setting stricter environmental regulations). Of the 23 states that are not precluded from adopting more stringent air pollution standards, only 14 report that they actually set tougher standards at a rate greater than "infrequently." RESTRICTIONS ON THE STRINGENCY OF STATE AND LOCAL AIR QUALITY PROGRAMS, *supra*, at 2.

17 *See* Kirsten H. Engel, *State Environmental Standard-Setting: Is There a "Race" and Is It "To the Bottom"?*, 48 HASTINGS L.J. 271, 348 (1997) (discussing that the trend towards "federal minimum/state maximum" environmental regulations evidences that the race-to-the-bottom still exists); Jerome M. Organ*, Limitations on State Agency Authority to Adopt Environmental Standards More Stringent than Federal Standards: Policy Considerations and Interpretive Problems*, 54 MD. L. REV. 1373, 1393 (1995) (noting that the trend for state governments to set federal minimum standards as state maximum standards indicates that "the concern about the 'race-to-the-bottom' in the absence of federal minimum standards remains valid"). It is possible, on the other hand, to infer that state officials just believe, either normatively or on the basis of some cost-benefit or technical analysis, that the federal standards are too stringent. *See* Engel*, supra.* (states may be "simply attempting to minimize the welfare losses that would accrue from more stringent standards").

on the existence of this fear,[18] the infrequency with which states actually do so would appear to strengthen the race-to-the-bottom hypothesis.[19]

Richard Revesz, however, questioned the theoretical basis of the hypothesis in 1992.[20] Using neoclassical economic models, he argued that there was no support for the belief that competition among the states for industry would result in a race that harms overall social welfare since such competition, although it would tend to create less stringent environmental standards, would produce an efficient allocation of industrial activity through industrial migration.[21] Even were there a basis to believe that a socially undesirable race would take place in the environmental arena, he argued that federal minimum standards could not effectively protect overall social welfare since states could simply lower standards in other areas.[22] Revesz ignited a flurry of debate in the legal academy.[23] Several scholars challenged his theoretical approach contending that it was based on unrealistic assumptions,[24] while Kirsten Engel demonstrated empirically that state officials commonly believe that industrial development concerns affect the quality of environmental decisionmaking in their states.[25]

I do not intend to address these rationales for federal regulation—interstate spillover effects, economies of scale, the advantages of centralization as opposed to decentralization, or the race to the bottom—at any greater length in this Article.

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18 *See* Revesz, *Rethinking the "Race-to-the-Bottom"*, *supra* note 8, at 1227–28 (explaining how several Northeastern states agreed to "reduce substantially the emission of nitrogen oxides by electrical utilities" and also announced that they would "adopt California's pollution control requirements for automobiles, which are more stringent than the federal standards").

19 *See* SELMI & MANASTER, *supra* note 12 (noting that it is rare for states to set stricter air or water pollution standards than required by federal law). For instance, among the states that are not precluded from adopting more stringent air pollution standards, 14 report that they have done so only "infrequently." RESTRICTIONS ON THE STRINGENCY OF STATE AND LOCAL AIR QUALITY PROGRAMS, *supra* note 16, at 2; *N.C. Restricts Envtl. Rulemaking*, *supra*, note 16 at 143 (noting the passage of a North Carolina law, adding it to the list of states that are wholly or partially forbidden from setting stricter environmental regulations). A number of states, however, have acted from time to time as important laboratories of democracy, filling regulatory gaps and creating models worthy of emulation by other jurisdictions, including the federal government. *See* William L. Andreen, *Delegated Federalism Versus Devolution: Some Insights from the History of Water Pollution*, *in* PREEMPTION CHOICE: THE THEORY, LAW, AND REALITY OF FEDERALISM'S CORE QUESTION 257, 261–62 (William W. Buzbee ed., 2009) [hereinafter Andreen, *Delegated Federalism Versus Devolution*] (describing some of the "innovative approaches" states have taken to environmental problems). California's regulation of automobile emissions and the efforts by approximately half of the states to do something to mitigate climate change are notable examples. *See* William L. Andreen, *Federal Climate Change Legislation and Preemption*, 3 ENVTL. & ENERGY L. & POL'Y J. 261, 274–79, 287 (2008) (providing an overview of the different ways states have committed to reduce greenhouse gas emissions).

20 Revesz, *Rethinking the "Race-to-the-Bottom"*, *supra* note 8, at 1211.

21 *Id.* at 1211–12, 1232.

22 *Id.* at 1245–46.

23 Ann E. Carlson, *Interactive Federalism and Climate Change*, 103 NW. U. L. REV. 1097, 1102 (2009).

24 *See* Esty, *supra* note 14, at 629–38 (discussing the differences between race-to-the-bottom and regulatory competition theories); Peter P. Swire, *The Race to Laxity and the Race to Undesirability: Explaining Failures in Competition Among Jurisdictions in Environmental Law*, 14 YALE L. & POL'Y REV. (SPECIAL ISSUE) 67, 94–105 (1996) (criticizing Revesz's analysis of the race-to-the-bottom); *see also* Engel, *supra* note 17, at 280 (contending that empirical data demonstrates that the assumptions relied upon by the critics are "unlikely to hold true in the real world").

25 Engel, *supra* note 17, at 337–47.

Rather, I want to turn my attention to a rationale that appears to have received less focused attention—the historical rationale for federal regulation.

Until the 1970s, the primary responsibility for controlling pollution resided at the state and local level.[26] In recognition of the fact that nuisance law alone could not check unsanitary conditions, health departments were established beginning in 1866—first at the local level and later at the state level—to check unsanitary conditions, including those created by water pollution.[27] By the end of the nineteenth century, a number of cities also began to adopt smoke abatement ordinances.[28] Despite these efforts, air and water quality continued to deteriorate.[29] Following World War II, the states began to create new regulatory agencies to control water pollution, a process that continued in the 1960s with the advent of new air pollution agencies.[30] These agencies received both financial and technical support from the federal government,[31] and by the mid-1960s, Congress began to try to prod the state agencies to take stronger action by requiring them to promulgate water quality standards for interstate waters[32] and to set ambient air quality standards.[33]

According to the conventional wisdom, these state and federal actions failed to reverse the rising tide of pollution, thus triggering the enactment of more comprehensive federal legislation in the 1970s, an approach that shifted the primary responsibility for pollution control from the states to the newly created EPA.[34] A number of legal scholars, however, dispute the accuracy of this account.[35] They do not question the fact that a perception of failure was a motivating factor in

26 Esty, *supra* note 14, at 600–02.

27 Andreen, *Evolution of Water Pollution Control: State and Local Efforts*, *supra* note 15, at 178–80.

28 *See infra* notes 100–01 and accompanying text.

29 *See* Andreen, *Evolution of Water Pollution Control: State and Local Efforts*, *supra* note 15, at 180–89 (explaining that "[b]acterial and organic water pollution from municipal sources continued to grow as more and more cities built underground sewers," as did untreated industrial waste discharges); *see infra* notes 101–13 and accompanying text.

30 *See* Percival, *supra* note 3, at 1155. (describing how states began to respond more to environmental problems after World War II).

31 *See id.* at 1155–57 (explaining, for example, that these agencies received federal financial aid and research assistance as well as "funding for the construction of municipal sewage treatment plants").

32 Water Quality Act of 1965, Pub. L. No. 89-234, § 5(a), 79 Stat. 903 (1965) (amending the Federal Water Pollution Control Act).

33 Air Quality Act of 1967, Pub. L. No. 90-148, § 102(a), 81 Stat. 485 (1967) (amending the Clean Air Act).

34 *See, e.g.*, Esty, *supra* note 14, at 600–02 (describing how the "poor performance of states as environmental regulators" led in part to the federalization of environmental regulation"); Percival, *supra* note 3, at 1144, 1157, 1160 (noting that environmental law was federalized "after a long history of state failure to protect what had come to be viewed as nationally important interests"); Stewart, *supra* note 8, at 1196 (stating that the "generally poor record" of the states in controlling pollution led to the passage of major new federal legislation).

35 *See, e.g.*, Richard L. Revesz, *Federalism and Environmental Regulation: A Public Choice Analysis*, 115 HARV. L. REV. 555, 577–78 (2001) [hereinafter Revesz, *Federalism and Environmental Regulation*]; Jonathan H. Adler, *Judicial Federalism and the Future of Federal Environmental Regulation*, 90 IOWA L. REV. 377, 464–66 (2005) [hereinafter Adler, *Judicial Federalism*].

Congress's action.[36] Rather, these revisionists challenge the underlying premise that state regulatory action had not successfully reduced air or water pollution.[37] Their argument is largely based upon other commentators who claim that the states were actually making substantial environmental progress in the years before the 1970s.[38] Three of these commentators examined federal air quality monitoring data for two air pollutants, total suspended particulates and sulfur dioxide,[39] and one examined data on organic wastes and bacteria from EPA's first national water quality inventory that was published in 1974.[40] Pointing to the air pollution data, Revesz concludes that state and municipal regulatory programs were making considerable progress before the federal regulatory era.[41] And pointing to all four commentators (dealing, therefore, with both air and water pollution), Jonathan Adler asserts that once a pollution problem was identified and understood, the states and local governments had begun to act and did so well before the federal government.[42] History thus demonstrates, according to Adler, the "environmental benefits of decentralization," and provides "ample reason to question the assumption that lessening federal environmental regulatory authority necessarily results in lessened environmental protection."[43] Hence, he argues, our present reliance on a form of cooperative federalism is unnecessary, and federal authority can be curtailed without negative environmental ramifications.[44]

Is the conventional narrative a "fable" as Adler claims?[45] The answer, of course, depends on the historical record. And care is required in examining that record because any significant change in our current regulatory structure could seriously undermine the effectiveness of our national effort to combat pollution. The question is not whether we should permit state experimentation. The states can certainly innovate and implement new policies as long as they do not fall below minimum environmental standards. The question is whether we are willing to

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36 Revesz, *Federalism and Environmental Regulation, supra* note 35, at 577–78; Adler, *Judicial Federalism, supra* note 35, at 464–66.

37 *See* Revesz, *Federalism and Environmental Regulation*, *supra* note 35, at 578–83 (claiming that "the concentrations of important air pollutants were falling at significant rates"); Adler, *Judicial Federalism, supra* note 35, at 464–66 (citing significant improvement in both water quality and air pollution).

38 Revesz, *Federalism and Environmental Regulation*, *supra* note 35, at 584; Adler, *Judicial Federalism, supra* note 35, at 464–66..

39 Indur Goklany, Clearing the Air: The Real Story of the War on Air Pollution 49–56 (1999); Paul R. Portney, *Air Pollution Policy*, *in* Public Policies for Environmental Protection 27, 50 (Paul R. Portney ed., 1990); Robert W. Crandall, Controlling Industrial Pollution: The Economics and Politics of Clean Air 16–21 (1983). A revised version of Paul Portney's 1990 book chapter later appeared in Paul R. Portney, *Air Pollution Policy*, *in* Public Policies for Environmental Protection 77, 98–99 (Paul R. Portney & Robert N. Stavins eds., 2d ed. 2000).

40 A. Myrick Freeman III, *Water Pollution Policy*, *in* Public Policies for Environmental Protection 169, 187 (Paul R. Portney & Robert N. Stavins eds., 2d ed. 2000).

41 Revesz, *Federalism and Environmental Regulation*, *supra* note 35, at 579–83.

42 Adler, *Judicial Federalism*, *supra* note 35, at 465–66.

43 *Id.* at 464–65 (emphasis omitted).

44 *See* Jonathan H. Adler, *The Fable of Federal Regulation*, PERC Reports, Dec. 2004, at 6, 8, *available at* http://www.perc.org/pdf/dec04.pdf (encouraging a reevaluation of the current federal role in environmental protection).

45 *See id.* at 6 (arguing that "the conventional narrative of the origins of federal regulation is a fable").

remove that floor, that safety net, and allow states to pursue policies that fall below those minimum levels.

In a paper published in 2009, I demonstrated that the revisionist account with respect to water pollution lacked credible historical support.[46] The 1974 EPA report[47] on which it was based was badly flawed and could not be regarded as support for the proposition that water quality was improving during the ten years preceding the enactment of the Clean Water Act.[48] "EPA, for example, did not attempt to control for variations in stream flow, a factor that strongly affects concentrations of organic pollutants" as well as other indicators of water quality.[49] This fact casts into doubt EPA's conclusion that there had been improvements in organic pollution levels between the period of 1963 to 1967 and that of 1968 to 1972[50] because large portions of the country, including the most heavily populated and industrialized regions, were experiencing drought conditions from 1963 to 1966.[51] A much more recent EPA study indicates that the discharge of organic pollutants from municipal wastewater treatment facilities actually increased 8% between 1962 and 1972,[52] data that strongly suggests that EPA's 1974 report was measuring the impact of dilution upon municipal waste—waste that typically contains both organic material and bacteria[53]—rather than the impact of state regulation.[54]

It cannot be denied, however, that water quality was improving in some locations in the years before 1972.[55] Much of the progress was due to the

46 *See* Andreen, *Delegated Federalism Versus Devolution*, *supra* note 19, at 257.

47 OFFICE OF WATER PLANNING AND STANDARDS, U.S. ENVTL. PROT. AGENCY, 1 NAT'L WATER QUALITY INVENTORY: 1974 REPORT TO CONGRESS (1974).

48 Andreen, *Delegated Federalism Versus Devolution, supra* note 19, at 266–67.

49 *Id.* at 264. For this reason, the Council on Environmental Quality urged that the report "be interpreted with caution." COUNCIL ON ENVTL. QUALITY, EXEC. OFFICE OF THE PRESIDENT, ENVIRONMENTAL QUALITY: THE FIFTH ANNUAL REPORT 287 (1974). The report also suffered from a number of other problems. The monitoring stations from which the data were drawn were not held uniformly constant, a fact that injects "a degree of ambiguity into many of the report's conclusions" since it was attempting to study water quality trends. Andreen, *Delegated Federalism Versus Devolution*, *supra* note 19, at 264–65. In addition, monitoring and data collection practices had changed over the study period, a fact that also creates some ambiguity. *See* COUNCIL ON ENVTL. QUALITY *supra*, at 284 (indicating that the report did not take these changes into account, and thus relied on implicit assumptions that they did not bias the results).

50 Andreen, *Delegated Federalism Versus Devolution*, *supra* note 19, at 265–66.

51 *Id.* at 266–67. The Northeast, Mid-Atlantic, Midwest, and Central states all experienced widespread drought between 1963 and 1966. *See* ANDREW STODDARD ET AL., MUNICIPAL WASTEWATER TREATMENT: EVALUATING IMPROVEMENTS IN NATIONAL WATER QUALITY 111 (2002). It is not surprising, therefore, that the 1974 report indicated that mean daily stream flows were much lower from 1963 to 1967 than they were from 1968 to 1972 in the following rivers: Delaware, Susquehanna, Potomac, Upper Ohio, Missouri, and upper Mississippi. Stream flows were also lower during the earlier period in the upper and lower Tennessee, lower Arkansas, lower Red, lower Colorado, Sacramento, and Willamette Rivers., NAT'L WATER QUALITY INVENTORY: 1974 REPORT TO CONGRESS, *supra* note 47, at 35 fig.11-4.

52 *See* STODDARD ET AL., *supra* note 51, at 477 tbl.B-20 (showing a discharge increase from 19,278.2 tons per day in 1962 to 20,831.4 tons per day in 1972).

53 Robert C. Kerr, *Pollution or Resources Out-of-Place—Reclaiming Municipal Wastewater for Agricultural Use*, 53 U. COLO. L. REV. 559, 563–64 (1982).

54 Andreen, *Delegated Federalism Versus Devolution*, *supra* note 19, at 266–68.

55 *Id.* at 268.

construction of new sewage treatment facilities,[56] a cost that was shared with the federal government.[57] Nevertheless, the nation was losing ground. The amount of pollution discharged by our cities and towns was still growing,[58] and the amount of water pollution produced by American industry was simply staggering.[59] Industry at this time was contributing at least 63% of all wastewater discharged into U.S. waters;[60] as late as 1968, 70% of industry's direct discharge received no treatment at all, while much of the rest received only rudimentary treatment.[61] In fact, between 1964 and 1968, the percentage of industrial waste being treated (to one extent or another) had increased only 1.2%.[62] It appears, therefore, that the "fable" in this case is the revisionist tale. State efforts, even when supported with federal funding and encouragement, were simply inadequate to the enormous task at hand.

What about air pollution? Is the revisionist story more accurate in depicting the amount of progress that states were producing in the years leading up to the 1970 enactment of the Clean Air Act? The answer, in short, is no; the revisionist tale is no more valid for air pollution than it was for water pollution.

Part II of this Article traces the development of air pollution control in the years between 1881 and 1970. This examination focuses primarily on state and local efforts, and details how those programs attempted to reduce emissions, most commonly smoke, through education and persuasion, as well as by regulation.[63] Nevertheless, by 1961, less than half of the communities in the United States that suffered from moderate to severe air pollution had functioning air pollution control programs,[64] and only six states, even with a generous interpretation, could be said to have had programs that actually enforced air pollution regulations.[65] The advent of substantial federal assistance for state and local programs in the early 1960s

56 *See id.* at 268–69 (discussing the implementation of sewage treatment in areas across the country).

57 *See id.* at 269–70. In 1971, EPA estimated that $1 billion per year had been spent on sewage treatment infrastructure from 1968 to 1971. U.S. ENVTL. PROT. AGENCY, 11 THE COST OF CLEAN WATER: COST EFFECTIVENESS AND CLEAN WATER 64 (1971). By way of contrast, EPA estimated that industry had spent half that sum, or $500 million per year, on wastewater infrastructure during the same period. *Id.*

58 *See* Andreen, *Delegated Federalism Versus Devolution*, *supra* note 19, at 270 (comparing the amount of organic waste discharged in sewage in 1962 with that in 1972).

59 *Id.*

60 *Id.* at 270–71. This figure is likely on the low side because it was based upon a survey that did not include discharges by manufacturing facilities using less than 20 million gallons of water per day. *Id.* at 271 n.80. For that reason, the 80% figure reported in AM. PUB. WORKS ASS'N, HISTORY OF PUBLIC WORKS IN THE UNITED STATES 1776–1976, at 410 (Ellis L. Armstrong ed., 1976), may be closer to the mark.

61 Andreen, *Delegated Federalism Versus Devolution*, *supra* note 19, at 271. It is likely that industry's untreated direct discharge was even higher since it is probable that treatment, even rudimentary treatment, was more common among the larger industrial facilities included in the survey than in the smaller ones that were not. *See id.* at 271, n.80 (discussing the percentage of industrial facilities with treatment sources, and the low presence of treatment at even fairly large facilities).

62 *See id.* at 271 (reporting that the overall percentage of treated industrial waste had risen from 29.2% in 1964 to 30.4% in 1968).

63 *See infra* Part II.A.1–2.

64 *See infra* Part II.A.2 and text accompanying note 171.

65 *See infra* Part II.A.2 and text accompanying notes 176–79 (detailing the limited extent to which states were devoting resources to air pollution control).

stimulated the creation of many more such programs,[66] but, even as late as 1969, most state and local programs remained poorly staffed and basically ineffective.[67] In fact, half of all of the local air quality control personnel in the country worked in just five metropolitan areas.[68] Nevertheless, the revisionists claim that these programs produced significant progress.[69]

Part III, therefore, takes a closer look at the two air quality reports upon which these claims are based. According to the revisionist story, state and local regulators had succeeded in reducing ambient levels of two air pollutants, sulfur dioxide and total particulate matter, in the period prior to 1970.[70] An analysis of these reports, however, demonstrates that both reports are significantly flawed and cannot be relied upon to support such a broad assertion.[71] The number of sampling locations from which the data was gathered was extremely small, and the sampling locations were not necessarily representative of either urban or rural conditions.[72] The data was often incomplete,[73] the periods of time analyzed were not extensive,[74] the sampling methodology was relatively crude,[75] and important meteorological conditions, such as a widespread drought that occurred for six years in the early- to mid-1960s, were not taken into account.[76] The reports are simply not good evidence that either sulfur dioxide or particulate matter pollution were improving in the United States in the years before the Clean Air Act was enacted.

Part IV then explores what can be learned by examining trends in air pollution emissions, energy consumption, and pollution control in the years before 1970. It reveals that sulfur dioxide emissions, rather than improving, were rapidly rising during the years leading up to 1970,[77] a trend that was consistent with a dramatic increase in the amount of coal and fuel oil burned in the United States during the same period[78] and the fact that few steps had been taken before 1970 to control sulfur dioxide emissions.[79] On the other hand, the emissions data indicates that particulate matter emissions were falling.[80] Most of this progress, however, had little to do with regulatory efforts. The years following World War II witnessed, for example, the increasing use of natural gas, rather than coal, to heat homes and businesses,[81] and the railroads replaced their coal-fired locomotives with new diesel-electric engines.[82] The drop in particulate matter emissions from the residential/commercial sector and the railroads between 1950 and 1970 appears, in

66 *See infra* Part II.C.
67 *See infra* notes 256–58 and accompanying text.
68 *See infra* note 258.
69 *See supra* Part I.
70 *See* discussion *infra* Part III.A.
71 *See* discussion *infra* Part III.B.
72 *See infra* notes 333–44 and accompanying text.
73 *See infra* notes 333–44 and accompanying text.
74 *See infra* text accompanying notes 340–43.
75 *See infra* text accompanying note 344.
76 *See infra* text accompanying notes 345–50, 356.
77 *See infra* notes 361–62 and accompanying text.
78 *See infra* notes 361–65 and accompanying text.
79 *See infra* notes 366–68 and accompanying text.
80 *See infra* notes 369–74, 377–86 and accompanying text.
81 *See infra* notes 370, 372 and accompanying text.
82 *See infra* notes 371, 373 and accompanying text.

fact, to account for 72% of the overall decline in particulate emissions during that period, and a drop in forest fires accounts for an additional 26% of the improvement.[83] These numbers, however, do not mean that some industrial facilities were not taking at least some steps to reduce their particulate emissions.

In order to save money on fuel, increase capacity, and reduce labor costs, many companies that used coal turned to new processes and equipment that burned coal more efficiently and, thus, reduced smoke emissions.[84] Other industries installed filtration devices that enabled them to recover valuable products from their emissions.[85] And still other industries occasionally took some steps to reduce the magnitude of obvious air emissions, such as smoke, dust, and fly ash, out of fear that these emissions would prompt nuisance actions or regulation.[86] Nevertheless, it would be incorrect to overstate the amount of progress that was achieved by industry before 1970, since the vast majority of the improvement in particulate pollution between 1950 and 1970 resulted from the adoption of cheap natural gas as a substitute for coal heating, and from the transition to diesel-powered locomotives.[87] It would also be incorrect to ascribe more than a small portion of industry's action to state and local regulation since those agencies remained, for the most part, weak and ineffectual throughout this period.[88]

The lack of broad progress prior to 1970 must be contrasted with the record produced by the Clean Air Act of 1970. Thus, Part V looks at air quality and emissions trends since 1970, and demonstrates that the Clean Air Act has produced dramatic reductions in pollutants such as sulfur dioxide, carbon monoxide, and the precursors of smog, all of which were increasing at an alarming rate before 1970.[89] It also doubled the rate of decline in particulate matter pollution over the drop experienced between 1950 and 1970.[90] While some problems remain, the Clean Air Act clearly created an approach that has produced remarkable progress over the past forty-two years. That record, and the lack of effective regulation during the years preceding it, provide ample reason to reject the revisionist claim that federal authority could be reduced today without producing adverse environmental impacts.

83 *See infra* note 374 and accompanying text.
84 *See infra* notes 108, 139, 142–43 and accompanying text.
85 *See infra* notes 156–61 and accompanying text.
86 *See infra* notes 140, 162–64 and accompanying text.
87 *See infra* notes 369–76 and accompanying text.
88 *See infra* Part IV.B.
89 *See infra* notes 454–458 and accompanying text.
90 *See infra* notes 370, 454 and accompanying text.

II. AIR POLLUTION CONTROL EFFORTS: 1881 TO 1970

A. State and Local Efforts Prior to 1963

1. The Anti-Smoke Crusade

As the environmental historian Joel Tarr has observed, transitions from one source of energy to another are nothing new in the United States.[91] By the end of the 1700s, the larger cities and towns along the East Coast were beginning to exhaust easily accessible sources of firewood.[92] While water power could provide some of the energy demands of the nascent textile industry, good hydropower sites were limited and water flows varied with the seasons.[93] A more consistent and flexible form of power was needed. Fortunately for the northeastern states, a supply of anthracite coal was located nearby in the northeastern corner of Pennsylvania, and soon a new network of canals and railroads was bringing this hard, relatively clean-burning coal to market in Philadelphia, Baltimore, New York, and Boston.[94]

West of the Alleghenies, Pittsburgh experienced a different kind of transformation, this one occasioned by the burning of large amounts of local bituminous coal. By the start of the Civil War, the use of this soft coal in Pittsburgh's furnaces and mills had earned the city the derisive moniker of the "Smoky City."[95] Rich deposits of bituminous coal were found throughout large portions of the Midwest and South, and urban growth and industrialization in cities such as Cincinnati, St. Louis, Cleveland, Chicago, and Birmingham were also fueled by the widespread use of smoky bituminous coal.[96] The nation's appetite for coal was rapacious in the years following the Civil War. Consumption rose from 20 million tons in 1860 to over 650 million tons in 1918—a peak to which it would not return until the mid-1940s.[97] Most of this coal was the smokiest kind, with the use of anthracite coal dwindling to 17% of the total by 1918.[98] Even northeastern cities, owing to the limited supply and cost of anthracite, had begun to use cheaper bituminous coal by the turn of the twentieth century.[99]

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91 JOEL A. TARR, THE SEARCH FOR THE ULTIMATE SINK: URBAN POLLUTION IN HISTORICAL PERSPECTIVE 227 (1996).

92 SCOTT HAMILTON DEWEY, DON'T BREATHE THE AIR: AIR POLLUTION AND U.S. ENVIRONMENTAL POLITICS, 1945–1970, at 21 (2000).

93 *Id.* at 22.

94 *See* BARBARA FREESE, COAL: A HUMAN HISTORY 112–13, 119–22 (2003).

95 DEWEY, *supra* note 92, at 22.

96 *See id.* at 22–23; DAVID STRADLING, SMOKESTACKS AND PROGRESSIVES: ENVIRONMENTALISTS, ENGINEERS, AND AIR QUALITY IN AMERICA, 1881–1951, at 12 (1999).

97 BUREAU OF THE CENSUS, U.S. DEPARTMENT OF COMMERCE, HISTORICAL STATISTICS OF THE UNITED STATES 1789–1945, at 155 (1949); STRADLING, *supra* note 96, at 12–13. Coal supplied over 75% of the country's energy needs in the 1910s. *Id.* at 12.

98 STRADLING, *supra* note 96, at 12

99 *Id.* at 12, 20. Many New Yorkers feared the impact that growing reliance on bituminous coal would have on their city. *Id.* at 17. As Andrew Carnegie told reporters outside his Fifth Avenue residence in 1902, "If New York allows bituminous coal to get a foothold, the city will lose one of her most important claims to pre-eminence among the world's great cities, her pure atmosphere." *Id.*

Beginning with Chicago in 1881, a number of cities enacted ordinances that attempted to abate the smoke problem.[100] This movement was propelled by Progressive-era reformers who were concerned about aesthetics and health concerns, and by local business and civic leaders who were concerned about the negative impact that smoky conditions would have on continued economic growth.[101] The ordinances, however, were generally simplistic[102] and most of the smoke control bureaus were poorly resourced.[103] While they occasionally made progress, it was often only temporary,[104] since industry was generally successful at thwarting the creation of truly effective regulatory and enforcement programs.[105] Most control authorities, therefore, relied primarily on education and voluntary action to reduce smoke and soot emissions, often invoking the creed of "smoke means waste."[106] Smoke is indeed emblematic of waste, since both smoke and soot are composed of carbon particles and other combustible material resulting from incomplete combustion.[107] In order to save money on fuel, increase capacity, reduce labor costs, and, in some cases at least, to reduce smoke emissions, many industrial operations began using mechanical stokers for their coal-fired boilers and furnaces.[108] Although

100 DEWEY, *supra* note 92, at 23; NOGA MORAG-LEVINE, CHASING THE WIND: REGULATING AIR POLLUTION IN THE COMMON LAW STATE 109 (2003).

101 DEWEY, *supra* note 92, at 24–25; STRADLING, *supra* note 96, at 16–17; FREESE, *supra* note 94, at 150–154; MORAG-LEVINE, *supra* note 100, at 109–11; FRANK UEKOETTER, THE AGE OF SMOKE: ENVIRONMENTAL POLICY IN GERMANY AND THE UNITED STATES, 1880–1970, at 20–21 (2009).

102 The 1881 Chicago ordinance, for example, declared the emission of "dense smoke" to be a public nuisance, unless it was emitted from a private residence. MORAG-LEVINE, *supra* note 100, at 112. Over time, of course, municipal ordinances grew somewhat more complex, but they remained nuisance-based for the most part during the late 19th and early 20th centuries. *See id.* at 115, 118.

103 UEKOETTER, *supra* note 101, at 26, 40. Some, moreover, were short-lived. The ordinance in Birmingham, Alabama, was passed in 1912 and weakened at the behest of major manufacturers in 1913. STRADLING, *supra* note 96, at 131–32. In 1915, the state legislature administered the coup de grace by prohibiting communities in Alabama from even enacting such legislation. *Id.* at 131–36. *See also* MORAG-LEVINE, *supra* note 100, at 113–14 (discussing a number of court cases that struck down municipal smoke ordinances that were enacted without state authorization).

104 MORAG-LEVINE, *supra* note 100, at 115; UEKOETTER, *supra* note 101, at 27.

105 *See* RICHARD N. L. ANDREWS, MANAGING THE ENVIRONMENT, MANAGING OURSELVES: A HISTORY OF AMERICAN ENVIRONMENTAL POLICY 207 (2d ed. 2006); DEWEY, *supra* note 92, at 26 (describing how "unenlightened and unashamed manufacturers could pull strings and manipulate those city councilors they controlled to prevent or delay [smoke control] regulation"). By so often focusing upon nuisance as the governing standard, municipal pollution authorities often found themselves in a dilemma. They could either demand abatement, regardless of how feasible that might have been in a given instance, or ignore the violation, because they had no discretion to fashion a solution between the two extremes. *See* MORAG-LEVINE, *supra* note 100, at 118.

106 UEKOETTER, *supra* note 101, at 94. By seeking voluntary cooperation, the municipal authorities were often doing the only thing that seemed available to them, especially since enforcement was a resource-intensive endeavor for the "[c]hronically understaffed pollution agencies." MORAG-LEVINE, *supra* note 100, at 118.

107 NAT'L AIR POLLUTION CONTROL ADMIN., U.S. DEP'T OF HEALTH, EDUC., & WELFARE, CONTROL TECHNIQUES FOR PARTICULATE AIR POLLUTANTS 2 (1969) [hereinafter NAPCA, CONTROL TECHNIQUES FOR PARTICULATES].

108 Arthur C. Stern, *History of Air Pollution Legislation in the United States*, 32 J. AIR POLLUTION CONTROL ASS'N 44, 46 (1982). The steel industry was also prompted by economics to begin the transition from filthy and wasteful beehive coking ovens to new by-products ovens, which were more efficient, produced high quality coke, and also yielded valuable amounts of ammonium sulphate

the new process did not produce the dense smoke that resulted from hand firing,[109] it created a major new air pollution problem in the form of cinders and fly ash.[110] Whatever interest companies had in lowering their fuel bills, however, ended with the entrance of the United States into World War I, as did the salience of smoke abatement efforts.[111] "War," after all, "meant smoke,"[112] and when coupled with large increases in industrial production, air quality in American cities fell precipitously.[113]

The war, however, created only a temporary hiatus in the smoke abatement movement. Although coal consumption declined to pre-war levels in the 1920s,[114] efforts to control smoke resumed.[115] By 1930, a total of fifty-one cities had smoke control ordinances coupled with smoke abatement bureaus.[116] Most of these bureaus continued to encourage voluntary smoke abatement by emphasizing the cost savings that could accompany more efficient combustion practices.[117] Coal, however, was both abundant and inexpensive after the war, reducing industry's incentive to invest in new, more efficient equipment.[118] As a result, relatively little progress was made.[119]

Even though coal usage declined precipitously during the Depression,[120] St. Louis embarked on a new, tougher course on smoke in 1937. Through ordinances approved in 1937 and 1940, the city council, at the behest of a former mechanical engineering professor, Raymond Tucker, required both industrial and domestic sources of smoke to use either higher-grade coal or better combustion techniques such as automatic stokers.[121] Tucker, furthermore, enforced these ordinances with a highly trained, professional staff, and soon the coal smoke over St. Louis began to

(fertilizer), tar, and gas to heat the coking chambers. Edwin C. Eckel, *The American Steel Industry under Competition*, 46 ENG'G MAG. 663, 683–84 (1914).

109 Clouds of black smoke were created when bituminous coal was shoveled by hand "onto an up-draft stationary flat grate." Stern, *supra* note 108.

110 *Id.* at 46–47. "Mechanical stokers [could also] handle much poorer grades of coal than . . . hand firing." F. Parkman Coffin, *The Use of Low-Grade Mineral Fuels and the Status of Powdered Coal*, 20 GEN. ELECTRIC REV. 606, 614 (1917).

111 STRADLING, *supra* note 96, at 147.

112 *Id.* at 138 (quoting remarks by Franklin Lane, Secretary of the Interior, in 1917).

113 *See id.* at 147–52 (describing the war-time increase in production as well as a decrease in enthusiasm for curbing smoke and the subsequent drop in air quality).

114 *See* BUREAU OF THE CENSUS, *supra* note 97, at 155.

115 STRADLING, *supra* note 96, at 153.

116 Stern, *supra* note 108, at 44 tbl.1. Approximately 140 other cities had smoke control ordinances, but no organization, personnel, or budget for implementation. *See id.* The situation in the North tended, on the whole, to be better than it was in the South where cities like Chattanooga, Memphis, Louisville, Nashville, and Birmingham were doing next to nothing. *See* DEWEY, *supra* note 92, at 28. On the other hand, if the South lagged behind, "it was not by much, for the 1920s and 1930s generally saw relatively little smoke control action at either the state or local level in other American regions." *Id.*

117 MORAG-LEVINE, *supra* note 100, at 121.

118 *Id.*

119 *Id.*; STRADLING, *supra* note 96, at 155–56. Stradling, in fact, concluded that "the post-[World War I] antismoke efforts proved no more successful than those before the war, and perhaps even less so." *Id*. at 156.

120 *See* BUREAU OF THE CENSUS, *supra* note 97, at 155 (showing a sharp decline in the annual consumption of coal during the 1930s).

121 *See* DEWEY, *supra* note 92, at 31–32; UEKOETTER, *supra* note 101, at 77–80 (providing a brief history of Tucker's successful antismoke efforts in St. Louis).

clear.[122] The success in St. Louis, however, owed much to the fact that its residents and industries could meet the new requirements by merely switching from the use of low-grade Illinois coal to a higher-grade coal produced in nearby Arkansas.[123]

The example of St. Louis gave heart to anti-smoke crusaders in Pittsburgh who, despite decades of effort, had made little progress.[124] Urged on by the press, angry housewives, and many civic leaders, the city council passed a St. Louis–style smoke ordinance in July 1941.[125] Although implementation was delayed by the onset of the Second World War, the dreary conditions produced by wartime iron and steel production—requiring, for example, that the streetlights in downtown Pittsburgh remained lit even at midday—made clear that enforcement would have to be rigorous once post-war implementation began.[126] Those who framed the ordinance, however, were surprised once implementation began, not only by the relative speed of success, but also by the way in which it was accomplished.[127] The key to success did not involve the use of cleaner coal or new combustion processes or gas cleaning equipment; rather, most of the rapid improvement resulted from another kind of major fuel switch, this time from coal to natural gas.[128] Due to supply disruptions, higher prices, and inconvenience, coal began to lose market share to natural gas once pipelines began to ship low-priced natural gas into the Pittsburgh area.[129] Between 1940 and 1950, the number of Pittsburgh households burning natural gas rose from 17.4% to 66%, and those using coal dropped from 81% to 31.6%.[130] In addition, the railroads were quickly phasing out steam locomotives with new, cleaner, diesel-electric engines.[131] Within a few years, heavy smoke events became rare in Pittsburgh.[132] As with St. Louis, the success of the smoke abatement program was largely due to fuel switching.[133] In Pittsburgh, however, the transition to natural gas would likely have occurred without regulation; the abatement program perhaps just sped it along.[134]

122 DEWEY, *supra* note 92, at 31–32.

123 UEKOETTER, *supra* note 101, at 81.

124 Cliff I. Davidson, *Air Pollution in Pittsburgh: A Historical Perspective*, 29 J. AIR POLLUTION CONTROL ASS'N 1035, 1039 (1979); *see also* STRADLING, *supra* note 96, at 167 (stating that "the city accomplished little regarding smoke control during the Depression); TARR, *supra* note 91, at 234 (declaring that "Pittsburgh had been faltering in its fight against smoke in the middle and late 1930s").

125 TARR, *supra* note 91, at 234–35, 242–43. The ordinance prohibited "such quantities of soot, cinders, noxious acids, fumes or gases . . . as to cause injury, detriment, or nuisance to any person or to the public." UEKOETTER, *supra* note 101, at 159.

126 TARR, *supra* note 91, at 243–44.

127 *Id.* at 248–51.

128 STRADLING, *supra* note 96, at 170–72.

129 *See* TARR, *supra* note 91, at 252 (stating that "[p]rice and convenience, therefore, drove a fuel and equipment transition"); *see also* FREESE, *supra* note 94, at 143–46 (discussing the laborious process of burning coal for domestic purposes).

130 TARR, *supra* note 91, at 252.

131 *Id.* at 277. The switch was primarily due to economic factors, not environmental ones. *Id.* at 280. The towboats that plied the city's rivers were also replacing old, coal-fired steam engines with diesel ones. Davidson, *supra* note 124, at 1039.

132 *See* Davidson, *supra* note 124 at 1040 ("By 1948, downtown visibility improved 67%, and the city received 89% more sunshine by 1954."); TARR, *supra* note 91, at 250.

133 "Eventually all smoke-plagued cities would benefit from a shift toward natural gas heating and diesel locomotion, but none so dramatically as Pittsburgh." STRADLING, *supra* note 96, at 172.

134 TARR, *supra* note 91, at 257.

While many commentators on the cleanup in Pittsburgh have focused primarily on the shift to natural gas by domestic sources,[135] industry also played a role.[136] A number of heavy industries in Pittsburgh, and eventually in Allegheny County, invested in improved combustion technologies, such as mechanical stokers, and installed various kinds of smoke abatement devices.[137] Many of these steps were undoubtedly required or encouraged by the smoke control authorities in Pittsburgh, and the same kind of interaction with agency officials was certainly taking place in a number of other communities.[138] Elsewhere, however, American industry was also taking voluntary actions, which served to reduce smoke emissions during the 1950s and 1960s.[139] While those actions may have been motivated, in part, by a desire to avoid nuisance actions or "restrictive legislation,"[140] or to burnish their image in the community,[141] one cannot lose sight of the economics behind the use of more efficient combustion techniques such as mechanical stokers and the injection of pulverized coal into high-efficiency boilers. Both of these processes decreased smoke emissions.[142] At the same time, both processes reduced the amount of coal necessary to produce the same amount of heat, increased boiler capacity, permitted the use of poorer grades of coal, and reduced labor costs.[143]

Despite these efforts, the skies over American cities did not completely clear. Although the days of heavy smoke were largely a thing of the past in Pittsburgh, smoke was still a commonplace annoyance in the city, as was fly ash.[144] Other less visible forms of air pollution were serious problems, as the tragic air inversion over suburban Donora, Pennsylvania, demonstrated in 1948.[145] In fact, despite the hoopla about the success of Pittsburgh's smoke control program, the U.S. Public

135 *See, e.g.*, *id.* at 227–28; STRADLING, *supra* note 96, at 169–71.

136 TARR, *supra* note 91, at 250 n.44.

137 *See* Davidson, *supra* note 124, at 1039 (explaining how industries "replaced old, worn out equipment with modern facilities designed for smokeless operation"). A smoke control ordinance applicable to the portions of Allegheny County outside of the City of Pittsburgh was passed in 1949. *Id.*

138 *Id.*

139 *See* UEKOETTER, *supra* note 101, at 120–24.

140 *Id.* at 121.

141 *See id.* at 120–23; *see also* Robert N. Rickles, *Air Pollution Control in the Chemical Industry*, *in* AIR POLLUTION CONTROL: GUIDEBOOK FOR MANAGEMENT 151, 151 (A. T. Rossano, Jr. ed., 1969) (referring to public relations and the creation of nuisance problems for residential neighbors as important reasons for developing an industrial air pollution control program).

142 Stern, *supra* note 108, at 46; Coffin, *supra* note 110, at 614, 624.

143 *See* Stern, *supra* note 108, at 46 (arguing the development of mechanical stokers and pulverized coal firing technologies was motivated by a desire to increase efficiency and decrease labor costs); Coffin, *supra* note 110, at 614, 618, 630 (discussing how mechanical stokers and pulverizing technologies coal allowed for industry to use both low-grade and high-grade coal).

144 Angela Gugliotta, *The "Smoky City" Between the Wars*, *in* SMOKE AND MIRRORS: THE POLITICS AND CULTURE OF AIR POLLUTION 100, 111 (E. Melanie DuPuis ed., 2004).

145 MORAG-LEVINE, *supra* note 100, at 123. Donora is a small mill town located about 20 miles from Pittsburgh and was home to a steel plant, a zinc smelter, and a sulfuric acid plant. As a result of the air inversion, which trapped the pollution from these facilities under a layer of cold air, 20 people died, dozens were hospitalized, and almost 6,000 became ill. Davidson, *supra* note 124, at 1039. Five years later, in 1953, a serious smog concentration in New York City killed 200. Randall B. Ripley, *Congress and Clean Air: The Issue of Enforcement, 1963*, *in* CONGRESS AND URBAN PROBLEMS 224, 225 (Frederic N. Cleaveland ed., 1969).

Health Service declared in 1966 that Pittsburgh remained the sixth most heavily polluted city in the country for air pollution.[146] Smoke, it appears, had not been the most significant problem.[147]

2. The Emergence of Broader Efforts to Deal with Air Pollution

Even as the smoke began to clear, it was obvious that the country suffered from many other dangerous air pollutants. Toxic industrial emissions—as well as sulfur dioxide, smog (ozone), carbon monoxide, and particulate matter other than smoke[148]—all plagued many urban, suburban, and rural locations in the United States.[149] Despite increasing public concern about the adverse health impacts of these air pollutants during the 1950s and into the 1960s,[150] many industries and public officials simply downplayed any problem.[151] In the 1950s, for example, the chemical industry attempted to minimize the disaster at Donora by urging the public to keep the event in perspective, saying that "in spite of highly concentrated air-polluting operations in many localities there has never been a similar occurrence elsewhere in this country."[152] And, in the early 1960s, Governor George Wallace took a deep breath outside a rural Alabama paper mill and exclaimed: "Yeah, that's the smell of prosperity. Sho' does smell sweet, don't it?"[153] In other instances, industry would argue that more research was needed before doing anything, or that industry should be left to take voluntary action because it knew best how to deal with its own problems.[154] Manufacturing companies would also sometimes threaten to relocate their facilities should a community have the temerity to engage in regulation.[155]

146 J. CLARENCE DAVIES III & BARBARA S. DAVIES, THE POLITICS OF POLLUTION 158 (2d ed. 1975).

147 MORAG-LEVINE, *supra* note 100, at 122–23.

148 Particulate matter pollution includes smoke as well as other small solid or liquid particles including fly ash and dusts of various kinds. *See* NAPCA, CONTROL TECHNIQUES FOR PARTICULATES, *supra* note 107, at 2 (defining particulate matter as "any material, except uncombined water, that exists as a solid or liquid in the atmosphere or in a gas stream at standard conditions").

149 DEWEY, *supra* note 92, at 228.

150 *See id.* at 90–93 (describing physicians', scientists', and the public's increasing concerns with the adverse effects of air pollution); UEKOETTER, *supra* note 101, at 155, 199 (discussing the public reaction to air pollution in Pittsburgh and Los Angeles in the 1950s); *see also* Helen B. Shaffer, *Poisoned Air*, EDITORIAL RESEARCH REPORTS, at 238, 239, 244–45 (Apr. 6, 1955) (referring to the rise of air pollutions problems other than smoke such as smog, sulfur oxides, nitrogen oxides, hydrocarbons, and various organic substances).

151 *See* G. Edward Pendray, *Management Aspects of Air Pollution: Good Public Relations Can Be a Powerful Adjunct in Industry's Struggle for Clean Air*, 77 MECH. ENG'G 581, 582 (1955) (discussing the process of denial which the author termed the industrial "air-pollution syndrome").

152 DEWEY, *supra* note 92, at 245 (quoting from a booklet published by the Manufacturing Chemists' Association in 1952); s*ee also* UEKOETTER, *supra* note 101, at 210 (referring to a representative of the automobile industry who asserted at a hearing before the California State Assembly in 1955 that new cars produced virtually no emissions).

153 DAVID R. GOLDFIELD, PROMISED LAND: THE SOUTH SINCE 1945, at 197 (1987).

154 DEWEY, *supra* note 92, at 244.

155 *See* UEKOETTER, *supra* note 101, at 153–54 (relating a conversation in which the Mayor of Struthers, Ohio told the U.S. Public Health Service that a representative of the local steel company had threatened to move portions of its operations if the town regulated the mill's air emissions); s*ee also* EARL FINBAR MURPHY, WATER PURITY: A STUDY IN LEGAL CONTROL OF NATURAL RESOURCES 105

On the occasions when industry did act to control these kinds of emissions,[156] it appears that it was often prompted to do so, at least in part, by economic self-interest. The carbon black industry, for example, used electrostatic precipitators to recover carbon black,[157] and paper mills used them for the "economic recovery of salt cake."[158] The steel industry also installed a large number of electrostatic precipitators on blast furnaces for economic purposes,[159] as did the chemical industry in cases where a valuable aerosol could be collected or where a gas needed to be cleaned for subsequent use.[160] Although copper, lead, and zinc smelters initially used precipitators in their struggle against nuisance actions, an even greater utility was discovered because precipitators could recover valuable copper, lead, zinc oxides, and other substances that would otherwise be carried out of their stacks in the form of dust.[161] In addition to economic purposes, these devices were often installed in order to forestall nuisance actions, as well as to delay regulation or improve a company's public image.[162] These concerns undoubtedly motivated both the cement industry and coal-fired electric generating stations to install electrostatic precipitators or other mechanical systems to reduce their otherwise huge emissions of cement kiln dust[163] and fly ash, respectively.[164] At other times, however, industrial air polluters may have been reacting, at least in part, to regulatory pressure, although it is not likely that such pressure was a common factor in these investment decisions.

(1961) (recounting similar threats by the paper industry made in response to water pollution enforcement efforts in Wisconsin).

156 In 1967, for example, U.S. industrial firms purchased nearly $105 million worth of air pollution control equipment from U.S. manufacturers. *See* NAPCA, CONTROL TECHNIQUES FOR PARTICULATES, *supra* note 107, at 38 tbl.4-1 (noting that in 1967, manufacturers shipped $110.5 million in industrial gas cleaning equipment and exported $5.7 million in equipment, for a total of $104.8 million in domestic sales).

157 HARRY J. WHITE, INDUSTRIAL ELECTROSTATIC PRECIPITATION 20 (1963) (noting that electostatic precipitators were often used in conjunction with a mechanical collector). The use of an additional device (either a bag filter or scrubber) was necessary, however, if more appreciable air pollution control was to be achieved. *Id.*

158 *Id.* at 21 (describing how electrostatic precipitators allowed paper mills to collect 100 to 150 pounds of salt cake per ton of pulp); NAPCA, CONTROL TECHNIQUES FOR PARTICULATES, *supra* note 107, at 18. Higher efficiency precipitators than those generally used were necessary if more effective air pollution control was actually sought. WHITE, *supra* note 157, at 21.

159 WHITE, *supra* note 157, at 16.

160 *Id.* at 18.

161 *Id.* at 10–11.

162 UEKOETTER, *supra* note 101, at 123. Industry had little interest in dealing with pollutants such as sulfur dioxide, which had little economic value, were not readily perceptible, and were likely expensive to control. *Id.* at 235. For a contemporary discussion of the community relations opportunity presented by reducing the amount of perceptible air pollutants emitted, see Pendray, *supra* note 151, at 584.

163 *See, e.g.*, Boomer v. Atlantic Cement Co., 257 N.E.2d 870, 873 (N.Y. App. Div. 1970) ("It seems reasonable to think that the risk of being required to pay permanent damages to injured property owners by cement plant owners would itself be a reasonable effective spur to research for improved techniques to minimize nuisance."); NAPCA, CONTROL TECHNIQUES FOR PARTICULATES, *supra* note 107, at 18 (explaining that electrostatic precipitators and fabric filters were used to try to control emissions of cement kiln dust).

164 *See infra* notes 429–50 and accompanying text (discussing the fly ash problems created by the injection of pulverized coal into high-temperature steam boilers).

Most existing smoke control bureaus were simply not prepared or equipped to deal effectively with these new challenges. Although some had been renamed to reflect the wider field of air pollution control, many continued to focus on smoke control.[165] This perhaps reflected the professional orientation and special expertise of the mechanical engineers who so often staffed the local agencies. They simply did not have the kind of specialized scientific knowledge that was needed to deal with more sophisticated problems.[166] The lack of relevant expertise made the search for appropriate standards nearly impossible.[167] All too often these agencies simply applied the Ringelmann Scale—a smoke-control era chart that gauged visible emissions coming out of a smokestack by comparing them to four shades of gray[168]—or used "common sense" to regulate other pollutant problems.[169] The agencies also lacked the funds that were necessary to address a broader, more complicated regulatory agenda.[170]

In 1961, only 43% of the communities with major or moderate air pollution problems had control programs whose budget exceeded $5,000 per year.[171] Although the eighty-five local programs that served these communities spent a total of nearly $8 million in 1961, over half of that was spent in California alone, and 80% of that was spent in Los Angeles.[172] Even if the local agencies had been well staffed and funded, their jurisdiction generally ended at the city line. They simply could not reach the growing number of polluting facilities that were located in adjacent towns and unincorporated areas.[173] Of the eighty-five local programs with

165 UEKOETTER, *supra* note 101, at 13, 155–56.

166 *Id.* at 156, 159.

167 *Id.* at 160.

168 BUREAU OF MINES, DEP'T OF THE INTERIOR, RINGELMANN SMOKE CHART 1–2 (1967), *available at* http://www.cdc.gov/niosh/mining/pubs/pdfs/ic8333.pdf.

169 UEKOETTER, *supra* note 101, at 160. If a "standard" was applied, it often required the use of a commonly accepted engineering practice. *Id.* In short, "[n]o agency was capable of providing authoritative clarifications, and no regular way of defining norms emerged—one that would have provided at least procedural backing for threshold values." *Id.* at 162.

170 This comported with industry's desire to keep these agencies from being strong enough to "take the initiative on more stringent and systemic oversight." *Id.* at 125. "The smaller the agency, the easier it was to keep under control," and industry's effort to keep these agencies small and pliable was aided in large measure by the fact that industrial polluters provided a large number of the members of the supervisory bodies for these agencies in the 1950s and 1960s. *Id.* at 125–26.

171 Ripley, *supra* note 145, at 226. To put this figure into perspective, the annual salary of an engineer in 1961 ranged from approximately $6,576 to $19,056. BUREAU OF LABOR STATISTICS, U.S. DEP'T OF LABOR, NATIONAL SURVEY OF PROFESSIONAL, ADMINISTRATIVE, TECHNICAL, AND CLERICAL PAY: WINTER 1960–61, at 12 (1961), *available at* http://www.bls.gov/ncs/ocs/patc_1960_1961.pdf. Using the Consumer Price Index, $5,000 in 1961 would amount to approximately $36,400 in 2010 dollars. Measuring Worth, *Seven Ways to Compute the Relative Value of a U.S. Dollar Amount—1774 to Present*, http://www.measuringworth.com/uscompare/result.php?use%5B%5D=DOLLAR&year_source=1961&amount=5000&year_result=2010 (last visited Mar. 20, 2012). A budget of less than $5,000 per year for air pollution control activities, therefore, could not have supported a functioning program. *See* Stern, *supra* note 108, at 44 (stating that most local jurisdictions that had passed air pollution control ordinances over the years had failed to provide the organization, personnel, and fiscal means necessary to implement their ordinances).

172 Ripley, *supra* note 145, at 226.

173 UEKOETTER, *supra* note 101, at 13, 150.

budgets of over $5,000 per year in 1961, only fifteen were county-wide programs and seven of those were in California. All the rest were municipal programs.[174]

The problems posed by limited jurisdiction, underfunding, lack of scientific expertise, and the sheer absence of programs in many smaller communities could have been addressed by comprehensive state action.[175] Unfortunately, however, most states were doing very little. In 1961, only seventeen states devoted more than $5,000 per year to air pollution control, and once again, the lion's share of spending was in California. Of the total of $2 million that these states were spending, California was responsible for 57%.[176] In fact, the states in 1961 had a grand total of 148 full-time and 29 part-time employees working on air pollution control, and over one-third of them were in California.[177] In contrast, local programs employed 876 individuals in 1961.[178] Furthermore, "[n]ot more than six States, even with a generous interpretation, could be said to enforce air pollution regulations."[179]

Los Angeles and the State of California were far and away the leaders in air pollution control during the post-war period. Los Angeles had never experienced the smoky conditions that had afflicted so many other American cities because it relied primarily upon natural gas and fuel oil, rather than soft coal.[180] Beginning in 1940, however, a new kind of pollution descended upon the Los Angeles basin—photochemical smog or, as we call it today, ozone pollution.[181] The smog grew worse as World War II progressed, often causing thousands to experience eye irritation, sneezing, and coughing.[182] Public concern led, first, to the enactment of a city ordinance in 1944 setting limits on smoke emissions and, then, a nearly identical county ordinance in 1945.[183] The county ordinance, however, did not cover the incorporated cities in the county, and, despite prompting by the county,

174 *Id.* at 151.

175 *Id.* at 153. At that time, it was assumed that a city had to have a population of at least 150,000 to be able to afford an air pollution control program. *Id.*

176 Ripley, *supra* note 145, at 226.

177 UEKOETTER, *supra* note 101, at 153.

178 *Id.* Industrial interests appear to have appreciated the emphasis on local programs at the time since it was easier for them to exert pressure on local government. *Id.* at 127. Oregon, however, was an exception. It enacted the first state air pollution statute in 1951, in part, perhaps, because industry was concerned about the stringency of a new ordinance that was under consideration in Portland. *See id.* (describing how the industry attacked Portland's local ordinance because they believed it gave officials the power to resort to drastic measures); *see also Report on Air Pollution in Portland*, 35 PORTLAND CITY CLUB BULL. 381, 386 (1955), *available at* www.pdxcityclub.org/system/files/reports/Air_Pollution_1955.pdf (explaining that Oregon's state-wide approach to air pollution was unique).

179 PUBLIC HEALTH SER., U.S. DEP'T OF HEALTH, EDUCATION, & WELFARE, STATE AND LOCAL PROGRAMS IN AIR POLLUTION CONTROL 5 (1966) [hereinafter STATE AND LOCAL PROGRAMS IN AIR POLLUTION CONTROL].

180 DEWEY, *supra* note 92, at 27.

181 UEKOETTER, *supra* note 101, at 187.

182 JAMES E. KRIER & EDMUND URSIN, POLLUTION AND POLICY: A CASE ESSAY ON CALIFORNIA AND FEDERAL EXPERIENCE WITH MOTOR VEHICLE AIR POLLUTION 1940–1975, at 52–53 (1977). The Los Angeles basin is an ideal location for ozone pollution since it is ringed by mountains to the east and north, enjoys prevailing westerly winds from the Pacific, and commonly experiences temperature inversions that trap cooler air and pollutants beneath a lid of warm air. DEWEY, *supra* note 92, at 39.

183 DEWEY, *supra* note 92, at 41.

many of these cities refused to pass Los Angeles–type ordinances.[184] Raymond Tucker, the former smoke control chief in St. Louis, was soon brought into town by the *Los Angeles Times* to review the local situation, and, early in 1947, he recommended that the state fill this gap by creating countywide air pollution control agencies.[185] Despite strong opposition from industrial interests, particularly oil companies and the railroads, Governor Earl Warren signed a bill into law in 1947 that permitted every county in California to create an air pollution control district.[186] The Act also contained two common prohibitions: one directed at nuisances and the other at dense smoke.[187] But it also permitted districts to enact additional requirements consistent with the purposes of the Act.[188]

Los Angeles County used its new authority to create a relatively well-funded Air Pollution Control District (APCD) in the fall of 1947.[189] The APCD set upon its task with vigor. It soon imposed technology-based requirements on a number of large industrial emitters including iron foundries and open-hearth steel mills, and required oil storage tanks to have floating roofs. In addition, by the early 1950s, smoke was curtailed through tough enforcement of a prohibition on visible emissions; the open burning of garbage in dumps was banned; and sulfur emissions from oil refineries were eventually reduced.[190] Despite the city's leadership in air pollution control by the early 1950s, the smog over Los Angeles was increasing in severity[191] because its principal source—the automobile—had not been controlled.[192]

Although some air pollution control officials in Los Angeles suspected that auto emissions had something to do with smog, no one knew precisely how those emissions caused smog. Tucker, therefore, had made no recommendations about automobiles in his 1947 report on air pollution in Los Angeles,[193] and the automobile industry claimed in the same year that "they had never considered the automobile as capable of producing irritating gases in objectionable amounts."[194] Even though the APCD considered cars to be only a minor part of the problem, it nevertheless engaged the services of an obscure biochemistry professor from the California Institute of Technology, Dr. A. J. Haagen-Smit, whose experiments on smog had impressed the agency.[195] Haagen-Smit worked quickly, and in November 1950 he announced his startling conclusion: In the presence of nitrogen oxides (a

184 KRIER & URSIN, *supra* note 182, at 55.

185 DEWEY, *supra* note 92, at 42–43. This was one of 23 recommendations contained in Tucker's January 1947 report. *Id.* at 43.

186 KRIER & URSIN, *supra* note 182, at 61–62.

187 *Id.* at 62.

188 *Id.*

189 DEWEY, *supra* note 92, at 43–44.

190 *Id.* at 45–46.

191 *See id.* at 46–47 (describing high levels of eye irritation experienced by residents and general haze in the city).

192 *See id.* at 49 (explaining the resistance of residents and the automobile industry to regulations regarding automobile use).

193 KRIER & URSIN, *supra* note 182, at 59–60. He did acknowledge, however, that the automobile was part of the problem. *Id.* at 59.

194 DEWEY, *supra* note 92, at 47.

195 KRIER & URSIN, *supra* note 182, at 79–80.

product of the high temperature, high compression engines common in post-war cars) sunlight transformed hydrocarbons—such as gasoline vapor—into smog.[196]

Although Haagen-Smit had solved the riddle of ozone pollution, his work produced a firestorm of controversy. Some of the criticism came from members of the public who did not relish any blame being placed on the family car.[197] Much of the criticism, however, came from scientists working on a grant from the petroleum industry, which had taken particular umbrage at Haagen-Smit's suggestion that cars and petroleum refineries were equally responsible for southern California's smog.[198] These scientists contended that the problem was much more complex than Haagen-Smit had indicated and that there was, in fact, a huge void of scientific understanding.[199] Other, more independent, scientists eventually examined the question and corroborated Haagen-Smit's findings, although they found that refineries were not responsible for as much of the problem as he had originally thought.[200] By 1957, a consensus had emerged: the automobile was the major cause of smog in Los Angeles.[201]

To deal with the problem, the APCD urged the state to pass legislation to abate motor vehicle pollution.[202] The first step was taken in 1959 when the California legislature passed a bill directing the state's Department of Public Health to set advisory air quality standards.[203] Then, in 1960, the California Motor Vehicle Pollution Control Act was enacted.[204] The bill established the Motor Vehicle Pollution Control Board (MVPCB) within the Department of Public Health.[205] The MVPCB, in turn, was directed to set criteria for approving exhaust control devices, and once two devices were certified as meeting those criteria and the advisory air pollution standards, cars were not to be registered unless they were equipped with a certified device.[206] By 1962, a number of crankcase devices had been certified and were required on all new cars sold in California beginning with the 1964 models.[207] Then, in 1964, the MVPCB certified four exhaust devices—three catalytic converters and one direct flame afterburner[208]—one of which would have to be installed on new 1966 models.[209] Suddenly, the automobile industry was able to do something that it had claimed it could not do: produce engine modifications that yielded better results than these early exhaust devices.[210] By getting their own engine modifications certified, the industry was able to avoid installing exhaust devices during the next model year.[211] Nevertheless, it was clear

196 DEWEY, *supra* note 92, at 48.
197 *See* KRIER & URSIN, *supra* note 182, at 83.
198 *Id.* at 82.
199 *Id.* at 81–83.
200 *Id.* at 85.
201 *Id.* at 86.
202 *Id.* at 116–17.
203 *Id.* at 117–18.
204 *Id.* at 138–39.
205 *Id.* at 138.
206 *Id.* at 138–39; DEWEY, *supra* note 92, at 63–64.
207 KRIER & URSIN, *supra* note 182, at 147.
208 *Id.* at 158.
209 *Id.*
210 *Id.* at 158–59.
211 *Id.*

that California had given birth to a regulatory program that held great promise for the future.

B. Federal Efforts Prior to 1963

While air pollution was primarily a local concern before the 1960s, the federal government was not completely missing in action. Federal action, however, was sporadic and relatively minor before 1955.[212] In 1912, for example, the newly created U.S. Bureau of Mines published several bulletins that detailed ways to reduce smoke emissions from coal-burning equipment.[213] Its work on air pollution continued in the following years as the Bureau performed occasional studies and surveys on particular air pollution problems.[214] In the 1920s, the U.S. Public Health Service became alarmed about General Motors' production of tetraethyl lead as an anti-knock gasoline additive in new high-compression car engines.[215] The government wanted proof that human health would not be harmed by its production and use.[216] A conference of experts was held in 1925, production was voluntarily halted, and further research was performed.[217] The panel that conducted this research concluded, however, that no grounds existed at that time for banning the use of leaded gasoline, as long as the concentration of tetraethyl lead did not exceed a specified limit.[218] Then, during the Depression, the Works Progress Administration and other New Deal programs helped perform some of the first comprehensive urban air pollution surveys, measuring both smoke levels and sootfall.[219]

In the aftermath of the 1948 Donora tragedy,[220] federal activity began to increase. Experts from the U.S. Public Health Service and the U.S. Weather Bureau investigated the disaster,[221] and by 1950, twenty-three other cities had asked the Public Health Service for assistance in analyzing their local air pollution problems.[222] This heightened level of concern prompted President Truman to call

212 *See* Ripley, *supra* note 145, at 228–31 (describing the federal government's limited involvement in air pollution control prior to 1955).

213 *Id.* at 228. The Bureau of Mines also published a model smoke control ordinance in 1912. Stradling, *supra* note 96, at 97.

214 Dewey, *supra* note 92, at 28.

215 *Id.* at 29.

216 *Id.*

217 *Id.* at 29–30.

218 *Id.* The research panel, however, recommended that Congress provide funds for further study to address a number of uncertainties. *Id.* The production of the fuel additive resumed, Congress did not appropriate funds for additional study, and the research that was done was conducted by the industry and, unsurprisingly, concluded that there was no evidence of any danger to public health from the use of leaded gasoline. *Id.*; David Rosner & Gerald Markowitz, *"A Gift of God"?: The Public Health Controversy over Leaded Gasoline During the 1920s*, *in* Dying for Work: Workers' Safety and Health in Twentieth-Century America 121, 135 (David Rosner & Gerald Markowitz eds., 1987).

219 Dewey, *supra* note 92, at 28; Stradling, *supra* note 96, at 159–61.

220 Morag-Levine, *supra* note 100, at 123, 127.

221 Leonard B. Dworsky, Conservation in the United States: Pollution 549 (Frank E. Smith et al. eds., 1971).

222 *Id.* at 550.

for the first United States Technical Conference on Air Pollution.[223] The conference, which took place in 1950, urged the federal government to help identify air pollution problems and to assist in developing the technology necessary to combat them.[224] Nevertheless, numerous efforts to enact legislation broadening the federal role failed in Congress between 1949 and 1954.[225] Frustrated by this inaction, two Republican Senators, Thomas Kuchel of California and Homer Capehart of Indiana,[226] sought help from President Eisenhower, who responded by appointing an interdepartmental committee in 1954 to explore possible federal action.[227] The committee cautiously recommended additional research and technical assistance, and Eisenhower urged Congress to pass such legislation in his 1955 State of the Union message.[228] Congress did so later in 1955.[229] The bill, while emphasizing the primary responsibility of state and local governments for air pollution control, authorized expenditures of $5 million per year for five years for federal research on air pollution and for the provision of technical support to state and local agencies.[230] Although Eisenhower's Secretary of Health, Education, and Welfare, Arthur Flemming, later wanted to expand the federal role to include some limited enforcement authority,[231] Congress merely extended the 1955 bill for four additional years in 1959,[232] and then for two more years in 1962.[233]

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223 MORAG-LEVINE, *supra* note 100, at 127. President Truman, however, did not envision an expansive role for the federal government in air pollution control. DEWEY, *supra* note 92, at 237. He instead viewed the responsibility for taking corrective action as primarily a matter for local officials. *Id.*

224 Ripley, *supra* note 145, at 228.

225 *See* DEWEY, *supra* note 92, at 237 (identifying some of the resistance by President Truman to addressing this issue); DWORSKY, *supra* note 221, at 555 (discussing the continued dialog within Congress about the growing need to control air pollution); Stern, *supra* note 108, at 49 (outlining the history of several failed bills).

226 Senator Kuchel, of course, was quite familiar with the smog situation in southern California, while Senator Capehart was concerned about air pollution in Gary and Indianapolis. DEWEY, *supra* note 92, at 237.

227 *Id.* at 238.

228 Samuel M. Rogers, *Air Pollution Legislation—A Review of Current Developments*, 50 AM. J. PUB. HEALTH 642, 642 (1960); Stern, *supra* note 108, at 49.

229 Act of July 14, 1955, Pub. L. No. 84-159, 69 Stat. 322 (1955).

230 *Id.* §5(a), 69 Stat. at 322-23. Congress, however, only appropriated $16.5 million during this five-year period. Stern, *supra* note 108, at 49.

231 Ripley, *supra* note 145, at 232; KRIER & URSIN, *supra* note 182, at 110–11, 169 (reporting Flemming's proposal at a December 1958 news conference that "the federal government should be empowered to hold hearings on interstate air pollution on its own initiative and make findings and recommendations"). The Public Health Service, however, opposed any such expansion in its power, viewing itself as a research-oriented organization and fearing that such enforcement authority might disrupt its good relationship with state and local officials. KRIER & URSIN, *supra* note 182, at 111; Ripley, *supra* note 145, at 232–33; Uekoetter, *supra* note 101, at 217. President Eisenhower, moreover, was not enthusiastic about such mission creep. *See* ARNOLD W. REITZE, JR., AIR POLLUTION CONTROL LAW: COMPLIANCE AND ENFORCEMENT 14 (2001) [hereinafter REITZE, AIR POLLUTION CONTROL LAW].

232 Act of Sept. 22, 1959, Pub. L. No. 86-365, 73 Stat. 646 (1959). Congress also enacted a bill in 1960 that required the Surgeon General to study motor vehicle air pollution and report back to Congress within two years. Act of June 8, 1960, Pub. L. No. 86-493,74 Stat. 162 (1960).

233 Act of Oct. 9, 1962, Pub. L. No. 87-761, 76 Stat. 760 (1962). The bill also required the Surgeon General to make the study of motor vehicle exhaust a permanent part of the mission of the Public Health Service. *Id.* § 2, 76 Stat. at 760.

C. An Era of "Creative" Federalism: 1963–1970[234]

In both 1961 and 1962, President Kennedy declared that he supported a major expansion of federal efforts to control air pollution.[235] Despite the President's support, passage of a more comprehensive act proved difficult.[236] In 1963, however, Congress finally succeeded in enacting the Clean Air Act.[237] The Act greatly expanded the federal budget for air pollution activities, authorizing the expenditure of $95 million over the next four and one-half years.[238] Nearly $20 million of this sum could be used as grants to support up to two-thirds of the cost of initiating or improving state and local air pollution programs[239]—thus creating a powerful incentive for state and local governments to either begin to build or, in some cases, enhance their capacity in this area.[240] The Act also increased federal research, training, and technical services[241] and, perhaps most importantly, required the Secretary of Health, Education, and Welfare to publish air quality criteria for harmful air pollutants, setting forth the adverse health effects that could be expected from various levels of these pollutants.[242] In addition, the Act contained the first provision for federal enforcement.[243] Modeled along the lines of the Federal Water Pollution Control Act,[244] the enforcement process was slow and awkward. Federal enforcement was limited to instances in which human health or welfare was endangered, and, unless interstate pollution was involved, it could be triggered only by state or local request.[245] The federal government, furthermore, could not bring suit against a polluter until both a conference and a public hearing had been held,[246] and the court in such a proceeding was required to consider "the physical and economic feasibility" of abating the pollution.[247] It is, therefore, not surprising

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234 "Creative" federalism refers to the belief, held by many in the 1960s, that state and local government would effectively regulate air pollution as long as the federal government would provide them with funding, support, leadership, and exhortation. John C. Esposito & Larry J. Silverman, Vanishing Air: The Ralph Nader Study Group Report on Air Pollution 152 (1970).

235 Ripley, *supra* note 145, at 235–36.

236 *Id.* at 236.

237 Pub. L. No. 88-206, 77 Stat. 392 (1963) (codified as amended at 42 U.S.C. §§ 7401–7671q (2006)).

238 *See id.* § 13, 77 Stat. at 401 (authorizing $5 million for fiscal year ending June 30, 1964; $25 million for fiscal year ending June 30, 1965; $30 million for fiscal year ending June 30, 1966; and $35 million for fiscal year ending June 30, 1967).

239 *Id.* § 4(a), 77 Stat. at 395.

240 *See, e.g.*, *infra* notes 185–91 and accompanying text.

241 § 3, 77 Stat. at 394–95 (1963).

242 *Id.* § 3(c)(2), 77 Stat. at 395. This kind of research would prove of immense value when the Clean Air Act Amendments of 1970 called upon EPA to set ambient air quality standards in expedited fashion. Pub. L. No. 91-604, sec. 4 § 109, 84 Stat. 1676, 1679–80 (1790). The air quality criteria envisioned by the 1963 Act were not binding: they were "acted upon by the states only if they were so inspired." William H. Rodgers, Jr., Environmental Law 131 (2d ed. 1994).

243 *See* § 5, 77 Stat. at 396–99.

244 *See* William L. Andreen, *Beyond Words of Exhortation: The Congressional Prescription for Vigorous Federal Enforcement of the Clean Water Act*, 55 Geo. Wash. L. Rev. 202, 210–13 (1987).

245 § 5(c)(1), 77 Stat. at 396.

246 *Id.* § 5(c)–(f), 77 Stat. at 396–98.

247 *Id.* § 5(g), 77 Stat. at 398.

that this enforcement approach proved of limited utility; just ten enforcement conferences ever took place, and only one case went to court.[248]

The 1963 Act was successful in stimulating the growth of local and state programs. Between 1961 and 1966, for instance, the number of state programs with budgets of $5,000 per year or more increased from seventeen to forty, although only nine of these state programs were involved in any regulatory activities.[249] And the number of local programs with budgets of at least $5,000 per year, increased 50%, from eighty-five to one-hundred thirty, but less than 20% of the largest counties had air pollution programs.[250] The work was only beginning;[251] for example, Chicago had fewer air pollution inspectors in the mid-1960s than in 1910.[252] Eventually, in addition to development and improvement funding, Congress authorized grants to subsidize the operation of these state and local programs.[253] By 1970, all fifty states had air pollution programs and the number of local agencies had risen to 188.[254] However, most of these agencies—at both the state and local level—remained understaffed and underfunded.[255] Half of the state agencies had fewer than ten budgeted employees in 1969, while half of the local agencies had fewer than seven budgeted employees.[256] In short, it would be fair to conclude that most state and local programs, even with the stimulation provided by the federal grants program,

248 ARNOLD W. REITZE, JR., 1 ENVTL. L. 3–27 (1972); *see also* DEWEY, *supra* note 92, at 241–42 (discussing that solitary case); RODGERS, *supra* note 242, at 133 (concluding that "the conferences provided little, if any, improvement in air quality").

249 STATE AND LOCAL PROGRAMS IN AIR POLLUTION CONTROL, *supra* note 179, at 5; *see also* Jean J. Schueneman, *Organization and Operation of Air Pollution Control Agencies*, *in* 5 AIR POLLUTION: AIR QUALITY MANAGEMENT 109, 137 (Arthur C. Stern ed., 3d ed. 1977) (stating that the "activities of state agencies in 1965 were rather limited").

250 *See* STATE AND LOCAL PROGRAMS IN AIR POLLUTION CONTROL, *supra* note 179, at 7. The spending by the 50 largest cities in the country averaged less than half of the amount that was commonly considered an acceptable minimum. *Id.*

251 By the end of 1966, 72 new program grants had been made along with 40 improvement grants. *Id.* at 4.

252 UEKOETTER, *supra* note 101, at 125.

253 Clean Air Act Amendments of 1966, Pub. L. No. 89-675, § 3(a)(1), 80 Stat. 954, 954. Overall funding for the federal program was increased in 1967, with Congress authorizing the expenditure of $169 million for 1968–1969 and $134 million for 1970. *See* Air Quality Act of 1967, Pub. L. No. 90-148, § 309, 81 Stat. 485, 506–07 (1967).

254 *See* Stern, *supra* note 108, at 44 tbl.I (listing the number of municipalities and counties that had operating air pollution control agencies by 1970 at 107 and 81, respectively). Federal grants had been extended to over 200 state and local agencies between 1965 (when the first grants were made) and 1970. SECRETARY OF HEALTH, EDUCATION AND WELFARE, THIRD REPORT, PROGRESS IN THE PREVENTION AND CONTROL OF AIR POLLUTION, S. Doc. No. 91-64, at 20 (1970).

255 MORAG-LEVINE, *supra* note 100, at 133.

256 COUNCIL ON ENVTL. QUALITY, EXEC. OFFICE OF THE PRESIDENT, ENVIRONMENTAL QUALITY: THE FIRST ANNUAL REPORT 85 (1970). Moreover, only 80% of these budgeted positions were filled, which was primarily due to the low salaries which state and local agencies offered. *Id.* The problems with regard to staffing reflected budgetary constraints. Only 6 of the 55 state and territorial programs which had received federal aid actually enjoyed funding which met minimum standards for adequacy. The funding situation at the local level was somewhat better: 45% of the grantee agencies had budgets that met minimum levels. *Id.* at 83.

were "rudimentary and ineffectual" in the years before the Clean Air Act Amendments of 1970.[257]

The year 1965 saw the first legislation that gave the federal government the authority to directly regulate air pollution. The Motor Vehicle Air Pollution Control Act[258] ordered the Department of Health, Education and Welfare (HEW) to promulgate emission standards for new vehicles, taking into consideration technological feasibility and economic costs.[259] One year later, HEW set standards—approximately the same as those that California applied in 1966—to become effective nationwide with the 1968 model year.[260] The bill's passage owed much to California, which wanted federal help in its campaign to curtail automobile-generated pollution.[261] The automobile industry on the other hand opposed the bill, arguing that controls should be set at the state level.[262] The industry later changed its mind when an emission control bill was introduced in Pennsylvania, and a bill even tougher than California's was introduced in New York. Fearing the proliferation of diverse state standards, the industry reluctantly endorsed federal regulation as long as it preempted state efforts.[263] The 1965 Act, however, did not explicitly address the question of state preemption, and Congress would not address the issue for two more years.

The push for greater federal involvement continued. In 1966, John Gardner, the Secretary of HEW, criticized the states for failing to act more forcefully and called for uniform national air quality standards and emissions standards.[264] Despite the fact that Senator Edmund Muskie, Chair of the Senate Special Subcommittee on Air and Water Pollution, opposed such an increase in federal authority,[265] President Johnson sent a message to Congress in January 1967 recommending legislation that would include national emission limitations for major industrial sources, and also regional interstate air quality commissions, where necessary, that would implement those limits and set air quality standards by which to control other air pollution sources.[266] As the Administration's bill went through Congress,

257 DEWEY, *supra* note 92, at 242; *see also* RICHARD J. TOBIN, THE SOCIAL GAMBLE 74 (1979) (reporting that few state programs had adequate staff or monitoring data in the late 1960s); Robert C. Cluster, *State and Local Manpower Resources and Requirements for Air Pollution Control*, 19 J. AIR POLLUTION CONTROL ASS'N 217, 220 (1969) (relating that half of all of the local air quality personnel in the whole country worked in just five metropolitan areas).

258 Pub. L. No. 89-272, tit. II, 79 Stat. 992 (1965).

259 *Id.* § 202, 79 Stat. at 992.

260 KRIER & URSIN, *supra* note 182, at 175.

261 *Id.* at 173.

262 *Id.* at 173–74.

263 *Id.* at 174–75. By the mid-1960s, automobile-generated ozone pollution was found in virtually every urban area in the country. DEWEY, *supra* note 92, at 228–29.

264 DEWEY, *supra* note 92, at 240. According to Professors Krier and Ursin, "state and local efforts had been relatively scant" to date. KRIER & URSIN, *supra* note 182, at 179.

265 *See* DEWEY, *supra* note 92, at 240–41; KRIER & URSIN, *supra* note 182, at 180. Muskie believed that national standards would impair growth in poorer states and that the federal government should focus its efforts on those areas that were seriously polluted. *See* DEWEY, *supra* note 92, at 240; KRIER & URSIN, *supra* note 182, at 180.

266 Special Message to the Congress: Protecting our Natural Heritage, 1 PUB. PAPERS 93, 94–95 (Jan. 30, 1967). With regard to national emission limits, President Johnson wrote:

Senator Muskie—still believing in "creative federalism"[267]—attempted to restore primary responsibility to the states; and with industry support,[268] he was largely successful. The Air Quality Act of 1967[269] did not provide for national emission limitations or strong regional air quality standards. Instead, HEW was directed to delineate air quality control regions,[270] develop or reevaluate air quality criteria that set forth the impact of particular air pollutants on health and welfare,[271] and publish information on recommended air pollution control technology.[272] The states, rather than HEW, were then called upon to set ambient air quality standards for their air quality control regions and to adopt a plan for the implementation of those standards.[273] In addition to adding more funding,[274] the Act also provided for direct federal civil enforcement action in emergency situations.[275]

Perhaps the most contentious issue involved the preemption of state motor vehicle emission standards. Despite California's desire that the federal standards would only set a minimum floor level for the nation, permitting states to be more stringent, the Senate version of the bill only contained an exemption for California, and only if the state could show that the more stringent standard was necessary.[276] In the House, Representative John Dingell of Detroit attempted to eliminate the exemption altogether.[277] Lobbying by California, however, overcame his opposition, and the House eventually passed an even broader exemption.[278] Following conference with the Senate, the House version was enacted into law.[279] While national motor vehicle emission standards would normally preempt state law, HEW was directed to waive preemption for more stringent California standards, unless HEW could demonstrate that the standards were not necessary to meet compelling and extraordinary conditions.[280]

> Today, no such [emission control] levels exist. Industries do not know to what extent they should control their sources of pollution or what will be required of them in the future. Strong State and local standards—essential to pollution control—cannot be effective if neighboring states and cities do not have strong standards of their own. Nor can such local standards gain the support of industry and the public, unless they know that plants in adjoining communities must also meet standards at least as strict. *Id.* at 94.

267 *See* DEWEY, *supra* note 92, at 242.

268 *See* KRIER & URSIN, *supra* note 182, at 180. The concept of national emission standards, however, received a surprising level of support from state and local organizations. *Id.*

269 Pub. L. No. 90-148, 81 Stat. 485 (1967).

270 *Id.* § 107(a), 81 Stat. at 490–91.

271 *Id.* § 107(b)(1), 81 Stat. at 491. Senator Jennings Randolph of West Virginia, therefore, was successful in his and the coal industry's effort to force HEW to reconsider the previously issued criteria for sulfur dioxide. *See* KRIER & URSIN, *supra* note 182, at 180–81, 183.

272 § 107(c), 81 Stat. at 491.

273 *Id.* § 108(c)(1), 81 Stat. at 492.

274 *Id.* § 105(a)–(c), 81 Stat. at 489–90.

275 *See id.* § 108(k), 81 Stat. at 497 (permitting the Attorney General to bring suit to enjoin sources of pollution when those sources present an "imminent and substantial endangerment to the health of persons" and state and local authorities have not acted to abate the pollution).

276 KRIER & URSIN, *supra* note 182, at 181.

277 *Id.* at 181–82.

278 *Id.* at 182.

279 *Id.* at 183–84.

280 *Id.* at 184; § 208(b), 81 Stat. at 501 (codified as amended at 42 U.S.C. § 7543 (2006)). Congress permitted other states to follow California's lead in 1977. Once California obtains a waiver, other

As the 1960s came to a close, air pollution control remained primarily in state and local hands with the notable exception of motor vehicle emissions. The public's patience with this approach, however, was growing short.[281] There was "no clear evidence that pollution was being reduced on a broad national scale,"[282] and there was increasing skepticism about the ability and willingness of state or local government to take the action necessary to improve air quality.[283] While some progress had been made,[284] much more remained to be done due to the "paucity" of air pollution regulation at the local and state level.[285] The processes set in motion by the Air Quality Act, moreover, appeared to be too slow and too weak.[286] Stronger action, many believed, was needed.[287]

The Clean Air Amendments of 1970[288] ushered in a dramatic new age in air pollution control. The era of "creative" federalism was over, and with its demise

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states with nonattainment problems may now, as a result of the 1977 amendments, adopt California's standard. Clean Air Act Amendments of 1977, Pub. L. No. 95-95, § 177, 91 Stat. 685, 750 (1977) (codified as amended at 42 U.S.C. § 7507 (2006)).

281 *See* ALLEN V. KNEESE & CHARLES L. SCHULTZE, POLLUTION, PRICES, AND PUBLIC POLICY 51 (1975); ESPOSITO & SILVERMAN, *supra* note 234, at 23; DEWEY, *supra* note 92, at 241–42; KRIER & URSIN, *supra* note 182, at 200.

282 KNEESE & SCHULTZE, *supra* note 281, at 51.

283 *See* KRIER & URSIN, *supra* note 182, at 201; *see also* ESPOSITO & SILVERMAN, *supra* note 234, at 190–233 (describing the sad state of air pollution control in Houston, New York City, and Washington D.C. at the end of the 1960s).

284 Progress, for example, had been made in New York City. Although it was considered the dirtiest city in the nation in the mid-1960s and suffered 168 deaths during an air inversion in 1966, significant efforts to address the problem were made during the administration of Mayor John V. Lindsay. DEWEY, *supra* note 92, at 131–33. By switching to the use of lower sulfur coal and oil and by installing some particulate control equipment, Consolidated Edison appears to have reduced sulfur dioxide and particulate matter emissions from its old, outmoded power plants located in the City (its plan to retire some of these facilities and import more electricity from new facilities outside of the City had been delayed). ESPOSITO & SILVERMAN, *supra* note 234, at 213, 216. But the level of air pollution in 1970 remained the worst in the country because of, among other things, the continued operation of thousands of smoky oil furnaces, thousands of antiquated incinerators, and the failure of efforts to deal effectively with the interstate aspects of air pollution in the New York metropolitan area. DEWEY, *supra* note 92, at 133–34, 171–72. New York City was not typical, however—its Department of Air Resources was among the best in the country, enjoying a per capita budget twice the size of the national average. ESPOSITO & SILVERMAN, *supra* note 234, at 230.

285 R. M. Dobbins, *Legal Aspects of Air Pollution*, *in* AIR POLLUTION CONTROL: GUIDEBOOK FOR MANAGEMENT 188 (A. T. Rossano, Jr. ed., 1971); *see also* GEORGE H. HAGEVIK, DECISION-MAKING IN AIR POLLUTION CONTROL: A REVIEW OF THEORY AND PRACTICE 14 (1970) (concluding that, "[i]n the past, efforts at air quality control have been given low priority by most local governments"). Even in cities such as Pittsburgh, which had enjoyed some regulatory success, "[t]he élan of the early [smoke control] period, when considerable success was possible with little effort and expense, had by now largely evaporated." UEKOETTER, *supra* note 101, at 234.

286 *See* DAVIES & DAVIES, *supra* note 146, at 52–53; WALTER A. ROSENBAUM, THE POLITICS OF ENVIRONMENTAL CONCERN 155 (1973); *cf.* UEKOETTER, *supra* note 101, at 234 (noting the difficulties faced in setting air pollution controls during the 1960s). By February 1969, HEW had issued air quality criteria for only two pollutants, and HEW was setting a slow pace in designating air quality control regions. TOBIN, *supra* note 257, at 72–73. The states, partially as a result of delays at HEW, were slow in submitting their implementation plans, but even the plans they did submit contained many deficiencies. *Id.* at 74–75.

287 *See* KRIER & URSIN, *supra* note 182, at 200; ROSENBAUM, *supra* note 286, at 157; *see also* REITZE, AIR POLLUTION CONTROL LAW, *supra* note 231, at 15–16.

288 Pub. L. No. 91-604, 84 Stat. 1676 (1970).

came a major expansion of federal authority. Instead of air quality standards being set by the states, the newly created EPA[289] was given the responsibility to set tough standards designed to protect public health.[290] The states, in turn, were called upon to implement these standards through federally-approved implementation plans containing emissions limitations, compliance timetables, and monitoring requirements.[291] New sources of air pollutants were required to meet uniform technology-based limitations that were to be established by EPA, although the program could be implemented pursuant to federally approved state plans.[292] A similar assignment of federal-state responsibilities was set forth for new health-based standards applicable to hazardous air pollutants.[293] Finally, the 1970 amendments gave EPA substantial power to enforce the Act through administrative relief, civil action, and criminal sanctions—although the states retained concurrent authority to enforce their own plans and requirements.[294] So, while the states still had important roles to play, their significance had certainly been diminished.[295] The federal government was now charged with the promulgation of a wide array of new regulatory requirements and the difficult task of overseeing their implementation.[296]

289 Reorganization Plan No. 3 of 1970, 35 Fed. Reg. 15,623 (Oct. 6, 1970), *reprinted in* 5 U.S.C. app. 643 (2006), *and in* 84 Stat. 2086 (1970) (effective Dec. 2, 1970).

290 Clean Air Amendments of 1970, sec. 4(a), § 109, 84 Stat. at 1679 (codified as amended at 42 U.S.C. § 7409 (2006)).

291 *Id.* sec. 4(a), § 110, 84 Stat. at 1680 (codified as amended at 42 U.S.C. § 7410 (2006)). The budget for clean air activities was substantially increased. A total of $650 million was authorized for the next three years, *id.* sec. 13(a), § 316, 84 Stat. at 1709, with state agencies eligible for grants to develop, improve, and maintain their programs. *Id.* sec. 3(a), § 105, 84 Stat. at 1677. Another $365 million was authorized for research over the following three-year period. *See id.* sec. 13(a), § 316, 84 Stat. at 1709.

292 *Id.* sec. 4(a), § 111, 84 Stat. at 1683 (codified as amended at 42 U.S.C. § 7411 (2006)).

293 *Id.* sec. 4(a), § 112, 84 Stat. at 1685–86. In 1990, Congress replaced the chemical by chemical, health-based approach found in the 1970 amendments with a new regulatory scheme predicated upon the maximum achievable control technology found in a particular industrial category. *See* 42 U.S.C. § 7412(d) (2006). If those standards do not adequately reduce human health risks, EPA is directed to deal with the residual risk by setting health-based limits that also take into consideration costs and other relevant factors. *See* 42 U.S.C. § 7412(f) (2006).

294 Clean Air Amendments of 1970, sec. 4(a), § 113, 84 Stat. at 1686–87 (giving expanded enforcement authority to EPA) (codified as amended at 42 U.S.C. § 7413 (2006)); *id.* sec. 4(c), § 116, 84 Stat. at 1689 (giving concurrent enforcement authority to the states) (codified as amended at 42 U.S.C. § 7416 (2006)).

295 Although the 1970 act preempted less stringent state and local requirements, the act provided them with the latitude to adopt limitations and other requirements that are more stringent than federal law with regard to stationary sources of air pollution. *See id.* sec. 4(c), § 116, 84 Stat. at 1689 (codified as amended at 42 U.S.C. § 7416 (2006)).

296 A variety of new programs and refinements were enacted in 1977. *See e.g.,* Clean Air Act Amendments of 1977, Pub. L. No. 95-95, sec. 127(a), 91 Stat. at 731–42 (adding provisions for the Prevention of Significant Deterioration (PSD) of air quality in areas attaining the National Ambient Air Quality Standards (NAAQS)) (codified as amended at 42 U.S.C. §§ 7470–7479 (2006)); *id.* sec. 129(b), 91 Stat. at 745–51 (adding provisions pertaining to areas failing to attain compliance with NAAQS) (codified as amended at 42 U.S.C. §§ 7501–15 (2006)). The Act was again amended in 1990. *See, e.g.*, Act of Nov. 15, 1990, Pub. L. No. 101-549, sec. 401, 104 Stat. at 2584–631 (establishing the acid deposition control program, also known as the acid rain program) (codified at 42 U.S.C §§ 7651–7651o (2006)); *id.* sections 102–106, 104 Stat. at 2412–64 (amending and extending provisions pertaining to areas failing to attain compliance with NAAQS) (codified as amended at 42 U.S.C. §§ 7501–75 (2006)); *id.* sec. 301, 104 Stat. at 2531–74 (amending provision applying to

III. AN EXAMINATION OF THE CLAIMS FOR STATE REGULATORY SUCCESS PRIOR TO 1970

A. The Claims

In 2001, Professor Richard Revesz published a controversial article that attempted to refute the conventional view that the primary engine of environmental regulation ought to be at the federal level due to a number of public choice pathologies that encumber effective regulation at the state level.[297] In doing so, he took issue with the claim that the states had been ineffective environmental regulators prior to the environmental decade of the 1970s.[298] His argument cited three studies dealing with air pollution, which he claimed suggested that the "states [had] responded vigorously to those air pollution problems that were understood at the time."[299] In 2005, Professor Jonathan Adler cited the same three studies as "evidence of significant environmental improvement prior to the adoption of federal environmental regulation."[300] He then went further and suggested that the record provides "ample reason to question the assumption that lessening federal environmental regulatory authority necessarily results in lessened environmental protection."[301]

Robert Crandall of the Brookings Institution authored the earliest study upon which both Revesz and Adler relied.[302] Crandall used EPA monitoring data that had been reported by the Conservation Foundation in 1982.[303] The data was drawn

hazardous air pollutants) (codified as amended at 42 U.S.C. § 7412 (2006)); *id.* sec. 501, 104 Stat. at 2635-48 (creating a major new permit program) (codified as amended at 42 U.S.C. §§ 7661–7661f (2006)); *id.* §§ 601–602, 104 Stat. at 2648–70 (creating a program for stratospheric ozone protection) (codified as amended at 42 U.S.C. §§ 7671–7671q (2006)). Some have asserted that the statutes like the Clean Air Act Amendments of 1970 "were a natural outgrowth of a lawmaking process which began at least a decade earlier at the state level." E. Donald Elliott, Bruce A. Ackerman & John C. Millian, *Toward a Theory of Statutory Evolution: The Federalization of Environmental Law*, 1 J.L. ECON. & ORG. 313, 318 (1985). The 1970 Clean Air Amendments, however, appear to have owed much more to the pioneering efforts made at the local level over the course of many years and to the rather steady evolution in federal involvement during the 1950s and 1960s. In fact, the federal government appears to have stepped into a regulatory void, which had resulted from state inaction. The local agencies that had grown out of the smoke abatement movement possessed neither the sophistication nor the jurisdiction necessary to deal with modern air pollution problems, and the states seem to have lacked both the will and the means to fill the gap. *See* UEKOETTER, *supra* note 101, at 13–14, 153. Clearly, however, the 1970 Amendments marked a distinctly new path forward.

297 Revesz, *Federalism and Environmental Regulation*, *supra* note 35, at 555–57.

298 *Id.* at 578–83.

299 *Id.* at 580–82.

300 Adler, *Judicial Federalism*, *supra* note 35, at 465–66.

301 *Id.* at 464–65 (emphasis omitted).

302 CRANDALL, *supra* note 39; *see also* Revesz, *Federalism and Environmental Regulation*, *supra* note 35, at 580; Adler, *Judicial Federalism*, *supra* note 35, at 466.

303 CRANDALL, *supra* note 39, at 17–19 (citing CONSERVATION FOUNDATION, STATE OF THE ENVIRONMENT 1982, at 50–54 (1982)). This EPA data had been reported by the agency on at least two occasions in WILLIAM F. HUNT, JR. & EDWARD J. LILLIS, OFFICE OF AIR QUALITY PLANNING & STANDARDS, U.S. ENVTL. PROT. AGENCY, 1980 AMBIENT ASSESSMENT-AIR PORTION 2-1 to 2-7 (1981); and U.S. ENVTL. PROT. AGENCY, 1 THE NATIONAL AIR MONITORING PROGRAM: AIR QUALITY AND EMISSIONS TRENDS ANNUAL REPORT 1-10 to 1-12 (1973) [hereinafter EPA, 1973 AIR QUALITY TRENDS REPORT], *available at* http://www.epa.gov/airtrends/pdfs/Trends_Report_1973.pdf.

from ninety-five monitoring sites for total suspended particulate matter[304] between 1960 and 1971 and from thirty-two sites for sulfur dioxide concentrations from 1964 to 1971. According to this data, the average concentration of particulate matter fell 2.3% per year in the 1960s, and sulfur dioxide concentrations fell at an annual rate of 11.3% from 1964 to 1971.[305] While Crandall admitted that the data was "fragmentary" and not very reliable,[306] he nevertheless declared that they revealed an "interesting trend"[307] that suggested "[a] system of state air pollution policies could have been equally or more effective" than a federal program.[308]

In 1990, Paul Portney of Resources for the Future picked up on the same EPA data.[309] Despite his cautions that one "must be leery of trends based on such a small number of sites," he declared that the data was "important" since it indicated that, rather than deteriorating, air quality was actually improving before the 1970 Amendments were enacted.[310] The data, according to Portney, called into question the notion "that states and local governments would never impose the controls necessary to achieve healthful air."[311] While acknowledging that it was "arguable whether local governments acting alone" could actually have made progress after 1970, he urged that the "accomplishments" of state and local authorities "prior to 1970 should not be ignored."[312]

Finally, Indur Goklany, currently a policy analyst with the U.S. Department of the Interior, published a book in 1999 that largely focused on pre-1970 air pollution trends.[313] With respect to particulates and sulfur dioxide, he reported, in part, on the same data that Portney and Crandall used.[314] Goklany, however, added

304 Monitoring for total suspended particulate matter measured particulate matter of up to 25 μm to 40 μm in size. THAD GODISH, AIR QUALITY 60 (4th ed. 2004). EPA replaced the total suspended particulate matter air quality standards in 1987 with PM_{10}, 52 Fed. Reg. 24,663, 24,664 (July 1, 1987) (codified at 40 C.F.R. § 50.6 (2011)), and standards for $PM_{2.5}$ were added in 1997. 62 Fed. Reg. 38,711 (July 18, 1997) (codified at 40 C.F.R. § 50.7 (2011)). The total suspended particulate matter standards included particles that were too large to enter the human respiratory system; thus, they were not well calibrated to a health-based regulatory program. *See* GODISH, *supra*, at 222. By contrast, the PM_{10} standards and monitors apply to particles that can enter the thoracic region of the respiratory system, and the $PM_{2.5}$ standards and monitors apply to materials that can be deposited deep into human lung tissue. *See id.* at 60.

305 CRANDALL, *supra* note 39, at 19.

306 *Id.*

307 *Id.*

308 *Id.* at 21. Crandall's primary point involved a comparison between monitoring data collected in the 1960s and data collected in the 1970s, a comparison which, he argued, suggested that "pollution reduction was more effective in the 1960s, before there was a serious federal policy dealing with stationary sources, than since the 1970 Clean Air Act Amendments." *Id.* at 19. His analysis, however, is undermined by the fact that the monitoring sites relied upon for the comparison were not held constant (in fact, the number of sites in the 1970s rose from less than 100 to several thousand) and, as he noted, by the poor quality of monitoring data during both periods. *See id.* at 17, 19, 21, 26–27.

309 Portney, *supra* note 39, at 50–51. He looked, however, at a slightly different sample from this data base: total suspended particulate matter data for 95 sites from 1960 to 1970 and sulfur dioxide data for 31 sites from 1966 to 1971. *Id.* at 50.

310 *Id.* at 50–51.

311 *Id.* at 51.

312 *Id.*

313 GOKLANY, *supra* note 39, at 1–2.

314 *Id.* at 55–56 (reporting on 95 sites for particulate matter for the period 1960–1971, and 32 sites for 1964–1971).

more data to the mix. This data was apparently generated by the Mitre Corporation from raw EPA monitoring data and was reported by the Council on Environmental Quality (CEQ) in 1971.[315] The data for particulates included one set for sixty urban sites from 1957 to 1970 and twenty rural sites from 1958 to 1970. According to this data, particulate emissions fell from 121 $\mu g/m^3$ to 102 $\mu g/m^3$ in the urban areas, and rose from 23 $\mu g/m^3$ to 37 $\mu g/m^3$ in the rural areas.[316] To counter the rural data, Goklany also mentioned the existence of EPA data from eighteen non-urban monitoring stations for the period of 1960 to 1971 that revealed no overall trend because a decline early in the period was offset by an increase from 1968 to 1971 that "may have been attributable to decreased rainfall."[317] He also mentioned sulfur dioxide data that was found in the 1971 CEQ report. Based on that data from twenty-one urban monitoring stations, Goklany reported that the mean annual concentration had dropped about 40%, from 69.4 $\mu g/m^3$ in 1962 to 42.5 $\mu g/m^3$ in 1969.[318] All of this empirical data demonstrated, according to Goklany, that there had been "broad improvements in air quality before federalization" and that the improvements in total suspended particulates and sulfur dioxide "were especially noticeable in urban . . . areas."[319]

Goklany appears to have recognized that there may be some problems with this data. He stated, for instance, that monitoring stations are not always representative of broader conditions and that meteorological conditions, such as variable rainfall from year to year, can cast doubt on trend analyses.[320] He also discussed a number of economic and technological developments, such as the switch from coal to natural gas by many urban homeowners and the switch from coal to diesel fuel by the nation's railroads, as important factors in reducing smoke concentrations in many American cities.[321] Nevertheless, he declared that state and local regulations were responsible for improving urban sulfur dioxide levels in the 1960s,[322] and partially responsible for improvements in urban particulate levels in

315 *See* COUNCIL ON ENVTL. QUALITY, EXEC. OFFICE OF THE PRESIDENT, ENVIRONMENTAL QUALITY: SECOND ANNUAL REPORT 212–17, 241–43 (1971) [hereinafter CEQ, SECOND ANNUAL REPORT], *available at* http://www.slideshare.net/whitehouse/august-1971-the-first-annual-report-of-the-council-on-environmental-quality. Some of this data appears to have formed the basis of another report published in 1971. *See* Robert Spirtas & Howard J. Levin, *Patterns and Trends in Levels of Suspended Particulate Matter*, 21 J. AIR POLLUTION CONTROL ASS'N 329, 329–30 (1971) (reporting on particulate matter trends at 58 central city locations from 1957 to 1966 and 20 non-urban sites from 1958 to 1966).

316 GOKLANY, *supra* note 39, at 54.

317 *Id.* at 54–55. This data is found in EPA, 1973 AIR QUALITY TRENDS REPORT, *supra* note 303, at 4–9.

318 GOKLANY, *supra* note 39, at 56. The actual decline reported by CEQ, however, was somewhat less significant since the 1962 figure was actually 66.4 $\mu g/m^3$, not 69.4 $\mu g/m^3$, which was the reported figure for 1963. *See* CEQ, SECOND ANNUAL REPORT, *supra* note 315, at 242 tbl.A-1.

319 GOKLANY, *supra* note 39, at 150. With regard to particulate concentrations, he declared that "the worst [urban] areas were getting better long before the 1970 Clean Air Act was passed or became effective." *Id.* at 55. Goklany also reported on sparse pre-1970 monitoring data dealing with carbon monoxide, ozone, and lead, but his primary focus was on particulate matter and sulfur dioxide concentrations. *See id.* at 56–62, 65, 111, 113.

320 *Id.* at 50–51.

321 *Id.* at 21.

322 *Id.* at 78.

the 1950s and 1960s.[323] The impact of state and local regulation, combined with the rapid growth in the number of state and local air programs during the 1960s, indicate, according to Goklany, that "the race-to-the-bottom rationale is intrinsically flawed."[324] Thus, any "devolution of air pollution control to the states [would be] unlikely to result in rollback of the air quality improvements of the past few decades."[325]

B. A Closer Look at the Air Quality Data upon Which the Claims Are Based

The data that all these commentators rely on provides no support upon which to draw broad conclusions about the effectiveness of state and local regulation or to spin theories about the likely consequences of devolving significant regulatory authority to the states.

The original source of the data that was primarily relied upon by all of these commentators[326] appears to have been an EPA air quality trends report that was published in 1973.[327] According to the report, the composite average of total suspended particulate matter decreased from approximately 110 $\mu g/m^3$ in 1960 to 85 $\mu g/m^3$ in 1971, a drop of about 20%, at a group of ninety-five urban monitoring stations.[328] For sulfur dioxide, the drop in the composite average at thirty-two urban monitoring stations was over 50%, from 55 $\mu g/m^3$ in 1964 to approximately 25 $\mu g/m^3$ in 1971.[329] The non-urban particulate trends were drawn from eighteen monitoring sites between 1960 and 1971 and revealed no significant change.[330] All of the data came from EPA's National Air Surveillance Network (NASN) sites.[331]

The urban NASN sites were located in central business districts at locations that were as comparable as possible to sites in other cities.[332] No more than one site was located in any city,[333] a fact that casts significant doubt on the representative nature of the data. As the CEQ noted in its report on NASN data, "differences in site location will result in major differences in reported concentrations."[334] In fact,

323 *Id.* at 83.

324 *Id.* at 151.

325 *Id.* at 153. He added, however, that "in light of the progress made, and given that the easy—and several tough—reductions have already been made, further improvements in air quality may not be sustainable if they come at the expense of the broader quality of life." *Id.*

326 The additional report upon which Goklany also relied will be discussed *infra*, in the text accompanying notes 352–57.

327 EPA, 1973 AIR QUALITY TRENDS REPORT, *supra* note 303.

328 *Id.* at 1-8 to 1-9.

329 *See id.* at 1-8, 1-10.

330 *Id.* at 4-9.

331 *Id.* at 1-9 fig.1-1, 1-10 fig.1-2. The NASN network was originally established as the National Air Sampling Network by the U.S. Public Health Service in 1957, and the scope of operations grew gradually through the 1960s. By 1967, the number of operating urban stations had grown to 127 in 1967, while the number of operating rural stations had risen to 30. *See* PUBLIC HEALTH SERVICE, U.S. DEPT. OF HEALTH, EDUCATION & WELFARE, AIR QUALITY DATA FROM THE NATIONAL AIR SURVEILLANCE NETWORKS 1967 EDITION 1 (1969) [hereinafter HEW, AIR QUALITY DATA].

332 HEW, AIR QUALITY DATA, *supra* note 33. *Id.* at 17.

333 EPA, 1973 AIR QUALITY TRENDS REPORT, *supra* note 303, at 1-8, 4-4. Since only one monitor was located in a metropolitan area, "the central city site [seemed to be] the obvious choice." Spirtas & Levin, *supra* note 315, at 332.

334 CEQ, SECOND ANNUAL REPORT, *supra* note 315, at 243.

many readings from non-NASN sites, often downwind from major polluters, were "higher by an order of magnitude" than downtown NASN data, "especially for gaseous pollutants" such as sulfur dioxide.[335] Therefore, as EPA stressed, "it should not be assumed that the selected site was representative of the urban area as a whole,"[336] especially for the worst-case scenarios found in "heavily industrialized portions of many cities."[337] The non-urban monitoring stations, eighteen in total across the entire nation, were generally located in parks,[338] and thus do not appear to be representative of either rural or suburban areas with pollution problems. Data, moreover, was often missing. The EPA report chose to analyze a subset of ninety-five monitoring stations for particulates because they were the only stations that had at least one data point in each three-year period spanning the twelve-year scope of the overall project.[339] Consequently, the particulate data may not reflect substantial spikes or declines that may have occurred in those years in which the data is missing. The sampling protocols, moreover, were not especially rigorous in those early days. The NASN stations operated on only twenty-six randomly selected days per year.[340] In the early 1970s, EPA increased the minimum frequency of sampling for particulates and sulfur dioxide to once every six days, for a total of sixty days per year.[341]

The validity of this data, therefore, is highly suspect. The number of sampling locations was extremely small; they were not necessarily representative of either urban or non-urban areas; the data was often incomplete; the periods of time analyzed were not extensive; and the sampling methodology at the time was crude compared to modern monitoring standards.[342] EPA admitted as much when it wrote "that the difficulties in generating valid trend analyses at this time are due . . . to the incompleteness and uncertainties that pervade the available data base."[343] An additional problem affecting the reliability of this data was the possible impact of weather, especially precipitation, upon the readings taken at the monitoring stations. EPA explained in its 1973 report that rainfall can remove pollutants from the air by processes such as absorption, coagulation, and washout.[344] In addition,

335 *Id.*

336 EPA, 1973 AIR QUALITY TRENDS REPORT, *supra* note 303, at 1-8.

337 *Id.* at 4-4.

338 CEQ, SECOND ANNUAL REPORT, *supra* note 315, at 243. One such location, in fact, was Cape Hatteras. EPA, 1973 AIR QUALITY TRENDS REPORT, *supra* note 303, at 4-9.

339 EPA, 1973 AIR QUALITY TRENDS REPORT, *supra* note 303, at 4-8 to 4-9.

340 HEW, AIR QUALITY DATA, *supra* note 331, at 17.

341 *See* 40 C.F.R. § 51.17 (1972). The possibility of missing high-concentration days is increased with less frequent monitoring schedules. *See* Brian Rumburg et al., *Statistical Distributions of Particulate Matter and the Error Associated with Sampling Frequency*, 35 ATMOSPHERIC ENV'T 2907, 2908, 2919 (2001).

342 Standardized criteria for sampling heights, for example, were not available at this time. Therefore, "[m]easurements are . . . often made at roof level where pollutant concentrations may be higher or lower than actual representative levels according to the relative height or nearby emission sources." EPA, 1973 AIR QUALITY TRENDS REPORT, *supra* note 303, at D-6.

343 *Id.* at 1-7 to 1-8. According to EPA, the problem with the monitoring program in these early years was due to several factors including "geographical, spatial, and temporal sampling maldistribution, inconsistencies in sampling and analytic methods, lack of systematic validation of acquired data, and insufficient monitoring resources." *Id.* at 2-3.

344 *Id.* at D-6, 2-3. EPA added that other weather factors like wind, humidity, and temperature can affect monitoring results. *Id.* at 4-11 to 4-13.

the agency noted that dry conditions can increase particulate concentrations, a problem especially in arid areas of the American West.[345] The report, moreover, pointed to lower rainfall levels in certain places, namely in portions of the West and New England, as one reason to explain why certain non-urban monitoring stations in those regions reported upward trends in particulate levels during the last four years of the 1960–1971 monitoring period.[346] EPA, however, did not attempt to explain how a major, widespread drought that lasted for six years in the early to mid-1960s might have affected this data.

Widespread drought conditions afflicted the Northeast, Middle Atlantic, Midwest, and Central states beginning in 1961, and those conditions continued through 1966.[347] That fact may have affected the data from many of the monitoring locations that were used in establishing these trends by producing higher ambient concentrations early in the period and lower concentrations once the drought ended at the end of the 1960s. Without additional empirical work, it is impossible to quantify what effect this drought may have had on EPA's report, but it is certainly possible that the drought skewed many of the data points upward early in the period, thus contributing, for example, to what was reported as a dramatic fall in sulfur dioxide levels between 1964 and 1971.[348] Perhaps, the best thing one can say about this report is that it served as an early, and unfortunately, a rather rickety "prototype" for future efforts to analyze air quality trends.[349] EPA was thus absolutely correct in cautioning that the inadequacies of the "data base must of necessity limit the degree of confidence that can be placed on interpretations derived from it."[350]

Goklany cited additional data, which he gleaned from the 1971 CEQ report, covering a slightly longer period of time, from the late 1950s to 1970 for particulates and 1962 to 1969 for sulfur dioxide. This data, however, suffers from the same infirmities. It covered only slightly different reporting periods and was generally based on even fewer monitoring locations.[351] The data came from the same monitoring system, EPA's NASN system.[352] The urban sites, therefore, were also located in central business districts—sites that were often not representative of conditions in those urban areas[353]—and the non-urban sites were generally located in parks.[354] Data was also missing for some of the sixty urban and twenty non-

345 *See id.*, at D-6.

346 *Id.* at 4-11 (stating that "decreased moisture from rainfall may increase particulate matter entrained into the atmosphere from the surface and may decrease the chances for rainfall removal of airborne particulates").

347 STODDARD ET AL., *supra* note 51.

348 *See* EPA, 1973 AIR QUALITY TRENDS REPORT, *supra* note 303, at 1-8 to 1-12, fig.1-6.

349 EPA, 1973 AIR QUALITY TRENDS REPORT, *supra* note 303, at 2-3. The agency wrote that it hoped that its efforts would "eventually evolve into a truly complete and reliable representation" of trends in air quality. *Id.*

350 *Id.*

351 *See supra* Part III.A and text accompanying notes 318–20.

352 CEQ, SECOND ANNUAL REPORT, *supra* note 315, at 243. In fact, it is quite likely that the study upon which CEQ reported used much of the same raw data as was used by EPA in its 1973 report.

353 According to Spirtas and Levin, "[n]o inference about increases or decreases in pollution in an entire metropolitan area can be made from suspended particulate data from the single center-city site [that was the source of this urban NASN data]." Spirtas & Levin, *supra* note 315, at 332.

354 CEQ, SECOND ANNUAL REPORT, *supra* note 315, at 243.

urban sites that were relied upon to establish trends for suspended particulate matter.[355] The complexities of weather, especially the 1961–1966 drought; inconsistent and often crude monitoring methods; and the lack of systematic validation of acquired data[356] are all problems that cast doubt on the reliability of the CEQ data and any conclusions drawn from them. While it is certainly possible that some measures of air pollution were improving in a number of central city areas, we simply have no empirically valid data indicating that air quality was improving in any uniform fashion—either in metropolitan areas or more broadly—prior to 1970.

IV. A Clearer Picture Emerges

A. Trends in Air Pollution Emissions and Energy Consumption

Since the early 1970s, EPA has published estimates of annual air pollution emissions in an effort to gauge historic trends in pollutant emissions.[357] Although EPA has improved the methodology used in estimating emissions in the years since 1984,[358] the data from 1940 to 1984 are based on national "top-down" estimates drawn from aggregate national economic and demographic data.[359] The accuracy of the pre-1973 data, therefore, is limited, and the data do not provide an absolute indication of emissions for any particular year.[360] Nevertheless, an examination of emissions data may prove helpful at least to the extent that the data appear to be validated by other measures such as energy consumption and what we know about pollution control practices before 1970.

According to EPA's estimates, national sulfur dioxide emissions rose from approximately 22 million tons in 1960 to over 31 million tons in 1970,[361] an increase of 40%.[362] While only an estimate, it is consistent with the fact that coal consumption increased from 398 million tons in 1960 to 523 million tons in 1970,[363] an increase of 31%.[364] At the same time, the use of fuel oil to produce

355 *Id.* at 242.

356 *See supra* notes 343–52 and accompanying text.

357 *See*, *e.g.*, Office of Air Quality Planning & Standards, U.S. Envtl. Prot. Agency, National Air Pollutant Emission Trends, 1900 – 1998 (2000) [hereinafter EPA, Air Pollutant Emission Trends].

358 *Id.* at 1-2 to 1-3.

359 *Id.* at 1-3.

360 *Id.* at 1-2.

361 *See id.* at 3-12 tbl.3-4.

362 Most of this increase occurred among sources that either were not located in central city areas or discharged pollutants through tall stacks. Comm'n on Nat'l Resources, Nat'l Academy of Sciences, Air Quality and Stationary Source Emission Control, S. Doc. No. 94-4, at 239 tbl.6-2, 240 (1975).

363 Energy Info. Admin., U.S. Dep't of Energy, Annual Energy Review 2010, at 217 tbl.7.3 (2011) [hereinafter DOE, 2010 Annual Energy Review], *available at* http://205.254.135.24/totalenergy/data/annual/pdf/aer.pdf.

364 Between 1940 and 1970, sulfur dioxide emissions from electric utility plants doubled every decade as a result of increased coal burning. By 1970, coal combustion accounted for over 90% of the sulfur dioxide emitted by the electrical utility industry. EPA, Air Pollutant Emission Trends, *supra* note 357, at 3-12 tbl.3-4.

electricity in the United States grew nearly fourfold.[365] It therefore appears fair to say that sulfur dioxide pollution, rather than improving dramatically, actually grew much worse during the 1960s, a conclusion that correlates with the near absence of any effort by industry to control sulfur dioxide emissions. For example, relatively few fossil fuel–fired electric generating stations, responsible for approximately half of national sulfur dioxide emissions in 1970,[366] had taken any steps by 1970 to reduce these emissions.[367] Similarly, there was little control of sulfur dioxide emissions at the approximately 307,000 industrial boilers in operation across the United States.[368]

By contrast, EPA has estimated that national particulate matter emissions (PM_{10}) peaked in 1950—falling from over 17 million tons in 1950 to slightly over 13 million tons in 1970, a drop of 23%.[369] This decline corresponds with a fall in particulate emissions from the residential-commercial sector of 73%,[370] and a drop of nearly 99% in the railroad sector,[371] declines which appear consistent with the continuing switch from coal to natural gas and fuel oil by households and commercial concerns,[372] and from coal-fired to diesel-electric locomotives by the railroads.[373] In fact, the drop in emissions from the railroad industry and the residential/commercial sector accounts for fully 72% of the overall decline during this twenty-year period, while emissions from wildfires account for an additional

365 *See* DOE, 2010 ANNUAL ENERGY REVIEW, *supra* note 363, at 163 tbl.5.13d (citing an increase from 241,000 barrels per day in 1960 to 928,000 barrels per day in 1970). Fuel oils used in power plants vary in sulfur content from less than 0.5% to over 4%, compared with coal, which varies from about 0.5% to more than 5% sulfur. F. E. Gartrell, *Power Generation*, *in* 4 AIR POLLUTION: AIR QUALITY MANAGEMENT 465, 483 (Arthur C. Stern ed., 3d ed. 1977).

366 EPA, AIR POLLUTANT EMISSION TRENDS, *supra* note 357, at 3-12 tbl.3-4.

367 R. D. ROSS, AIR POLLUTION AND INDUSTRY 220 (1972). To the extent this was done, it was generally accomplished by substituting lower sulfur content fuel. *Id.*; *see also supra* text accompanying note 284 (discussing actions by Consolidated Edison in New York City). Only three generating units at electric power stations across the entire country were scheduled to have sulfur dioxide scrubbing systems in place before 1971. 1 HANDBOOK OF ENVTL. CONTROL: AIR POLLUTION 556 tbl.4.5-14 (Richard B. Bond et al. eds., 1972).

368 ROSS, *supra* note 367, at 213.

369 EPA, AIR POLLUTANT EMISSION TRENDS, *supra* note 357, at 3-13 tbl.3-5. EPA estimates that 15.5 million tons were emitted in 1960. *Id.*

370 *See id.* (reporting a fall from nearly 1.7 million tons in 1950 to less than half a million tons in 1970). The decline between 1960 and 1970 was 59%, representing a fall from 1.1 million tons to less than half a million tons in 1970. *Id.*

371 *See id.* (reporting a drop from over 1.7 million tons in 1950 to 25,000 tons in 1970). The fall between 1960 and 1970 was 77 percent, from 110,000 tons in 1960 to 25,000 tons in 1970. *Id.*

372 Coal consumption in the residential-commercial sector fell from 115 million tons in 1950 to 16 million tons in 1970. *See* DOE, 2010 ANNUAL ENERGY REVIEW, *supra* note 363. The use of natural gas by the residential sector, meanwhile, rose from 1,198 billion cubic feet in 1950 to 4,837 billion cubic feet in 1970, and from 388 billion cubic feet to 2,399 billion cubic feet in the commercial sector. *Id.* at 201 tbl.6.5. During the same period, the use of fuel oil by the residential sector increased from 390,000 barrels per day to 883,000 barrels per day, and from 308,000 barrels per day to 587,000 barrels per day in the commercial sector. *Id.* at 160 tbl.5.13a.

373 Coal usage in the transportation sector dropped from 63 million tons in 1950 to 300,000 in 1970. DOE, 2010 ANNUAL ENERGY REVIEW, *supra* note 363. At the same time, the use of distillate fuel oil by the transportation sector (utilized, for instance, by diesel railroad engines) rose from 226,000 barrels a day to 738,000 barrels a day. *Id.* at 162 tbl.5.13c. *See also* ANDREWS, *supra* note 105, at 207 (stating that real progress was made on urban air pollution only as cheap natural gas was substituted for coal heating and as diesel locomotives replaced coal-fired engines).

26% of the decline.[374] Meanwhile, particulate matter emissions from electric utilities increased nearly 21% between 1950 and 1970,[375] a rise which is consistent with the rapidly growing use of coal to generate electricity in the United States.[376]

Yet the emissions data do indicate that the electric utility industry was taking some steps to reduce particulate emissions. Particulate emissions from coal-fired electric generating stations fell about 16% between 1960 and 1970[377]—at a time when coal consumption by these facilities was increasing by nearly 82%.[378] This trend actually appears to have started at an earlier time. For example, between 1950 and 1960, coal consumption by the electric utilities almost doubled,[379] but particulate emissions from these coal-fired plants rose by only about 45%.[380] Nevertheless, the degree of control utilized by the industry prior to 1970 pales in comparison with later years. Between 1970 and 1980, coal consumption by the electric utility industry rose again, this time by 77.7%[381] (roughly equal to the increase in the 1960s), while particulate emissions fell by 52.6%[382] (over twice the rate of improvement witnessed in the 1960s). This post-1970 trend intensified during the 1980s with coal consumption rising 36%,[383] while particulate emissions dropped by a dramatic 66.7%.[384]

374 The decline in emissions from these two categories (railroads and the residential-commercial sector) totaled 2,936,000 tons per year between 1950 and 1970, compared to an overall decline of 4,091,000 tons per year. EPA, AIR POLLUTANT EMISSION TRENDS, *supra* note 357, at 3-13 tbl.3-5. PM_{10} emissions from wildfires, which are highly erratic from year to year influenced as they are by rainfall, are recorded to have dropped 1,095,000 tons, comparing 1950's experience with 1970. *Id.* at 3-8, 3-13 tbl.3-5. Decreases in a number of other sectors such as chemicals, petroleum, and other industrial processes (e.g., agriculture, paper, and mineral products) were largely offset by increases in areas such as electric generation, industrial combustion, metals processing, waste disposal, and on-and off-road diesels. *Id.* at 3-13 tbl.3-5.

375 *See* EPA, AIR POLLUTANT EMISSION TRENDS, *supra* note 357, at 3-13 tbl.3-5 (reporting a rise from 1,467,000 tons in 1950 to 1,775,000 tons in 1970).

376 *See generally* DOE, 2010 ANNUAL ENERGY REVIEW, *supra* note 363, at 217 tbl.7.3, 239 tbl.8.2b. Overall annual coal consumption in the United States rose a scant 6% between 1950 and 1970, from 494.1 million tons to 523.2 million tons. *Id.* at 217 tbl.7.3.

377 *See* EPA, AIR POLLUTANT EMISSION TRENDS, *supra* note 357, at 3-13 tbl.3-5 (reporting a decline from 2,092,000 tons in 1960 to 1,680,000 tons in 1970). The overall decline in PM_{10} emissions from all sources between 1960 and 1970 was about 16%, from 15,558,000 tons to 13,042,000 tons. *Id.* A fall in emissions from the residential-commercial and rail sectors, as well as from forest fires, accounts for approximately half of that reduction. *Id.* (indicating reductions of 658,000 tons, 85,000 tons, and 405,000 tons respectively). A number of other sectors experienced declines during this period including chemicals, petroleum, other industrial processes, and on-road diesels, while increases were seen in industrial combustion, metals processing, waste disposal, and non-road diesels. *Id.*

378 *See* DOE, 2010 ANNUAL ENERGY REVIEW, *supra* note 363 (reporting an increase from 176.7 million tons in 1960 to 320.2 million tons in 1970).

379 *See id.* (reporting a rise from 91.9 million tons in 1950 to 176.7 million tons in 1960).

380 *See* EPA, AIR POLLUTANT EMISSION TRENDS, *supra* note 357, at 3-13 tbl.3-5 (reporting an increase from 1,439,000 tons in 1950 to 2,092,000 tons in 1960).

381 *See* DOE, 2010 ANNUAL ENERGY REVIEW, *supra* note 363 (reporting a rise from 320.2 million tons in 1970 to 569.3 million tons in 1980).

382 *See* EPA, AIR POLLUTANT EMISSION TRENDS, *supra* note 357, at 3-13 tbl.3-5 (reporting a drop from 1,680,000 tons in 1970 to 796,000 tons in 1980).

383 *See* DOE, 2010 ANNUAL ENERGY REVIEW, *supra* note 363 (reporting an increase from 569.3 million tons in 1980 to 774.2 million tons in 1990).

384 *See* EPA, AIR POLLUTANT EMISSION TRENDS, *supra* note 357, at 3-13 (reporting a fall from 796,000 tons in 1980 to 265,000 tons in 1990).

To summarize, sulfur dioxide emissions, rather than declining, appear to have risen sharply in the 1960s. While particulate emissions fell, most of the reduction between 1950 and 1970 may be accounted for by fuel switching among homeowners, various commercial enterprises, and the railroads—along with a decline in wildfires in the benchmark years.[385] However, it also appears that the electrical utility industry was making some early strides forward in reducing particulate emissions, and some of that progress appears to have pre-dated 1960.[386]

Crandall, Portney, and Goklany, therefore, were incorrect in their conclusions regarding sulfur dioxide. The ambient air monitoring data upon which they relied so heavily appears to be unreliable and unrepresentative.[387] Furthermore, instead of falling, the emissions data indicate dramatic growth in sulfur dioxide emissions in the years before Congress enacted the Clean Air Act in 1970,[388] a fact that appears to be confirmed by reference to coal consumption data and the paucity of industrial efforts to control sulfur dioxide emissions.[389] The picture with regard to particulate matter is more complex, however. While the ambient air quality monitoring data that these commentators used cannot be regarded as reliable or representative,[390] the emissions data do suggest that particulate pollution was improving during the decades prior to 1970.[391] Most of that improvement, however, was due to fuel switching by homeowners, commercial enterprises, and the railroad industry (changes which may well have produced some air quality improvement in a number of our central city areas), as well as a drop in the incidence of wildfires.[392] Nevertheless, it is clear that the electrical utility industry as well as other industrial sectors were working to reduce their particulate emissions at least to some extent. How much of that effort can be attributed to state and local regulation?

B. Sorting Out Cause and Effect

While municipal efforts to reduce smoke emissions date back to the Progressive era,[393] significant reductions only came later, during the years following World War II. Encouraged by the examples of St. Louis and Pittsburgh, smoke control agencies in a number of American cities took steps to rid their skies of thick

385 *See supra* notes 369–74 and accompanying text (describing the reduction in particulate emissions between 1950 and 1970 in the non-energy sectors).

386 *See infra* note 428 and accompanying text (describing the early adoption of electrostatic precipitators by the electrical industry); *see also supra* Part IV.A (noting that between 1950 and 1960, coal consumption nearly doubled while particulate matter increased less than 50%).

387 *See supra* Part III.B.

388 *See supra* Part IV.A.

389 *See supra* notes 361–68 and accompanying text.

390 *See supra* Parts III.A–B.

391 *See supra* Part IV.A. and text accompanying note 370.

392 *See* STRADLING, *supra* note 96, at 172 (describing how all smoke-plagued cities, especially Pittsburgh, benefited from the shift toward natural gas heating and diesel-powered locomotion); *supra* Part IV.A and text accompanying notes 370–75.

393 *See supra* Part II.A.1 and text accompanying notes 100–19 (noting that efforts to reduce smoke emissions started in the early 1880s and had a rocky history through the end of the Second World War, due partly to the power and influence of industry, and the intervening forces of World Wars I and II).

clouds of smoke and soot.[394] Often, however, their task was facilitated by trends that had nothing to do with their efforts to encourage or require compliance with their relatively simple regulatory requirements.[395]

The post-war transition to cleaner, cheaper, and more convenient forms of energy, such as using natural gas and fuel oil to heat homes and commercial enterprises, as well as switching to diesel fuel to power new locomotives, made the jobs of these smoke control agencies much easier.[396] In addition, industry often acted to reduce their smoke emissions—at times at the behest of municipal authorities.[397] In many instances, however, industry acted independently of the regulatory authorities.[398] Smoke, since it is composed of carbon and other combustible substances, was indicative of incomplete combustion and therefore waste. It behooved industry, therefore, to turn to new combustion techniques to conserve fuel. These techniques included the use of mechanical stokers and pulverized coal, both of which not only reduced coal consumption and produced less smoke, but also lowered labor costs and increased boiler capacity.[399] The switch from beehive coking ovens to byproduct ovens also reduced smoke emissions while conserving coal and producing higher quality coke and other valuable products such as fertilizer, tar, and gas.[400] Not only did these new processes save money, but they also produced public relations benefits and helped stave off nuisance suits as well as tough local regulation.[401] Industry thus had many reasons, apart from the efforts of local regulators, to reduce their smoke emissions.

Following what appeared to be success in the fight against smoke, these local air pollution control agencies found it difficult to make the transition in the 1950s and 1960s from relatively simple smoke abatement to the control of other dangerous but less obvious air pollutants such as sulfur dioxide, nitrogen oxides, volatile organic compounds, dozens of toxic compounds, and small diameter particulate matter.[402] For the most part, they were staffed with mechanical engineers who had been recruited to abate smoke and little else.[403] The agencies, therefore, were ill-equipped in terms of both professional orientation and technical expertise for the assumption of a broader, more sophisticated pollution control agenda.[404] Often, in fact, the agencies just did not want to be responsible for dealing with

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394 *See* UEKOETTER, *supra* note 101, at 85–86, 124–25 (describing the success of these two cities in confronting the health problems posed by smoke emissions, influencing other cities to take action, and prompting further public consideration of air pollution after World War II).

395 *See supra* Part II.A.1 and text accompanying notes 108–10, 127–43; *supra* Part II.A.2 and text accompanying notes 157–64; *infra* Part IV.B and text accompanying notes 397–402, 422–52.

396 *See supra* Part II.A.1 and text accompanying notes 128–36 (discussing, for example, the improvements garnered in Pittsburgh and St. Louis due to fuel switching from coal to natural gas, along with advancements in industry, such as the movement from steam to diesel-electric locomotives on railroads).

397 *See supra* Part II.A.1.

398 *See supra* Part II.A.1.

399 *See supra* Part II.A.1. and text accompanying notes 108–10, 137–43.

400 *See supra* note 108 and accompanying text.

401 *See supra* Part II.A.1 and text accompanying notes 140–41.

402 *See supra* Part II.A.2 and text accompanying notes 148–151, 165–170.

403 UEKOETTER, *supra* note 101, at 13.

404 *See supra* Part II.A.2 and text accompanying notes 166–67.

pollutants that were not readily perceptible to the senses.[405] In any case, many communities had not created functioning air pollution control agencies, and the agencies that were functioning were additionally handicapped by limited geographic jurisdiction and limited resources.[406]

In 1961, less than half of the communities in the United States that suffered from major or moderate air pollution problems had established functioning air pollution control programs,[407] and only eight county-wide programs existed outside of California.[408] Moreover, just a handful of states—six—had programs that enforced air pollution regulations.[409] By 1966, even with the stimulus of federal grant money, the number of state agencies actually engaged in any enforcement work had increased to only nine, while over 80% of our largest counties had no programs at all.[410] Although more cities had organized air pollution programs, the resources necessary to support staff and technical facilities were sorely lacking. In fact, the programs in our fifty largest cities received less than half of the resources considered an acceptable minimum at the time.[411] By the end of the decade, the picture was not much improved. While by 1970 all fifty states had air pollution programs, half of them were budgeted for less than ten employees and only six met minimum standards for adequacy.[412] And while the number of local agencies had grown to 188, less than half of them met minimum standards for adequacy.[413] So, despite the fact that the total number of state and local programs had grown significantly during the 1960s,[414] largely due to federal support,[415] most of the programs were weak and ineffectual.

Other than in a few places, such as California and, to a more limited extent, New York City,[416] most of these agencies had neither the ability nor the apparent will to deal with air pollution other than smoke. Thus, it should not be surprising that rather than decreasing, as Crandall, Portney, and Goklany have claimed based upon fragmentary and unreliable ambient air quality data, sulfur dioxide pollution was actually growing much worse.[417] Total national emissions of nitrogen oxides were also rapidly rising: they were up 107% between 1950 and 1970.[418] At the

405 *See* UEKOETTER, *supra* note 101, at 13.

406 *See supra* notes 170–74 and accompanying text; *see also* UEKOETTER, *supra* note 101, at 13 (discussing the geographical limitations that hampered local efforts).

407 *See supra* Part II.A.2 and text accompanying notes 171–72.

408 *See* UEKOETTER, *supra* note 101, at 151.

409 *See supra* note 179 and accompanying text.

410 *See supra* notes 249–51 and accompanying text.

411 *See supra* note 251 and accompanying text .

412 *See supra* notes 255–258 and accompanying text.

413 *See supra* text accompanying notes 254–56.

414 *See* GOKLANY, *supra* note 39, at 23, 151; *supra* Part II.C.

415 *See supra* notes 237–40, 249–55 and accompanying text.

416 *See supra* notes 180–211, 285 and accompanying text.

417 Emissions between 1960 and 1970 were up 40%. EPA, AIR POLLUTANT EMISSION TRENDS, *supra* note 357, at 3-12 tbl.3-4. The rate of increase of sulfur dioxide emissions between 1950 and 1970 was also 40%. *See id.* (reporting sulfur dioxide emissions of 22,357,000 tons in 1950 and 31,161,000 tons in 1970).

418 *See id.* at 3-10 tbl.3-2 (reporting nitrogen oxide emissions of 10,093,000 tons in 1950 and 20,928,000 tons in 1970). The rate of increase between 1960 and 1970 was 48%. *See id.* (reporting nitrogen oxide emissions of 14,140,000 tons in 1960 and 20,928,000 tons in 1970).

same time, emissions of volatile organic compounds grew 48%,[419] and emissions of carbon monoxide increased by 26%.[420]

While particulate emissions did fall during this period, it appears that nonregulatory factors accounted for most of this progress.[421] As we have seen, a large portion of the smoky particulate problem was attacked by fuel-switching and by the use of newer, more efficient industrial combustion processes that not only conserved coal, but decreased labor costs, increased boiler capacity, and, in some cases, produced valuable products.[422] In the process, these industries also reduced the likelihood of nuisance actions and unwanted regulatory action, and enhanced their standing in the local community.[423] Many of these same factors motivated industry to tackle other, non–smoke related, particulate problems. A number of metal smelters, paper mills, chemical plants, steel mills, and carbon black facilities installed electrostatic precipitators and other filtration systems to recover substances of value such as metals, chemical aerosols, and alkali.[424] Once again, these actions also served to promote good public relations, lessen the risk of litigation, and forestall effective regulation.[425] Of course, it is also likely that some of these actions were at least partially prompted by the urging, regulatory or not, of local air pollution control authorities.[426]

The industry that may well have done the most to reduce its overall particulate emissions, the electric utility industry,[427] did not recover valuable product from the filtering process. However, the electric utilities had plenty of reasons apart from regulation for its actions.

Throughout the period in question, the electrical utility industry strove to produce ever greater amounts of electricity utilizing ever more efficient processes.[428] One way in which the industry increased the scale of electrical production was through the use of larger, high-efficiency boilers. By grinding coal into fine powder and then injecting the material into a boiler, the industry was able to produce

419 *See id.* at 3-11 tbl.3-3 (reporting volatile organic compound emissions of 20,936,000 tons in 1950 and 30,982,000 tons in 1970). The rate of increase between 1960 and 1970 was 27%. *See id.* (reporting volatile organic compound emissions of 24,459,000 tons in 1960 and 30,982,000 tons in 1970).

420 *See* EPA, AIR POLLUTANT EMISSION TRENDS, *supra* note 357, at 3-9 tbl.3-1 (reporting carbon monoxide emissions of 102,609,000 tons in 1950 and 129,444,000 tons in 1970). The rate of increase between 1960 and 1970 was 18%. *See id.* (reporting carbon monoxide emissions of 109,745,000 tons in 1960 and 129,444,000 tons in 1970).

421 *See supra* Part IV.A and text accompanying note 369.

422 *See supra* Parts II.A.1, IV.A.

423 *See supra* Parts II.A.1, IV.B.

424 *See supra* Part II.A.2.

425 *See supra* Part II.A.2 and text accompanying note 162.

426 By 1966, however, only 21 communities were regulating some form of solid particulate matter emissions from sources other than coal combustion. Stern, *supra* note 108, at 47.

427 *See supra* Parts IV.A–B. In 1962, the electrical power industry operated more electrostatic precipitators than any other industry in the United States. In fact, it operated more than a quarter of all precipitators in operation in the country at the time. *See* WHITE, *supra* note 157, at 25 tbl.1.1 (showing that 880 of a total of 3,360 electrostatic precipitators in the United States were being used in by the electric power industry).

428 *See* RICHARD F. HIRSH, TECHNOLOGY AND TRANSFORMATION IN THE AMERICAN ELECTRIC UTILITY INDUSTRY 15–21, 37–46, 56–70 (1989) (discussing the technological advancements resulting from economic pressures that led to greater efficiency in the electricity industry through the 1960s).

higher temperatures and greater steam pressure.[429] The process also burned coal more efficiently, permitted the use of inferior grades of coal (those containing, for instance, more noncombustible ash),[430] and reduced smoke emissions.[431] Unfortunately, the process also had major drawbacks.

The higher temperatures fused the residual ash found in the coal into abrasive particles[432] that, given the high velocity and heat in the boilers, eroded the refractory brick lining the boilers.[433] The ash, moreover, rather than settling to the bottom of the boiler, was propelled by the turbulence and heat inside the boiler up through the chimney and out into the environment.[434] The damage to the refractory brick was largely solved by lining the boiler walls with water-carrying steel tubes, part of the steam generation system.[435] The problem with fly ash being expelled through the chimney, however, remained.

The fly ash problem was substantial. Vast quantities were produced, as 10% or more of the coal that is burned in a utility's boiler may well be emitted as fly ash,[436] and the industry's appetite for coal was rapidly growing—from nearly 92 million tons in 1950 to over 300 million tons in 1970.[437] Meanwhile, generating stations were growing ever larger and more centralized,[438] concentrating and magnifying the production of fly ash. When large high-efficiency power stations were built without any meaningful way of extracting fly ash, the result was public outrage.[439] People in surrounding communities complained about Pompeii-like conditions, and school children had to don hats at recess to get some protection from the falling ash.[440] Therefore, the industry quickly learned, or otherwise understood, that something had to be done to mitigate what would otherwise be a "fly-ash plague" around their major new steam-fired plants.[441] In 1923, four years after the first high-efficiency power plant was built in the United States, the first

429 *Id.* at 45. The first use of pulverized coal to fire a utility boiler in the United States came in 1919. *See* WHITE, *supra* note 157, at 21 (discussing the use of pulverized coal as a means to increase power generation capacity).

430 ERICH RAASK, MINERAL IMPURITIES IN COAL COMBUSTION: BEHAVIOR, PROBLEMS, AND REMEDIAL MEASURES 6 (1985); UEKOETTER, *supra* note 101, at 95; Coffin, *supra* note 110, at 618, 622, 624 (discussing the successful use of pulverized coal containing up to 26% ash).

431 Stern, *supra* note 108, at 46; Coffin, *supra* note 110, at 624.

432 The abrasive nature of the ash results from the fusion of mineral impurities found in coal. See RAASK, *supra* note 430, at 44.

433 HIRSH, *supra* note 428, at 45.

434 UEKOETTER, *supra* note 101, at 95.

435 HIRSH, *supra* note 428, at 45.

436 WHITE, *supra* note 157, at 21.

437 DOE, 2010 ANNUAL ENERGY REVIEW, *supra* note 363.

438 *See* JACK CASAZZA & FRANK DELEA, UNDERSTANDING ELECTRIC POWER SYSTEMS: AN OVERVIEW OF TECHNOLOGY, THE MARKETPLACE, AND GOVERNMENT REGULATION 8 (2d ed. 2010) (referring to load growth and subsequent cost reductions that characterized the "golden age" of electric utilities, a period from 1945 to 1965); HIRSH, *supra* note 428, at 20–21, 36–46, 56–58, 60 (describing the shift towards larger, more interconnected power plants).

439 UEKOETTER, *supra* note 101, at 96 (referring to two large German power plants that went into operation during the 1920s and the resulting backlash from the surrounding communities).

440 *Id.* at 95–96.

441 *See Id.* at 96 (recounting how two power plants in Sodingen and Berlin, Germany recognized the need to curb fly-ash emissions or face "bureaucratic intervention").

full-scale electrostatic precipitator was installed in an American power plant.[442] The industry, however, tended to favor the use of cheaper, less-efficient mechanical fly ash collectors for their coal-fired plants located in rural locations,[443] and often chose to install small precipitators in urban locations rather than larger, more efficient units that could cost three times more.[444] By 1962, the industry had 880 electrostatic precipitators in place[445] and, most likely, an equal number or even more mechanical collectors.[446] In short, the use of some sort of fly ash collection system had become standard practice in the industry since nuisance-like conditions could be averted with relatively "little effort and expense."[447] It would be difficult to credit local control authorities for much of this development since only five local agencies had regulations in place in 1956 governing solid particulate emissions from coal combustion.[448] Even by 1966, only one-third of the communities that suffered from moderate to severe air pollution problems had regulations on the books—implemented or not—dealing with fly ash emissions.[449]

While a number of local and, perhaps, state programs can take some credit for reducing particulate emissions (primarily smoke) during the post-war period, one must be careful not to exaggerate the amount of credit that is due. It appears, in fact, that most of the cleanup should be attributed to a variety of nonregulatory factors ranging from fuel switching to the recovery of valuable products, from labor saving devices to larger, more efficient combustion processes, and to industry's desire to burnish its image while avoiding nuisance actions and tough regulation.[450] With regard to other air pollutants, including sulfur dioxide, most of these programs are due little or no credit. These problems were simply growing worse amid little regulation.[451] Despite large-scale federal assistance during the 1960s and the

442 WHITE, *supra* note 157, at 21.

443 *Id.* A multicyclone collector, for example, would collect approximately 70% of the fly ash from the stack gases. WAYNE T. SPROULL, AIR POLLUTION AND ITS CONTROL 62 (2d ed. 1972). These mechanical systems were significantly less expensive than electrostatic precipitators. UEKOETTER, *supra* note 101, at 99.

444 SPROULL, *supra* note 443, at 62–63. A precipitator designed to collect 90% of the fly ash had a size and cost that were considered tolerable by most utility companies. *Id.* Units designed to recover 99% of the fly ash would, by contrast, cost twice as much, while a unit recovering 99.9% would cost three times more. *Id.* Many units, however, failed to achieve these levels of efficiency due to lack of maintenance or changes in fuel or operating conditions. Gartrell, *supra* note 365, at 502–03.

445 WHITE, *supra* note 157, at 25.

446 According to one survey of systems installed between 1958 and 1962, 62% were mechanical collectors as opposed to electrostatic precipitators. *See* John. R. O'Connor & Joseph F. Citarella, *An Air Pollution Control Cost Study of the Steam-Electric Power Generating Industry*, 20 J. AIR POLLUTION CONTROL ASS'N 283, 285 (1970) (describing trends in the installation of mechanical collectors). For the period of 1963–1967, the numbers were reversed with electrostatic precipitators accounting for 78% of the total. *Id.*

447 UEKOETTER, *supra* note 101, at 122.

448 Stern, *supra* note 108, at 47.

449 *See id.* (referring to regulations in 65 communities: 53 cities and 12 counties); Ripley, *supra* note 145, at 226 (indicating that approximately 198 communities had moderate or severe air pollution problems in the early 1960s).

450 *See supra* Part II.A.1.

451 As Arthur Stern declared in 1966, "The problem of air pollution continues to grow faster than the combined Federal, State, and local efforts to deal with it." UEKOETTER, *supra* note 101, at 219. Dr. Stern was a pioneer in the air pollution control movement. With support from the Works Progress Administration, he studied smoke pollution in New York City during the 1930s. Later, he worked on air

existence of some exemplary programs, the necessary regulatory infrastructure was often nonexistent or nearly so at the state and local level.

The three studies that Revesz and Adler relied upon were, therefore, incorrect in their conclusions. There was no broad improvement in sulfur dioxide pollution before 1970, and most of the improvement that occurred with regard to particulate emissions had little to do with state or local regulation. Revesz and Adler were thus mistaken in asserting, based on these three studies, that state and local regulatory efforts were responsible for significant improvements prior to the advent of federal regulation.[452] The historical record, in fact, indicates that state and local regulation prior to 1970 was not equal to the task at hand. A new approach was desperately needed.

V. AIR QUALITY AND EMISSIONS TRENDS SINCE THE PASSAGE OF THE CLEAN AIR ACT IN 1970

Compared to the nominal gains that regulation produced prior to 1970, the progress made since the Clean Air Act was enacted in 1970 has been absolutely phenomenal. Particulate matter (PM_{10}) emissions, for example, fell from 12,184,000 tons in 1970 to 2,053,000 tons in 2011, a drop of 83%.[453] During the same period, sulfur dioxide emissions declined from 31,218,000 tons to 7,999,000 tons, a 74% reduction.[454] What makes these decreases even more remarkable is the fact that coal combustion in the United States doubled between 1970 and 2010, from 523,200,000 tons to over 1 billion tons.[455] Ambient air quality data reflect these improvements.[456] Sulfur dioxide concentrations, for instance, improved 54%

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pollution control issues for the New York state government and joined the U.S. Public Health Service's air pollution program in the early 1950s. In 1968, he accepted an appointment as Professor of Air Hygiene at the University of North Carolina. MERRIL EISENBUD, NATIONAL ACADEMY OF ENGINEERING OF THE UNITED STATES OF AMERICA: 6 MEMORIAL TRIBUTES 221 (1993).

452 Revesz, *Federalism and Environmental Regulation*, *supra* note 35, at 579; Adler, *Judicial Federalism*, *supra* note 35, at 465.

453 *See* U.S. ENVTL. PROT. AGENCY, NATIONAL EMISSIONS INVENTORY AIR POLLUTANT EMISSIONS TRENDS DATA, PM10Primary tab (2011) [hereinafter EPA, NATIONAL AIR POLLUTANT EMISSIONS INVENTORY], *available at* http://www.epa.gov/ttn/chief/trends/index.html (click on "1970-2012 Average annual emissions, all criteria pollutant in MS Excel") Emissions for the miscellaneous category, which only included forest fires in 1970, were excluded since EPA added other sources such as dust from unpaved roads and agriculture in 1985. *Id.*; EPA, AIR POLLUTANT EMISSION TRENDS, *supra* note 357, at 3-13 tbl.3-5.

454 *See* EPA, NATIONAL AIR POLLUTANT EMISSIONS INVENTORY, *supra* note 453, at SO2 tab (excluding emissions from forest fires).

455 DOE, 2010 ANNUAL ENERGY REVIEW, *supra* note 363. However, data from the residential and commercial, industrial, transportation, and electric power sectors, shows that consumption of fuel oil fell 8% during that period, from a combined 4,744,000 barrels per day to 4,334,000 barrels per day. *See id.* at 160 tbl.5.13a (reporting a drop in residential distillate, commercial distillate, and commercial residual fuel oil consumption from a combined 1,470,000 barrels per day in 1970 to 535,000 barrels per day in 2010); *id.* at 161 tbl.5.13b (reporting a decline in the industrial sector from 1,285,000 barrels per day of distillate and residual fuel oil in 1970 to 586,000 in 2010); *id.* at 162 tbl.5.13c (reporting an increase in the transportation sector from 1,070,000 barrels per day of distillate and residual fuel oil in 1970 to 3,108,000 in 2010), 163 tbl.5.13d (reporting a drop in the electric power sector from 919,000 barrels per day of distillate and residual fuel oil in 1970 to 105,000 in 2010).

456 The number of air quality monitors grew tremendously after 1970. By 1980, for example, there were 522 carbon monoxide monitors, 1,113 sulfur dioxide monitors, 224 nitrogen oxide monitors, 3,595

between 1983 and 2002, a period during which emissions fell 33%, while PM_{10} concentrations improved 13% between 1993 and 2002, a period during which emissions declined 22%.[457]

The record with regard to other air pollutants has been impressive as well. Emissions of carbon monoxide, a pollutant that is primarily generated by motor vehicles,[458] fell 74% between 1970 and 2011, from 197,277,000 tons per year to 51,986,000 tons per year.[459] And the ambient air quality data appears to validate the general magnitude of that reduction, showing 65% improvement between 1983 and 2002.[460] Emissions of the two precursors of ground-level ozone pollution—nitrogen oxides and volatile organic compounds[461]—also evince progress. Emissions of nitrogen oxides dropped 55% between 1970 and 2011,[462] while air quality concentrations improved 21% between 1983 and 2002.[463] Meanwhile emissions of volatile organic compounds fell 65% between 1970 and 2011,[464] which appears to be confirmed by a 65% improvement in air quality concentrations between 1983 and 2002.[465] Ground-level ozone, however, remains a problem. Although air quality concentrations fell 18% between 1983 and 1993, they rose by 4% between 1993 and 2002.[466] Since 2001, the trend has once again been downward, declining 10% between 2001 and 2008,[467] with the majority of the

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monitors for total suspended particulate matter, and 791 ozone monitors. U.S. ENVTL. PROT. AGENCY, THE BENEFITS AND COSTS OF THE CLEAN AIR ACT, 1970 TO 1990, at C-2 tbl. C-1, C-5 tbl.C-3, C-7 tbl.C-5, C-14 tbl.C-6, C-21 tbl.C-13 (1997) [hereinafter EPA, BENEFITS AND COSTS OF THE CLEAN AIR ACT, 1970–1990]. Currently, there are approximately 4,000 air monitoring stations in the State and Local Air Monitoring Network (SLAMS), a subset of approximately 1,080 of which are part of the National Air Monitoring Network (NAMS). These two networks date from 1979. *See* 40 C.F.R. §§ 58.2(c), 58.20(a), 58.30(a) (1979); NAT'L RES. COUNCIL, AIR QUALITY MANAGEMENT IN THE UNITED STATES 221 (2004). Also in 1979, EPA significantly improved the methodology governing the monitoring process. *See* 44 Fed. Reg. 27,571 (May 10, 1979) (to be codified at 40 C.F.R. §§ 58.10–58.14, 58.22, 58.33, pt. 58 app. c).

457 U.S. ENVTL. PROT. AGENCY, LATEST FINDINGS ON NATIONAL AIR QUALITY: 2002 STATUS AND TRENDS 3 (2003) [hereinafter EPA, NATIONAL AIR QUALITY 2002 REPORT]. The later starting date for the PM_{10} data reflects the fact that a shift from total suspended particulate matter monitors to PM_{10} monitors began in the mid-1980s. EPA, BENEFITS AND COSTS OF THE CLEAN AIR ACT, 1970–1990, *supra* note 456, at C-13.

458 Oren, *supra* note 5, at 1235.

459 *See* EPA, NATIONAL AIR POLLUTANT EMISSIONS INVENTORY, *supra* note 453, at CO National tab (excluding emissions from forest fires).

460 EPA, NATIONAL AIR QUALITY 2002 REPORT, *supra* note 457.

461 *See* AIR QUALITY MANAGEMENT IN THE UNITED STATES, *supra* note 456, at 26 (noting that ground-level ozone is formed by the reaction of either volatile organic compounds or nitrogen oxides, or both, in the presence of sunlight).

462 *See* EPA, NATIONAL AIR POLLUTANT EMISSIONS INVENTORY, *supra* note 453, at NOX National tab (reporting a reduction from 26,883,000 tons in 1970 to 12,009,000 tons in 2011).

463 EPA, NATIONAL AIR QUALITY 2002 REPORT, *supra* note 457.

464 *See* EPA, NATIONAL AIR POLLUTANT EMISSIONS INVENTORY, *supra* note 453, at VOC tab (reporting a reduction from 34,659,000 tons in 1970 to 12,129,000 tons in 2011).

465 EPA, NATIONAL AIR QUALITY 2002 REPORT, *supra* note 457.

466 *See id.* (reporting on eight-hour ozone concentrations).

467 U.S. ENVTL. PROT. AGENCY, OUR NATION'S AIR: STATUS AND TRENDS THROUGH 2008 15 (2010) [hereinafter EPA, NATIONAL AIR QUALITY 2008 REPORT] (reporting on eight-hour ozone concentrations).

improvement occurring in the eastern portion of the country[468]—a region which had just undergone a significant tightening of limitations governing nitrogen oxides.[469]

Even emissions of pollutants which have only been regulated for a short period of time have shown remarkable improvement. Emissions of hazardous air pollutants, most of which were only regulated under a program enacted in 1990, fell by about 40% between 1990 and 2005.[470] Emissions of lead, perhaps the most ubiquitous of these hazardous pollutants, have declined in an especially dramatic fashion. Between 1983 and 2002 emissions of lead, a toxic heavy metal that has been regulated for a longer period than most other hazardous air pollutants, fell 93%, while air quality concentrations improved by 94%.[471]

The analysis of air pollution trends is not a perfect science. Although EPA has refined its methodology for determining air emissions[472] and makes use of some directly measured emissions,[473] the dependence on estimates for most of the calculation still injects a degree of uncertainty into EPA's analyses.[474] In addition, despite the fact that an extensive air quality monitoring network has existed since the 1980s, that network was primarily designed to monitor urban pollution levels and thus does not provide broadly representative data.[475] Furthermore, meteorological conditions can produce a good deal of variability in concentrations, a fact that can be mitigated but not entirely eliminated by the use of various statistical methods like regression-based modeling.[476] Nevertheless, air quality data can be used to verify emissions trends,[477] and that data would certainly appear to confirm, qualitatively if not quantitatively, that air pollution emissions have declined substantially since the Clean Air Act was enacted in 1970.[478] And while a number of nonregulatory factors may have been responsible for reducing some emissions,[479] it is absolutely clear that the Clean Air Act was responsible for the lion's share of the progress that has been made over the past forty years.[480]

468 *Id.* at 17.

469 In 1998, EPA promulgated a rule (commonly referred to as the NO_X SIP Call Rule) that required 22 states in the eastern United States to revise their State Implementation Plans in order to reduce nitrogen oxide emissions from electric power plants and other large stationary sources by an overall 28% of 1996 levels by 2007. *See* 63 Fed. Reg. 57,356, 57,365, 57,378, 57,407, 57,433–34, 57,438–39 (Oct. 27, 1998) (to be codified at 40 C.F.R. §§ 51, 72, 96).

470 EPA, NATIONAL AIR QUALITY 2008 REPORT, *supra* note 467, at 1–2.

471 EPA, NATIONAL AIR QUALITY 2002 REPORT, *supra* note 457, at 17.

472 *See supra* Part IV.A.

473 *See* EPA, AIR POLLUTANT EMISSION TRENDS, *supra* note 357, at 1-3 (referring to the use of continuous emission monitoring (CEM) data reported by sources, such as electric utilities, that are regulated under the acid rain provisions of the Clean Air Act).

474 AIR QUALITY MANAGEMENT IN THE UNITED STATES, *supra* note 456, at 218. *But see id.* at 217 (stating that CEM has produced "direct evidence of substantial reductions in SO_2 emissions from utilities since the implementation of the acid rain controls").

475 *Id.* at 219.

476 *Id.* at 237.

477 *See id.* at 219.

478 *See id.* ("[I]t would appear that air quality monitoring data provide qualitative but not quantitative confirmation that pollutant emission trends are downward (especially in urban areas) in the United States.").

479 The decline of the American steel industry over the past 50 years is one example that comes readily to mind. *See* PAUL A. TIFFANY, THE DECLINE OF AMERICAN STEEL: HOW MANAGEMENT, LABOR, AND GOVERNMENT WENT WRONG 3 (1988). The reduction in air pollution from the steel

VI. CONCLUSION

Air pollution was not broadly declining before the Clean Air Act of 1970 was enacted. In fact, just the opposite was true. Sulfur dioxide emissions were rapidly rising, as were a number of other emissions including carbon monoxide[481] and the two precursors of ozone pollution: nitrogen oxides[482] and volatile organic compounds.[483] Only one pollutant parameter, particulate matter, was falling to some extent, but most of that decline can be attributed to fuel switching and a number of other factors other than state and local regulation.[484] Nevertheless, the nation does owe a debt of gratitude to the pioneers of air pollution control who worked to abate smoky conditions in many American cities, and to those scientists, engineers, and officials in California and elsewhere who at a later time turned their attention to more complex problems such as ozone pollution. While their contributions were significant, the overall effort at the state and local level proved too fragmented and much too meager. Rather than proving that the race-to-the-bottom is intrinsically flawed, the record of air pollution regulation in the United States prior to 1970 demonstrates that a greater level of federal involvement was absolutely necessary. Fortunately, Congress acted in 1970 to chart a wholly new approach, an approach which, despite some difficulties, has proven remarkably successful.

industry's decline, however, was likely more than offset by other trends. For example, the gross national product and the total number of miles driven more than doubled during this period, and energy consumption increased by a factor of 1.5. *See* AIR QUALITY MANAGEMENT IN THE UNITED STATES, *supra* note 456, at 37.

480 *See, e.g.*, EPA, BENEFITS AND COSTS OF THE CLEAN AIR ACT, 1970–1990, *supra* note 456, at 15–16 fig.2, fig.3, fig.5, fig.6 (concluding that, in the absence of the Clean Air Act, emissions of carbon monoxide, sulfur dioxide, nitrogen oxides, and particulate matter in 1990 would have been larger by factors of approximately 2, 1.6, 1.4, and 3 respectively).

481 Carbon monoxide emissions rose from 102,609,000 tons in 1950 to 129,444,000 tons in 1970. EPA, AIR POLLUTANT EMISSION TRENDS, *supra* note 357, at 3-9 tbl.3-1.

482 Emissions of nitrogen oxide increased from 10,093,000 tons in 1950 to 20,928,000 tons in 1970. *Id.* at 3-10 tbl.3-2.

483 Emissions of volatile organic compounds jumped from 20,936,000 tons in 1950 to 30,982,000 tons in 1970. *Id.* at 3-11 tbl.3-3.

484 *See supra* Part IV.A.