The Unfocused Regulation of Toxic and Hazardous Pollutants

John C. Dernbach
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I. INTRODUCTION

Environmental regulation of manufacturing is at a turning point. The legal structure that has been in place for the past quarter of a century, with its permitting, enforcement, standard setting, and other regulatory apparatus, has unquestionably improved human health and the environment.¹ Many say that the system is costly and inefficient, however, and urge that much or all of it be replaced or abandoned.² Others look at the remaining and often ill-distributed costs of pollution itself and argue for strengthening regulation.³ The partisans for each side usually see a win for one as a loss for the other.⁴

¹ See infra note 15.
³ See infra notes 270–271 and accompanying text.
The debate about how to regulate, however, has all but ignored the most fundamental question of all—what to regulate. The choice of which pollutants to regulate profoundly affects the environment, human health, and the economy. Manufacturing facilities emit thousands of different pollutants. Decision makers have not aimed to control all of these pollutants, perceiving such a goal as too expensive and technically complex. Instead, the major environmental and occupational health programs each regulate a list of toxic or hazardous pollutants. However, the lists of the various programs differ extraordinarily from one another. As a result, factories emit partially or wholly unregulated pollutants, creating potentially significant risks to human health and the environment and bolstering the argument for greater regulation. Yet the differences among the lists are also a major underlying reason for costliness and inefficiency in the current regulatory structure.

This Article explains how the lack of focus in the lists used by various regulatory statutes weakens the nation’s efforts to reduce toxic and hazardous pollutants. The Article also proposes steps to focus these laws. Resolving the issue of what to regulate provides an enormous opportunity to protect human health and the environment while simultaneously fostering economic development—in other words, an opportunity for both sides to win.

All other aspects of environmental and occupational health protection programs depend on the decision about what to control. If a pollutant is regulated, it is “inside” the general regulatory program, and facilities, government agencies, consultants, and the public give it serious attention. If a pollutant is unregulated altogether or is unregulated under a particular statute, it is “outside” the system and most often is ignored.

the past several years, however, EPA has initiated a number of voluntary programs to reconcile economic and environmental interests. See infra text accompanying notes 356–357 (voluntary pollutant reduction program); see also Daniel J. Fiorino, Toward a New System of Environmental Regulation: The Case for an Industry Sector Approach, 26 ENVTL. L. 457, 470–77 (1996) (other programs).

5. More than 50,000 chemical substances are in commerce in the United States. See STEERING COMM. ON IDENTIFICATION OF TOXIC AND POTENTIALLY TOXIC CHEMICALS FOR CONSIDERATION BY THE NAT’L TOXICOLOGY PROGRAM, NATIONAL RESEARCH COUNCIL, TOXICITY TESTING: STRATEGIES TO DETERMINE NEEDS AND PRIORITIES 125 (1984). “[T]housands or even tens of thousands of chemicals are legitimate candidates for toxicity testing related to a variety of health effects.” Id. at 14. Approximately 14,000 of these chemicals are produced in quantities of more than 10,000 pounds per year. See Environmental Protection Agency, Master Testing List—1992, at 12 (1992).
The decision of which chemicals to manage provides a foundation for five federal statutes that regulate routine releases of toxic and hazardous pollutants from and within industrial facilities. Three statutes directly limit releases of such pollutants into various media of the environment. The Clean Water Act\(^6\) controls discharges of toxic and nonconventional pollutants into surface waters; the Resource Conservation and Recovery Act ("RCRA")\(^7\) controls the transportation, storage, and disposal on land of hazardous wastes; and the Clean Air Act\(^8\) controls the release of hazardous air pollutants into the ambient or outdoor air. A fourth statute, the Occupational Safety and Health Act ("OSH Act"),\(^9\) limits the concentration of toxic substances in the air inside the workplace. Finally, the Emergency Planning and Community Right-to-Know Act ("EPCRA")\(^10\) requires manufacturers to report publicly their releases of toxic chemicals to water, land, outdoor air, and other media and to report their off-site transfers of these chemicals. Although EPCRA does not impose restrictions on the type or concentration of pollutants that may be released, the public reporting of these releases has led to their reduction.\(^11\)

Other statutes also cover on-going manufacturing operations,\(^12\) but these five are the most fundamental as they are the only statutes

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11. By requiring public reporting, EPCRA indirectly limits the routine release of pollutants. See infra note 15; see also Ethan Shenkman, Right to Know More, ENVTL. F., July-Aug. 1990, at 20, 23.
12. The first four statutes are regulatory in the classic sense in that they include standard setting, whereas EPCRA requires disclosure, an alternative form of regulation. See STEPHEN BREYER, REGULATION AND ITS REFORM 161-64 (1982).

The Toxic Substances Control Act ("TSCA"), 15 U.S.C. §§ 2601-2692 (1994), prohibits any person from manufacturing a new chemical substance or manufacturing or processing any chemical substance for a significant new use without first providing certain data about the substance to EPA. See 15 U.S.C. § 2604(a)-(b). This requirement has prevented the introduction of many new chemicals and subjected the new use of many existing chemicals to specific restrictions. See 40 C.F.R. pt. 721 (1996) (significant new use restrictions); see also Ernie Rosenberg & John Wheeler, Unreasonably at Risk, ENVTL. F., July-Aug. 1993, at 18, 21. TSCA also authorizes EPA, on a substance-by-substance basis, to regulate generally chemical substances that are already in commerce. See 15
that directly limit, or require disclosure of, the release of pollutants during the ordinary course of operations.\textsuperscript{13}

Each of these statutes centers on a list that specifies which pollutants are subject to regulation. Regulation by list means that a particular regulatory program applies to multiple toxic and hazardous pollutants. Such a system hastens implementation of a statutory program because Congress or the agency identifies target pollutants in a single action. A list is more efficient for the government and less disruptive and costly for business than developing an individualized regulatory program for each chemical.\textsuperscript{14} To a degree, the list approach has worked. Among other achievements, the laws have caused a major decline in improper hazardous waste management and a considerable reduction in releases to surface water of toxic and nonconventional water pollutants.\textsuperscript{15}


This Article does not address accidental or emergency releases of pollutants because they are a separate issue. In any event, the problems associated with different emergency-release lists are likely to be similar to those associated with the routine release lists.


But there is a hidden problem with regulation by list. The strategy leaves gaps in what is regulated. The list names used by the various statutes—toxic chemicals, toxic materials, toxic and nonconventional water pollutants, hazardous waste, and hazardous air pollutants—sound comparable and nonspecialists use them interchangeably. Although lawyers recognize that the terms have different legal meanings, they tend to see formulation and use of the lists as best left to toxicologists, chemists, and engineers. The contents of each list, however, dramatically vary from that of the others.

Part II of the Article provides a comparative analysis of the five lists, highlighting the extent of the inconsistencies in their coverage. Differences in coverage cause gaps in regulation. Some gaps are medium-specific, with a pollutant regulated in some but not all of the environmental media in which it is dangerous. Other gaps are more profound, with dangerous pollutants escaping regulation altogether. On the other hand, some regulatory mechanisms work to reduce gaps in coverage. For example, the Clean Air Act and the Clean Water Act regulate a number of ordinary pollutants and sometimes can indirectly control toxic or hazardous air and water pollutants as a result. But, as Part II also explains, the five
statutory programs also increase regulatory gaps in numerous other ways.

Part III analyzes the development of all five lists to show that policy grounds fail to explain or justify the inconsistencies in coverage. To some extent, differences in chemical effects do account for certain discrepancies. It is possible for some pollutants to be toxic when inhaled, for example, but not when ingested through drinking water, so that it may be rational to regulate them when released in the air but not in the water. Most differences among lists, however, do not reflect a coherent response to these differing pollutant effects. Rather, discrepancies stem from the fact that different experts developed the lists independently over two decades and based the lists on different criteria. Thus, some of the lists demonstrate a great degree of ecological consideration and some ignore ecology; specific effects on human health receive more attention in certain lists than in others. Furthermore, decisions about the contents of the pollutant lists were often based on factors that have nothing to do with the effects of the pollutant. Many pollutants that are toxic to humans and the environment were excluded from the lists in order to contain management and compliance costs to government and industry. Finally, changing the lists requires a chemical-by-chemical justification, and each statute contains a different set of criteria for modification. These cumbersome requirements impede efforts to make the lists more coherent or inclusive.

As Part IV demonstrates, inconsistencies in the lists limit the practical effectiveness of environmental protection and occupational health laws. Regulatory gaps encourage the transfer of pollutants that are regulated in a particular medium into other, unregulated media. In addition, inconsistent listing prevents government officials, the public, and most facility managers from gaining an overall understanding of the types and amounts of pollutants being released from and within individual facilities.

Part V outlines a legislative proposal to address the problem. Under the proposal, Congress would adopt from the EPCRA list a subset of pollutants that are known to have substantial environmental and human health effects when they are present in any of several media. Facilities would be obliged to reduce deeply their generation of these pollutants and their release into all media. The facilities would have considerable flexibility in doing so as long as
they did not exceed legal limits for the release of pollutants into any particular medium. By setting goals, providing flexibility about the means, and using incentives, this approach should better protect human health and the environment at less cost than the medium-specific controls now existing under these statutes. The information and experience gained from the implementation of this program would then be used for similar prevention programs involving more pollutants. In addition, Congress would expand EPCRA reporting to include all toxic or potentially toxic pollutants released from or within a facility. As a result, industry, government, and citizens would have an overall understanding of what is released from a facility. Finally, Congress would encourage and support efforts to reduce all pollutants released from facilities, aiming to use pollution prevention to reduce releases of all pollutants to as close to zero as possible. By focusing directly on pollutants and pollutant reductions, and by requiring more complete information about pollutants, Congress could, at a greatly reduced cost, protect human health and the environment.

II. CRAZY QUILT COVERAGE OF POLLUTANTS

The sheer scale of differences in coverage is evident from an analysis of the statutory programs and the lists of toxic or hazardous pollutants on which they are based.

A. Statutory Programs

1. Clean Water Act

The Clean Water Act\(^\text{18}\) defines pollutants as virtually anything that humans discharge into water\(^\text{19}\) and establishes a regulatory program for three types of pollutants. Conventional pollutants have been regulated for the longest time and include contaminants that


\(^{19}\) The Act defines "pollutant" as "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water." 33 U.S.C. § 1362(6) (1994).
absorb oxygen from water. Toxics are those that, alone or in combination with other substances, will cause death, disease, behavioral abnormalities, genetic mutations or similar problems in organisms or their offspring. Nonconventional pollutants are those that do not fit into the other two categories.

In the years immediately following the Act's adoption in 1972, EPA and the states concentrated on conventional pollutants. Although EPA had the statutory authority to regulate toxics on a pollutant-by-pollutant basis, it was unable to exercise that authority effectively. The Agency had to demonstrate that a pollutant was toxic enough to deserve regulation, but it usually lacked sufficient toxicological data to make that demonstration. It also sought to avoid the disruptive effects to industry of a "pollutant-of-the-month" approach.

Finally, in 1976, EPA settled several lawsuits filed by the Natural Resources Defense Council, Environmental Defense Fund, and others by agreeing to regulate a list of toxic or priority pollutants. Congress ratified the toxic pollutants list contained in the consent decree when it reauthorized the Act in 1977, and the list now contains 126 pollutants. EPA developed a list of 22 nonconventional pollutants at approximately the same time.

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20. See 33 U.S.C. § 1314(a)(4) (1994). These pollutants, which can suffocate fish and other organisms, include suspended solids, fecal coliform, oil and grease, high or low pH, and substances that demand biological oxygen. See 40 C.F.R. § 401.16 (1996).
22. See Rybachek v. Environmental Protection Agency, 904 F.2d 1276 (9th Cir. 1990).
24. See Ridgway M. Hall, supra note 23, at 516.
The Clean Water Act regulates the three types of pollutants, and occasionally other individual pollutants, through two principal mechanisms: water quality standards and effluent limitations. Water quality standards are based on designated uses for particular water bodies (e.g., fishing, swimming) and contain criteria based on the concentration of specific conventional, nonconventional, and toxic pollutants that will impair the uses of particular waters. Effluent limitations restrict the quantity or concentration of specific pollutants that an individual source can discharge into a particular body of water.

Although EPA has the authority to adopt effluent limitations for other individual pollutants, the overwhelming majority of promulgated effluent limitations are for conventional, nonconventional, or toxic pollutants. In fact, when EPA adopted effluent limitations for the organic chemicals industry, it limited itself to toxic and nonconventional pollutants, notwithstanding the presence of hundreds of other organic chemicals in the industry's wastewater.

The 148 toxic and nonconventional pollutants are subject to more stringent regulation than the conventional pollutants. Effluent limitations for all of the toxic pollutants and all but four of the nonconventional pollutants are based on the best available technology that is economically achievable for each class of regulated industries. Effluent limitations for conventional pollutants, by contrast, are based on the less exacting requirement of best practicable


31. See 40 C.F.R. pts. 405-471 (1995). Most exceptions occur because of the use of particular substances in the specific industry for which effluent limitations were promulgated. See, e.g., 40 C.F.R. § 421.252 (1996) (use of gold in nonferrous metals manufacturing industry); § 440.32 (use of uranium in ore mining and dressing); § 455.22 (use of organic pesticide chemicals in pesticide chemical industry).


control technology currently available for each class of regulated industries.\(^\text{34}\)

2. *Resource Conservation and Recovery Act*

RCRA\(^\text{35}\) addresses solid waste, which it defines as “any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material.”\(^\text{36}\) The Act recognizes three kinds of solid waste: hazardous, municipal, and industrial. Hazardous waste is solid waste that may cause or significantly contribute to an increase in mortality or serious illness, or may pose a substantial threat to human health or the environment.\(^\text{37}\) Most of RCRA’s regulatory apparatus governs the treatment, storage, and disposal of hazardous waste.\(^\text{38}\) Municipal waste is ordinary household and commercial trash and is subject to more limited EPA regulation.\(^\text{39}\) Industrial waste is not legally hazardous, although it may present significant risks. More than 96% of all waste generated by industry fits into the industrial waste category\(^\text{40}\), but EPA has not adopted regulations for it.\(^\text{41}\)


\(^{36}\) 42 U.S.C. § 6903(27). The term includes “solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining and agricultural operations, and from community activities,” id., but excludes material in domestic sewage and several other types of materials.

Materials are “discarded” if they have been abandoned, were recycled at another location, or are “inherently waste-like.” 40 C.F.R. § 261.2(a)(2) (1995); see also American Mining Congress v. Environmental Protection Agency, 824 F.2d 1177, 1193 (D.C. Cir. 1987) (noting that “discarded” refers to materials that are “disposed of, abandoned, or thrown away”); American Mining Congress v. Environmental Protection Agency, 907 F.2d 1179 (D.C. Cir. 1990) (holding that wastes managed in land disposal units that are part of wastewater treatment systems are discarded within the meaning of the statute).


\(^{41}\) EPA is convening a series of focus group meetings to develop voluntary
A solid waste is legally hazardous if it is listed as such or if it has one or more specific characteristics. There are four lists of hazardous wastes. Under two of the lists, specified pollutants are hazardous waste if they are (1) commercial chemical products, off-specification commercial chemical products, or manufacturing chemical intermediates of such products, and (2) discarded, intended to be discarded, or disposed of in other ways. The other two lists are not pollutant-specific; they are based on pollutant mixtures or combinations from particular types of sources. Wastes are also hazardous under RCRA if they meet technical tests or descriptive standards for at least one of four characteristics—ignitability, corrosivity, toxicity, and reactivity.

Because wastes can be hazardous in different ways, and because some of these ways do not lend themselves to pollutant-specific identification, it is difficult to delineate the RCRA pollutants authoritatively. However, EPA has developed a master list of 506 chemicals and chemical classes regulated under RCRA. The master list collects information from a variety of other lists used to determine whether a waste is hazardous, and was used to develop a significant regulatory proposal. It thus provides a reasonable basis for analyzing hazardous pollutants under RCRA.


43. See 40 C.F.R. § 261.30-.35.
44. See 40 C.F.R. § 261.33.
45. See 40 C.F.R. § 261.31 ("F" list—hazardous wastes from non-specific sources, such as plating bath solutions from electroplating operations (F007)); § 261.32 ("K" list—hazardous wastes from specific sources, such as untreated process wastewater from the production of toxaphene (K041)).
46. See 40 C.F.R. § 261.20-.24.
49. EPA's original hazardous waste regulations applied to any waste that was mixed with or derived from any hazardous waste, regardless of the risk that it posed. See 60 Fed. Reg. at 66,346. A court invalidated the mixture and derived-from rules because EPA did not provide proper notice during rulemaking. See Shell Oil Co. v. Environmental Protection Agency, 950 F.2d 741 (D.C. Cir. 1991).
3. Clean Air Act

The Clean Air Act, originally adopted in 1970, defines "air pollutant" broadly to include any physical, chemical, biological, or radioactive substance or matter that has entered the ambient air, including any precursor to the formation of an air pollutant. The Act regulates two kinds of air pollutants: criteria pollutants and hazardous air pollutants. Criteria pollutants are regulated based on a three-step process: (1) publication of criteria describing identifiable effects of various concentrations of that pollutant in the ambient air; (2) adoption of national standards, based on the criteria, to protect human health and welfare; and (3) adoption and implementation of state plans to ensure compliance with these standards. Only six pollutants are directly regulated under this system: sulfur dioxide, particulate matter, carbon monoxide, ozone, nitrogen dioxide, and lead.

The Act also authorizes the regulation of hazardous air pollutants. Before 1990, EPA was obliged to regulate hazardous air pollutants one at a time, by determining the level of protection needed for public health and issuing emission standards accordingly. This part of the Act was ineffective, however; only certain sources of seven pollutants were covered by national emission standards for hazardous air pollutants in 1990. Because EPA was

In response to that decision, EPA developed a regulatory proposal that would allow wastes with minimal concentrations of certain hazardous constituents to escape regulation as hazardous waste. EPA also wanted to ensure that facilities would not escape regulation by mixing together hazardous wastes to form "new," unlisted wastes. See 60 Fed. Reg. at 66,346. As a balance, EPA narrowed the master list to 376 constituents that would not cause the waste to be regulated as hazardous if they were below specified concentrations. See id. at 66,350.

52. See id. § 7408.
53. See id. § 7412.
54. See id. § 7408(a).
55. See id. § 7409(a), (b).
56. See id. § 7410(a).
58. See RODGERS, supra note 29, § 3.8(A) at 231-32. The seven pollutants are benzene, beryllium, mercury, vinyl chloride, radionuclides, asbestos, and inorganic arsenic. See 40 C.F.R. pt. 61 (1995). In Natural Resources Defense Council v. Environmental Protection Agency, 824 F.2d 1146 (D.C. Cir. 1987), the court held that, in promulgating National Emission Standards for a Hazardous Air Pollutant ("NESHAPS"), EPA must first determine an emissions level for the pollutant that represents an acceptable level of risk.
unable to establish a broader program for regulating hazardous air pollutants, Congress took it upon itself in the 1990 Clean Air Act amendments to direct the development of such a program for 189 hazardous air pollutants.\(^5^9\)

4. **Occupational Safety and Health Act**

When Congress passed the OSH Act\(^6^0\) in 1970, it authorized the Occupational Safety and Health Administration ("OSHA") to establish interim standards for air pollutants based on existing federal or national consensus standards.\(^6^1\) Consequently, OSHA adopted maximum permissible exposure limitations for approximately 425 air pollutants that occur in occupational settings.\(^6^2\)

The Act also enabled OSHA to establish new occupational safety and health standards for "toxic materials or harmful physical agents" in the workplace.\(^6^3\) OSHA has adopted such standards for 28 pollutants in addition to the air pollutants discussed above.\(^6^4\) Although the original air contaminant standards were adopted in a different manner than the 28 occupational safety and health standards, their importance to occupational health is roughly equivalent. When OSHA seeks to amend any of the air contaminant standards, it must comply with the legal rules applicable to the toxic pollutant list.\(^6^5\) Thus, it is reasonable to combine both lists to obtain a definitive list of the 453 pollutants regulated under the Act.

5. **Emergency Planning and Community Right-to-Know Act**

EPCRA\(^6^6\) requires large manufacturers of specified toxic chemicals to submit forms annually to EPA reporting the number of pounds of each toxic chemical that the manufacturer released into

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\(^6^1\) See infra notes 144-146 and accompanying text.


the air, water, or land, injected underground, or transferred off-site.\textsuperscript{67} Reports from specific facilities are public information.\textsuperscript{68} EPA then compiles these reports and publishes them as the annual Toxics Release Inventory ("TRI").\textsuperscript{69} The initial list of chemicals that must be reported contained 329 chemicals and chemical categories.\textsuperscript{70} By the end of 1995, the list contained approximately 588 toxic chemicals and 27 chemical categories.\textsuperscript{71}

**B. Differences in Pollutant Coverage**

The number of pollutants on each list, adjusted slightly to ease comparability, varies considerably:\textsuperscript{72}

<table>
<thead>
<tr>
<th>Clean Water Act</th>
<th>148</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource Conservation &amp; Recovery Act</td>
<td>502</td>
</tr>
<tr>
<td>Clean Air Act</td>
<td>189</td>
</tr>
<tr>
<td>Occupational Safety &amp; Health Act</td>
<td>450</td>
</tr>
<tr>
<td>Emergency Planning &amp; Community Right-to-Know Act</td>
<td>599</td>
</tr>
</tbody>
</table>

The longest list is almost four times the size of the shortest list. Because the lists have different lengths, inconsistencies are inevitable.\textsuperscript{73}

Inconsistencies among lists extend well beyond variations in list length, however. A total of 1134 pollutants are regulated as toxic or hazardous under at least one of the five statutes:\textsuperscript{74}

\textsuperscript{68} See 42 U.S.C. § 11023(h).
\textsuperscript{69} See, e.g., TRI Public Data Release, supra note 15.
\textsuperscript{71} See 40 C.F.R. § 372.65 (1995).
\textsuperscript{72} Four chemicals are excluded from the RCRA master list of 506 chemicals and chemical classes to make the data easier to compare for this Article. For example, chromium III and chromium VI were consolidated into a single item, chromium and compounds, a designation used for other lists. Under EPCRA, for another example, lead is listed separately from lead compounds in the regulations. The two have been consolidated here into a single listing (lead and lead compounds).
\textsuperscript{73} The differing regulatory consequences of the lists, including cost and program administration, help explain their differing lengths. See infra note 279.
\textsuperscript{74} See Toxic and Hazardous Pollutants Regulated for Routine Releases Under Five Statutes 41-42, 43-83 (1996) (unpublished numerical analysis generated by author for this article) [hereinafter Toxic and Hazardous Pollutants]. This document compiles toxic and hazardous pollutants regulated under the five programs discussed in this Article. Chemical Abstract Service numbers were used to identify chemicals and thus to avoid duplication. The data in this document were analyzed using a Microsoft Access Data Base Program.
Regulated under all five 49
Regulated under at least four\textsuperscript{75} 119
Regulated under three or more 210
Regulated under two or more\textsuperscript{76} 371
Regulated under only one\textsuperscript{77} 768

Each list excludes pollutants that are on all four of the others,\textsuperscript{78} and each list includes pollutants that are not on any of the others.\textsuperscript{79}

The magnitude of inconsistencies is evident from a comparison of the pollutants on any two of the lists. As Figure 1 indicates, common pollutants represent only 13.0\% to 29.2\% of the total pollutants in any pair of lists.\textsuperscript{80} Put another way, more than two-thirds of the total pollutants regulated under any two programs are regulated under only one of those programs.

Several of the lists include chemical categories, so they may encompass more individual chemicals than the numbers suggest. The RCRA list is somewhat longer than 502 chemicals because it includes more than two dozen chemical classes. See Background Document, supra note 47, at 17–20. The EPCRA list also contains chemical categories. See supra note 70 and accompanying text.

EPA has developed a document that contains several of these lists. See Environmental Protection Agency, Title III List of Lists (1995) (listing some or all chemicals under two of the five programs as well as all those listed under three other programs).

\textsuperscript{75} Most of the pollutants that are on four but not five lists are not on the Clean Water Act list (47 of 70). See Toxic and Hazardous Pollutants, supra note 74, at 41, 43–48.

\textsuperscript{76} See id. at 41–42, 49–68.

\textsuperscript{77} Note that this number is more than two-thirds of the 1134 total. Most of these pollutants are from the longer lists: RCRA (215), OSH Act (239), and EPCRA (290). See id. at 42, 69–83.

\textsuperscript{78} See id. at 41.

\textsuperscript{79} See id. at 42.

\textsuperscript{80} Data in Figure 1 are from Toxic and Hazardous Pollutants, supra note 74, at 84–115.
Figure 1
Percentage of Common Pollutants on Paired Lists

<table>
<thead>
<tr>
<th>Paired List</th>
<th>No. of Common Pollutants</th>
<th>Total Pollutants</th>
<th>% of Common Pollutants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean Water Act-Clean Air Act</td>
<td>68</td>
<td>269</td>
<td>25.3%</td>
</tr>
<tr>
<td>Clean Water Act-RCRA</td>
<td>121</td>
<td>529</td>
<td>22.9%</td>
</tr>
<tr>
<td>Clean Water Act-OSH Act</td>
<td>69</td>
<td>529</td>
<td>13.0%</td>
</tr>
<tr>
<td>Clean Water Act-EPCRA</td>
<td>86</td>
<td>661</td>
<td>13.0%</td>
</tr>
<tr>
<td>Clean Air Act-RCRA</td>
<td>134</td>
<td>557</td>
<td>24.1%</td>
</tr>
<tr>
<td>Clean Air Act-OSH Act</td>
<td>122</td>
<td>517</td>
<td>23.6%</td>
</tr>
<tr>
<td>Clean Air Act-EPCRA</td>
<td>178</td>
<td>610</td>
<td>29.2%</td>
</tr>
<tr>
<td>RCRA-OSH Act</td>
<td>153</td>
<td>799</td>
<td>19.1%</td>
</tr>
<tr>
<td>RCRA-EPCRA</td>
<td>229</td>
<td>872</td>
<td>26.3%</td>
</tr>
<tr>
<td>EPCRA-OSH Act</td>
<td>184</td>
<td>865</td>
<td>21.3%</td>
</tr>
</tbody>
</table>

When more than two lists are compared, the extent of the inconsistency increases substantially. Figure 2 shows the relationships among pollutants on the Clean Air Act, Clean Water Act, and RCRA lists.

Of the five programs, these three are based on the most similar regulatory goals and structures. Each contains technology-based standards, requires permits, and has considerable enforcement machinery backing it. Yet the discrepancies, even under these three programs, are considerable.\(^{81}\) Moving from three to any four of the lists, or to all five, simply magnifies the complexity of the analysis.

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81. Data in Figure 2 are from Toxic and Hazardous Pollutants, supra note 74, at 116-30. Most of the 579 total pollutants (382, or 65.3%) are regulated under only one of the three programs, and of these, most are regulated under RCRA. Only 63, or 10.9%, are regulated under all three. The rest are regulated for air and waste but not water (71, or 12.3%), water and waste but not air (58, or 10.0%), or air and water but not waste (5, or 0.9%). On the other hand, 85.1% of the Clean Water Act pollutants, 73.5% of the hazardous air pollutants, but only 38.2% of the RCRA pollutants are regulated under at least one of the other programs. See id.
C. Regulatory Effects on Pollutant Coverage

The numerical analysis in the preceding section does not reflect the phenomenon of disparate regulatory coverage in its full complexity. The basic context for regulation, after all, is the individual industrial facility. A given facility most likely does not release all of the pollutants that appear on these lists, but does release some of them. Moreover, facilities usually release some pollutants that are not regulated by any list. Furthermore, the statutory programs for implementing the five lists have features that both increase and decrease gaps in regulatory coverage.

1. Tendency to Increase Gaps

The data in the preceding section tend to understate gaps in the regulation of toxic and hazardous pollutants in several ways.

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82. See, e.g., New Jersey Department of Environmental Protection and Energy, Facility-Wide Permit, Schering Corp., Kenilworth, N.J. (1994) (listing substances, some of which are not covered by any list, that are used in each production process at facility).
Although the lists suggest that the pollutants they include are actually being regulated, in many cases, this assumption simply is not correct. The regulatory program for hazardous air pollutants, for example, is still in a relatively early stage of implementation; the pollutants on that list are not directly regulated except in limited ways. Under the Clean Water Act, a permit writer may choose to exclude effluent limitations for toxic pollutants from an industrial facility's permit if EPA has not adopted categorical effluent limitations for those pollutants and if various factors lead the writer to conclude that water quality standards will not be violated. As a result, there are more gaps in regulation than the lists suggest.

In addition, some statutes only regulate facilities that pass a certain threshold of size, number of employees, or amount of emissions or waste. Because these regulatory thresholds vary from program to program, pollutants from many facilities are regulated under some programs but are totally unregulated under others. For example, the EPCRA reporting requirement applies to facilities that have ten or more full-time employees and that manufacture 25,000 pounds of a toxic chemical per year or use at least 10,000 pounds of a toxic chemical per year. The hazardous air pollutant program, by contrast, applies primarily to stationary sources that emit or have the potential to emit at least ten tons (20,000 pounds) of any hazardous air pollutant or at least twenty-five tons (50,000 pounds) of any combination of such pollutants. RCRA takes a

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83. The permitting agency is obliged to establish effluent limitations for pollutants for which EPA has adopted relevant effluent limitations, and for any conventional, nonconventional, or toxic pollutants that may cause or contribute to an excursion above any state water quality standard, including any narrative standard. See 40 C.F.R. §§ 122.44(a), (b)(1), (d)(1)(i) (1996). In deciding whether to put an effluent limit in a permit, the permit writer may take into account the concentration of the pollutants in the discharge, the amount of the discharge compared to the volume of the receiving water, or other considerations. See id. EPA has not adopted categorical effluent limitations for many of the industrial categories required for toxic pollutant regulation. See Oliver A. Houck, The Regulation of Toxic Pollutants Under the Clean Water Act, 21 Envtl. L. Rep. (Envtl. L. Inst.) 10,528, 10,541 (1991) (citing EPA report). As a result, it is less likely that toxic pollutants from those sources will be limited in individual permits.


85. See 42 U.S.C. § 7412(a)(1) (1994). The program also applies to "area sources," which are stationary sources of hazardous air pollutants that are not major sources. See id. § 7412(a)(2). In lieu of the emission standards required of major sources, EPA may require area sources to comply with generally available control technology or management practices. See id. § 7412(d)(5).
graduated approach. Generators of up to 100 kilograms of hazardous waste per month are subject to relatively minimal oversight under RCRA. Facilities that generate more than 100 but less than 1000 kilograms per month are subject to somewhat more restrictive requirements, but still less than those on large quantity generators. The Clean Water Act and the OSH Act, meanwhile, contain no thresholds. Differing regulatory thresholds, in sum, increase inconsistencies and gaps in regulation.

Furthermore, the pollutants regulated under a particular program may not be regulated uniformly. In fact, several programs contain built-in mechanisms that magnify the list-based inconsistencies. RCRA is the most prominent example. The definition of solid waste in RCRA contains two exemptions that together exclude the majority of hazardous waste. Under one definition, hazardous waste that is discharged to surface water under a Clean Water Act permit is regulated under that Act rather than under RCRA. Under the other, hazardous waste that is combined with domestic sewage and discharged to a publicly owned treatment works is excluded from regulation under RCRA, although it is subject to relevant pretreatment and other requirements under the Clean Water Act. As a result, facilities discharge into publicly

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87. These requirements also apply to different types of facilities, again increasing the inconsistencies in coverage. EPCRA reports, for example, are required only for certain types of facilities. EPCRA applies primarily to manufacturing facilities but not to coal-fired power plants, regardless of emissions from those facilities. See 42 U.S.C. §§ 11023(b)(1)(A) (listing Standard Industrial Classification Codes 20 through 39). This provision covers a variety of manufacturing facilities but not energy generating facilities. See U.S. ENVIRONMENTAL PROTECTION AGENCY, 1994 TOXICS RELEASE INVENTORY 4, at A-1 to A-2, A-18 (1996) (listing industries in each SIC code). The Clean Air Act, by contrast, regulates both types of facilities as long as they emit more than a minimum amount of air pollution. See, e.g., 42 U.S.C. § 7411(a)(3) (defining stationary source as one “which emits or may emit any air pollutant”).
88. The OSH Act contains a somewhat similar distinction. Employees have general rights to have hazards communicated to them, see 29 C.F.R. § 1910.1200 (1995), and to have access to relevant medical and exposure records, see 29 C.F.R. § 1910.20 (1995). The standards that OSHA promulgated one at a time differ from the standards it adopted in unison, however, in that the former also include requirements for initial and periodic monitoring, medical surveillance, housekeeping, training, and other actions. See, e.g., 29 C.F.R. § 1910.1001 (asbestos), § 1910.1006 (methyl chloromethyl ether).
90. RCRA is structured so that hazardous waste is a type of solid waste. See 42 U.S.C. § 6903(5) (1994) (defining hazardous waste). The definition of solid waste excludes “solid or dissolved material in domestic sewage.” 42 U.S.C. § 6903(27); see also 40 C.F.R. § 261.4(a).

Although most states closely track the federal system, California, at least, does not
owned treatment works a great deal of hazardous waste that ostensibly qualifies for RCRA coverage. These pollutants are moved into the Clean Water Act program, under which most of them are not directly covered.

Consequently, facilities can take advantage of the list inconsistencies to limit the extent of their regulation. Although the great majority of Clean Water Act pollutants are regulated under RCRA (121 of 148), RCRA includes 381 pollutants that are not directly regulated under the Clean Water Act.\textsuperscript{91} Much RCRA hazardous waste is in the form of organic chemicals that are discharged directly into publicly owned treatment works. For every kilogram of such hazardous waste that is also regulated as a toxic water pollutant, two-and-one-half kilograms are not regulated as a toxic water pollutant.\textsuperscript{92} These data suggest that considerable amounts of pollution that would otherwise fall under RCRA coverage escape actual RCRA control.

Similarly, the Clean Water Act requires different procedures for waste released directly into surface waters and waste released through publicly owned treatment works. Facilities must obtain a specific permit if they wish to discharge industrial waste directly into a river or other surface water from a “point source,” such as a pipe.\textsuperscript{93} However, to discharge industrial water into a publicly owned treatment works, the facility need only treat the waste water to meet pretreatment limits. The limits are liberal; the facility does not have to treat the waste at all unless it otherwise would pass through the plant untreated and violate the effluent limitations in

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\textsuperscript{91} See Toxic and Hazardous Pollutants, supra note 74, at 74.

\textsuperscript{92} See ENVIRONMENTAL PROTECTION AGENCY, REPORT TO CONGRESS ON THE DISCHARGE OF HAZARDOUS WASTES TO PUBLICLY OWNED TREATMENT WORKS 3-25 (1986). These nontoxic pollutants may adversely affect human health and the environment, as well as operations at the publicly owned treatment works (“POTW”) into which they are discharged. See id. at E-4. This is particularly true because effluent limitations for POTWs infrequently contain specific limits for toxic pollutants, concentrating instead on conventional pollutants appropriate for domestic sewage. See ENVIRONMENTAL PROTECTION AGENCY, NATIONAL PRETREATMENT PROGRAM: REPORT TO CONGRESS 7-15 (1991).

\textsuperscript{93} The facility must obtain a National Pollutant Discharge Elimination System (“NPDES”) permit. No person may discharge “any pollutant” from a manufacturing facility without first obtaining a permit from the appropriate state authority. See 33 U.S.C. §§ 1311(a), 1342(a) (1994); see also 33 U.S.C. § 1362(12), (14) (1994) (defining discharge and point source). The Act authorizes states to administer the permitting program if they meet certain conditions. See 33 U.S.C. § 1342(b) (1994).
the plant's own permit, or unless it would interfere with the operation of the plant.\textsuperscript{94} Because the volume of water flowing through a publicly owned treatment works dilutes the concentration of toxic pollutants, facilities can avoid the cost of a permit and perhaps even the cost of pretreatment if they discharge to such plants. The result is that four times more toxic water pollutants are discharged to publicly owned treatment works than are released directly to surface waters.\textsuperscript{95}

Another complicating feature of the overall regulatory scheme is the many other lists that apply to industry. These other lists contain different or overlapping sets of chemicals and also vary in length. They include hazardous substances that may trigger a required clean-up under the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA" or "Superfund");\textsuperscript{96} substances whose accidental release to the air would likely cause "death, injury, or serious adverse effects to human health or the environment";\textsuperscript{97} extremely hazardous substances whose presence in certain facilities in excess of specified quantities must be reported to state and local emergency response authorities;\textsuperscript{98} hazardous chemicals for which a materials safety data sheet or list must be submitted by a manufacturer to state and local emergency response authori-

\textsuperscript{94} See 40 C.F.R. § 403.8(a) (1995) (requiring pre-treatment program); 40 C.F.R. § 403.3(n) (defining pass through). Industrial users are prohibited from causing pass through or interference with a POTW, and from introducing pollutants that could cause specified adverse effects on equipment or employee health. See id. § 403.5(a), (b).

EPA also may establish industry-specific pretreatment standards. See 33 U.S.C. §§ 1317(b), (c) (1994). Only one tenth of the facilities that now discharge toxic water pollutants to POTWs, however, are subject to such standards. See Robert W. Adler et al., The Clean Water Act: 20 Years Later 145 (1993).

By allowing facilities to discharge industrial wastewater to POTWs, the Act authorizes the division of regulatory responsibility for industrial wastewater discharges between the state environmental agency that enforces the NPDES program and the municipal government or authority that operates the POTW. This separation of authority leads to significant differences in staffing, expertise, experience, institutional support, and regulatory programs between and among the state and POTW operators.

\textsuperscript{95} See Telefax from Catherine G. Miller, Hampshire Research Institute, to author (Nov. 6, 1995) (on file with author). Using the national TRI data base for 1993, Miller compared releases and transfers of toxic and nonconventional water pollutants with releases and transfers of other pollutants listed under TRI. Approximately 2.2 million pounds of toxic and nonconventional water pollutants were directly discharged to surface water in 1993, compared with 9.2 million pounds that were transferred to POTWs.


\textsuperscript{97} 42 U.S.C. § 7412(r) (1994). The list, which is limited by statute to 100 substances, is at 40 C.F.R. § 68.130.

ties as well as the local fire department; contaminants for which EPA has adopted maximum contaminant levels, or drinking water standards; chemicals subject to significant new use restrictions under the Toxic Substances Control Act; and hazardous materials whose transportation in interstate commerce is subject to controls under the Hazardous Materials Transportation Authorization Act. These lists, each different from the others, add to the inconsistencies in the five primary lists.

2. Tendency to Decrease Gaps

The programs also work in several ways that reduce gaps in coverage of pollutants. The clean air and clean water programs in particular use umbrella parameters based on certain physical, chemical, or toxicological characteristics to limit releases of pollutants that are not specifically regulated. Such parameters are based on a different regulatory strategy than lists of specific pollutants; the strategy is intended to compensate partially for the drawbacks of lists.

For example, ozone is one of the criteria air pollutants under the Clean Air Act, but the statute does not directly limit the release of ozone. Rather, it controls volatile organic compounds, such as acetone and methyl ethyl ketone, that react with nitrogen oxides in the presence of sunlight to produce ozone and other photochemical oxidants. Most of the listed hazardous air pollutants are also volatile organic compounds. Regulation of another criteria pollutant, particulate matter, may restrict the release of metals, such as cadmium, nickel, chromium, and zinc, which can be emitted into the air as particulate matter. Until the 1990 Clean Air Act amend-

103. See, e.g., TITLE III LIST OF LISTS, supra note 74.
105. See supra text accompanying notes 54-57.
108. Similarly, some pollutants not listed by OSHA could be regulated under the
ments, hazardous air pollutants (beyond the listed seven) were controlled indirectly through regulation of criteria air pollutants.\footnote{Most of the reduction in air toxics emissions to date has probably occurred as a result of control technologies installed primarily to abate emissions of criteria air pollutants from industrial and mobile sources.”\textsc{Science Advisory Board, Environmental Protection Agency, Reducing Risk: Appendix C, Report of the Strategic Options Subcommittee 71} (1990).} Moreover, the 1990 legislation requires major stationary sources of criteria pollutants, including particulates and ozone, to obtain permits.\footnote{See \textit{Natural Resources Defense Council v. Environmental Protection Agency}, 902 F.2d. 962, 969–72 (D.C. Cir. 1990) (upholding revised particulate standard based on EPA’s findings concerning lung function and respiratory symptoms); \textit{American Petroleum Inst. v. Costle}, 665 F.2d 1176, 1185, 1187 (D.C. Cir. 1981) (upholding ozone standards based on health effects).} This permitting program is likely to strengthen the regulation of many (but not all) volatile organic compounds (“VOCs”), metals, and other pollutants that are not directly regulated.\footnote{Most of the reduction in air toxics emissions to date has probably occurred as a result of control technologies installed primarily to abate emissions of criteria air pollutants from industrial and mobile sources.”\textsc{Science Advisory Board, Environmental Protection Agency, Reducing Risk: Appendix C, Report of the Strategic Options Subcommittee 71} (1990).} While umbrella parameters include otherwise unregulated pollutants and thus mitigate inconsistencies among the lists, they do not ensure that other pollutants are consistently or adequately regulated. To begin with, the air quality standards for ozone and particulates are based on their effect on human respiration and lung function. As important as those standards are, they do not take into account the toxicological effects of individual pollutants that happen to fall under the ozone and particulate matter regulatory umbrellas.\footnote{See 42 U.S.C. § 7661a(a) (1994).} In addition, many toxic or hazardous pollutants are simply not covered by indirect regulation of volatile organic compounds and particulates.\footnote{Most of the reduction in air toxics emissions to date has probably occurred as a result of control technologies installed primarily to abate emissions of criteria air pollutants from industrial and mobile sources.”\textsc{Science Advisory Board, Environmental Protection Agency, Reducing Risk: Appendix C, Report of the Strategic Options Subcommittee 71} (1990).} This is why Congress concluded in 1990 that, despite indirect regulation, hazardous air pollutants continued to present severe public health risks that required a greatly strengthened control program.

\footnote{While umbrella parameters include otherwise unregulated pollutants and thus mitigate inconsistencies among the lists, they do not ensure that other pollutants are consistently or adequately regulated. To begin with, the air quality standards for ozone and particulates are based on their effect on human respiration and lung function. As important as those standards are, they do not take into account the toxicological effects of individual pollutants that happen to fall under the ozone and particulate matter regulatory umbrellas. This is why Congress concluded in 1990 that, despite indirect regulation, hazardous air pollutants continued to present severe public health risks that required a greatly strengthened control program.
A more developed system of umbrella parameters exists under the Clean Water Act. Effluent limitations for conventional or non-conventional pollutants (such as total suspended solids)\(^{114}\) can serve as an indirect means of limiting the discharge of pollutants not otherwise regulated.\(^{115}\) In addition, EPA and some states have begun to limit discharges based on whole effluent toxicity, which measures the toxicity of the entire waste stream by exposing it to fish or other organisms. This method has the twin virtues of including nonpriority pollutants in the waste stream as well as measuring the cumulative effect of a mixture of pollutants.\(^{116}\)

However, even under the more extensive Clean Water Act, umbrella parameters are of limited value in reducing regulatory gaps. They do not account for the toxicity of the particular pollutants affected. The evidence suggests that umbrella parameters were the primary mechanism of regulation under the Clean Water Act before the 1976 consent decree, and clearly did not control pollutants adequately.\(^{117}\) The fact that EPA sets effluent limits for specific toxic water pollutants in addition to limits based on umbrella parameters indicates that umbrella parameters miss some specific pollutants.\(^{118}\) Moreover, direct release of substantial quantities of unregulated pollutants, including organic compounds, continues, illuminating the limits of these parameters.\(^{119}\) Although whole effluent toxicity is a promising approach, it is being used only on a limited basis and cannot measure the long-term toxic effects of unregulated pollutants.\(^{120}\)

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\(^{114}\) Total suspended solids is a measure of both organic and inorganic materials that are suspended in water. See FMC Corp. v. Train, 539 F.2d 973, 977 n.3 (4th Cir. 1976).


\(^{116}\) If testing of a POTW indicates that the discharge could cause an in-stream excursion above water quality criteria for whole effluent toxicity, the permit is required to contain effluent limits for whole effluent toxicity. See 40 C.F.R. § 122.44(d)(1)(iv), (v) (1995). See generally Environmental Protection Agency, Technical Support Document for Water Quality-based Toxics Control 56–60 (1991) (encouraging use of whole effluent toxicity testing and effluent limitations).

\(^{117}\) See supra text accompanying notes 23–25.

\(^{118}\) See supra text accompanying notes 23–25.

\(^{119}\) See supra text accompanying notes 23–25.

\(^{120}\) See supra text accompanying note 94, at 162; see also Houck, supra note 83, at 10,555–58.
Several statutes fill regulatory gaps in another way, by providing an opportunity for the regulation at particular facilities of individual pollutants that would not otherwise be regulated. Permit application reviewers under the Clean Water Act, for example, may write effluent limitations, on a case-by-case basis, for particular pollutants that are not otherwise regulated when the reviewers believe it necessary to do so to meet water quality standards. Workplace chemicals not listed under the OSH Act can be limited by that statute's imposition of a general duty on employers to provide a workplace free of recognized hazards that are likely to cause serious physical harm.

Technology, too, may have the effect of limiting unregulated pollutants. Control technologies usually utilize forms of biological, physical, or chemical treatment that operate similarly on similar chemicals. Thus, when the technology is used to treat regulated chemicals, it also may incidentally treat unregulated pollutants. The likelihood that unregulated pollutants also will be affected depends on their similarity to regulated pollutants, the type of technology being employed, and other site-specific factors. For economic and technical reasons, this additional control is usually unintended.

Finally, and perhaps most importantly, state and local regulation of industry often fills holes created by inconsistent federal lists. The federal laws creating these programs expressly authorize states and municipalities to adopt and implement more stringent programs. Such programs can, and often do, include individual pollutants that are not regulated under federal law.

121. See 40 C.F.R. § 125.3(c)(2), (d) (1995) (allowing effluent limitations for otherwise unregulated pollutants). Somewhat similarly, operators of treatment, storage, or disposal facilities for hazardous waste may, and often do, accept industrial solid waste.


123. See Telephone Interview with Charles A. Cole, Professor of Engineering, Pennsylvania State University at Harrisburg (Mar. 18, 1996).


125. See supra note 90. Another example is the regulation of industrial solid waste, where some states have adopted comprehensive programs. See, e.g., 25 PA. CODE §§ 287–
The ability of states to reduce gaps, however, is circumscribed by practical and political concerns. Federal funding has a dominant influence on state decision-making, and many states do not wish to exceed federal mandates. Most states are unwilling, furthermore, to take political risks with more than a handful of environmental programs. Many states have overcome this resistance in varying degrees, but many have not. In addition, state regulatory agencies tend to have separate organizational units and priorities for each program, with minimal interaction among programs. Within a state agency, for example, the air quality program’s decision to increase the number of regulated pollutants is unlikely to be coordinated with other programs. As a result, greater coverage in one program could actually increase inconsistencies among the lists for all programs.

3. Differing Regulatory Consequences

The regulation of listed pollutants varies substantially from program to program. Some require permits, some do not. Four of the five programs are administered by EPA and one is administered by OSHA; the two agencies have different missions and constituencies. The stringency of the five programs varies considerably. The detailed “cradle to grave” controls adopted under RCRA probably make compliance with that program more complex and difficult than any other. Thus, different types of regulation occur even with pollutants that all five statutes recognize as hazardous or toxic.

127. See generally BARRY G. RABE, FRAGMENTATION AND INTEGRATION IN STATE ENVIRONMENTAL MANAGEMENT (1986) (discussing state efforts to overcome organizational barriers to facility-wide regulation).
128. Much of the basic environmental law course is devoted to understanding the similarities and differences among at least three of these statutes. See, e.g., ZYGMUNT J.B. PLATER ET AL., ENVIRONMENTAL LAW AND POLICY: NATURE, LAW, AND SOCIETY (1992).
III. THE UNCOORDINATED LIST DEVELOPMENT PROCESS

Differences in chemical release and properties can justify some of the inconsistencies among lists. Pollutants are emitted into different media in varying amounts, depending in part on whether they occur in solid, liquid, or gaseous form. It may not be necessary to regulate discharges of a particular pollutant into surface water, for example, because it is rarely discharged into water. In addition, the toxicity of most regulated pollutants varies with the route of exposure. Each route of exposure affects different organs in humans and other organisms, and these organs react to chemicals in varying ways. Thus it may be appropriate to regulate a pollutant when it is airborne because it has toxic effects when inhaled, but not to regulate the same pollutant in the water because it is not toxic through ingestion (drinking) or dermal contact (swimming).

Unfortunately, an investigation of the processes used to develop and amend the statutory lists does not support the conclusion that pollutants are regulated in media where they are toxic and unregulated in media where they are not. On the contrary, many pollutants are unregulated in media where they may have substantial adverse effects. Although the list development decision-making procedures are unevenly documented, it is possible to reconstruct their basic contours. Each list alone can be explained reasonably, but there is no rationale that explains how the different lists fit together.

131. See OTTOBONI, supra note 17, at 45, 49.
132. Some inconsistencies are, no doubt, based on different effects of pollutants in different media. Still, there is no contemporaneous explanation for the overall result. Administrative law requires a contemporaneous explanation in order to ensure that the agency had a rational basis for its decision at the time and is not merely articulating rationalizations after the fact. See, e.g., Burlington Truck Lines v. United States, 371 U.S. 156, 168–69 (1962); see also Independent U.S. Tanker Owners Comm. v. Lewis, 690 F.2d 908, 920 (D.C. Cir. 1982), Citizens to Preserve Overton Park, Inc. v. Volpe, 401 U.S. 402, 419 (1971). After-the-fact rationalizations are particularly suspect in risk analysis because of the many underlying policy decisions and assumptions. See infra text accompanying notes 242–245.
A. Development of Lists

The list makers faced a daunting task. All risk assessment occurs in the context of scarce information about the effects of chemicals. No toxicity information is available for 78% of the 12,860 chemicals that are used in commerce in quantities of more than one million pounds per year, and only minimal toxicity information is available concerning the rest.\footnote{See Steering Committee on Identification of Toxic and Potential Toxic Chemicals for Consideration by the National Toxicology Program, National Research Council, Toxicity Testing: Strategies to Determine Needs and Priorities 11–12 (1984). A partial health hazard assessment is possible for only 11% of these chemicals. See id. at 12.} Data gaps exist even for regulated pollutants. The National Research Council concluded in 1994 that there were significant gaps in our understanding of the human health effects of many of the hazardous air pollutants listed under the Clean Air Act.\footnote{See Committee on Risk Assessment of Hazardous Air Pollutants, National Research Council, Science and Judgment in Risk Assessment 144–59 (1994) [hereinafter Science and Judgment].} For the relatively few chemicals that have been tested for human health effects, there is considerable information concerning carcinogenicity and acute toxicity, but much less information concerning chronic toxicity.\footnote{See Science Advisory Board, Environmental Protection Agency, Reducing Risk, Appendix B: Report of the Human Health Subcommittee, Reduction Project 30–32 (1990) [hereinafter Reducing Risk: Appendix B].} Only 10% of chemicals in commerce other than pharmaceuticals have been tested for neurotoxicity.\footnote{See National Research Council, Environmental Neurotoxicology 2 (1992).} Very little information is available concerning the synergistic effects of pollutants on human health.\footnote{See Science and Judgment, supra note 134, at 226–28; see also Citizens for a Better Env’t v. Environmental Protection Agency, 33 Env’t Rep. Cas. (BNA) 1460, 1463 (N.D. Ill. 1991) (citizen petition for testing certain substances was properly denied, even though data are insufficient, because testing was not feasible).} Even less information exists concerning the effects of various pollutants on other living things.\footnote{See William Cooper & Tom Rohrer, Multimedia Transfers—Ecological Perspective, in Multimedia Approaches to Pollution Control: Symposium Proceedings 24 (1987) (explaining that existing models do not take the pathways of chemicals into account when predicting their effects on various biological communities).} The fate of pollutants as they move through the environment is not well understood.\footnote{See Conservation Foundation, Controlling Cross-media Pollutants 27 (1984) ("Where do all the toxics go? The short answer is no one knows.").} In short, much work
remains in improving the accuracy of methods, models, and data used in risk assessment. 140

The stories of how each list developed in the face of so much uncertainty are important and rarely told. They show how the logic of a focused statute made possible a substantial regulatory program. They also demonstrate the weaknesses of viewing industrial facilities through the lenses of five different statutes. Because later lists are sometimes based on earlier lists, their development is best described in rough chronological order.

I. Occupational Health Standards for Toxic Materials

Prior to passage of the OSH Act, regulation of workplace pollutants was largely voluntary, and relied upon standards promulgated by a variety of organizations. Among the prominent sources of such standards was the American Conference of Governmental Industrial Hygienists ("ACGIH"), which published "Threshold Limit Values" 141 for pollutants, intended to represent the maximum concentrations to which workers could be exposed without adverse effect. 142 The American Standards Association ("ASA") also recommended certain national standards. 143

140. See SCIENCE AND JUDGMENT, supra note 134, at 137.
141. ACGIH's members are occupational safety and health professionals working in government agencies and educational institutions. The organization began establishing threshold limit values in the 1940s and has updated its list annually. Each year, the ACGIH publishes a notice of intended changes to the threshold limit values, requesting comments along with substantiating evidence, such as industry experience or human and animal studies. Approved changes become official recommendations. See JOHN M. MENDELOFF, THE DILEMMA OF TOXIC SUBSTANCES REGULATION: HOW OVERREGULATION CAUSES UNDERREGULATION AT OSHA 87-89 (1988). The ACGIH process requires much less documentation than the process under the OSH Act. See id. at 89.
143. The American Standard Association develops voluntary consensus standards
The 1970 OSH Act authorized the Occupational Safety and Health Administration ("OSHA") to create enforceable occupational safety and health standards by two methods. OSHA could formally adopt, without notice and comment, any existing federal standards or national consensus standards. In 1971 OSHA used this authority to establish maximum permissible exposure limitations for approximately 425 pollutants based on ACGIH's 1968 recommendations, and a smaller number based on recommendations of the ASA.

The OSH Act also authorized OSHA to update these standards or adopt new standards using normal notice and comment procedures. Such standards had to be founded on the "best available evidence," prevent adverse health effects over an employee's working life, and be feasible.

This second provision has resulted in the creation of only a small number of additional standards, in large part because of the courts' reluctance to support subsequent standards. In 1978, for example, OSHA reduced permissible benzene limits in light of evidence that benzene was carcinogenic and that compliance with the lower standard was feasible. Three years later, the Supreme Court invalidated the new rule by a narrow, five-justice majority. The Court held that, before adopting a new or revised standard, OSHA had to determine that the pollutant presented significant risks that would be reduced or eliminated by the standard.

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146. See AFL-CIO v. Occupational Safety & Health Admin., 965 F.2d at 968.
149. See Industrial Union Department, AFL-CIO v. American Petroleum Inst., 448 U.S. 607, 613 (1981). OSHA also concluded that no safe exposure level to carcinogens could be determined. See id.
150. See id. at 607.
151. See id. at 639–41. Although the requirement for such a finding is not explicitly contained in the Act, the Court based its analysis in part on the definition of occupational health standard, which means a method or practice that is "reasonably necessary or
cause no such finding had been made for the existing benzene standard, the revised standard could not stand.\textsuperscript{152}

In 1989, the agency attempted to make broader rules and again met resistance. Relying on updated ACGIH recommendations and on advances in scientific knowledge, OSHA promulgated regulations tightening standards for 212 substances and adding standards for 164 previously unregulated substances.\textsuperscript{153} OSHA indicated that it had reviewed health effects data for all of these substances, and determined that the new limits would substantially reduce the risk of adverse health effects in American workers. Noting that it had been able to regulate only a few additional toxic chemicals since 1971, OSHA concluded that a regulation of broad scope was needed to keep up with the thousands of chemicals introduced into the workplace.\textsuperscript{154}

This regulation was invalidated by a federal court of appeals.\textsuperscript{155} The court held that OSHA had failed to explain the risk posed by each regulated substance, did not assess the level at which a significant risk of harm for each chemical was eliminated or reduced, and did not adequately explain the technical or economic feasibility of the new or revised limits.\textsuperscript{156} Following this, OSHA reinstated its pre-1989 standards, to which only two additions have been made.\textsuperscript{157} The result is that all but 28 of the toxic and hazardous substances now regulated under OSHA derive primarily from the 1968 ACGIH recommendations.\textsuperscript{158}

\textsuperscript{152} See 448 U.S. at 653. OSHA’s cancer policy, the Court said, would “justify pervasive regulation limited only by the constraint of feasibility. In light of the fact that there are literally thousands of substances used in the workplace that have been identified as carcinogens or suspected carcinogens, the Government’s theory would give OSHA power to impose enormous costs that might produce little, if any, discernible benefit.” \textit{Id.} at 645. OSHA eventually adopted this revised standard. \textit{See} 29 C.F.R. § 1910.1028 (1995).


\textsuperscript{155} \textit{See} AFL-CIO \textit{v. Occupational Safety \\& Health Admin.}, 965 F. 2d 962 (11th Cir. 1992).

\textsuperscript{156} \textit{See id.} at 975–82.

\textsuperscript{157} The prior standards were reinstated at 58 Fed. Reg. 35,338, 35,340 (1993) (noting that “OSHA continues to believe that many of the old limits which it will now be enforcing are out of date . . . and not sufficiently protective of employee health”). The two new limits are at 29 C.F.R. § 1910.1048 (1995) (formaldehyde); 29 C.F.R. § 11910.1050 (1995) (methyleneedianiline).

\textsuperscript{158} \textit{Compare} 29 C.F.R. § 1910.1001–.1050 (1995) (substances for which OSHA
2. Toxic and Nonconventional Water Pollutants

The toxic pollutant list and the nonconventional pollutant list have different histories. The toxic pollutant list under the Clean Water Act was completed in 1976 as part of a settlement agreement with the Natural Resources Defense Council and Environmental Defense Fund. Based on EPA's own data, submissions from the two environmental groups, and the Stanford Research Institute, the Agency created a working list of compounds that are toxic in water. The parties then developed criteria to select pollutants on the working list as toxic pollutants. To receive this classification, pollutants or classes of pollutants had to be known to be present in effluent from point sources such as pipes. In addition, each pollutant or class of pollutants had to have certain human health or environmental effects. Three levels of effects were identified. The pollutants on Priority List I showed "substantial evidence" from human epidemiological or animal studies of being carcinogens, mutagens (capable of causing genetic changes), or teratogens (capable of causing birth defects). Point source discharges of these pollutants were thought to present significant risks to human health, at least in the vicinity of the discharges. The pollutants on Pri-

159. See supra note 25 and accompanying text.
160. See AD HOC WORK GROUP [FOR] SELECTION AND PRIORITIZATION OF TOXIC POLLUTANTS IN POINT SOURCE WATER EFFLUENT DISCHARGE, U.S. ENVIRONMENTAL PROTECTION AGENCY, THE PROCESS OF SELECTION AND PRIORITIZATION OF TOXIC POLLUTANTS IN POINT SOURCE WATER EFFLUENT DISCHARGE 7 (1976) (on file with author) [hereinafter SELECTION PROCESS]. A somewhat similar version of this memorandum appears in Implementation of the Federal Water Pollution Control Act (Regulation and Monitoring of Toxic and Hazardous Chemicals): Hearing Before the House Comm. on Public Works and Transportation, 95th Cong. 399-403 (1977) (Appendix VI to statement by Thomas C. Jorling, Assistant Administrator, Water and Hazardous Substances EPA) [hereinafter Appendix VI].
161. See Hall, supra note 14, at 92-93; see also SELECTION PROCESS, supra note 160, at 10-11 (noting that toxic pollutants were known to occur in "point source effluents, in aquatic environments, in fish and/or drinking water"); 33 U.S.C. § 1362(14) (1994) (defining point source). The work group also considered whether analytical methodologies were available to detect the pollutants. Methods were available for all 65 pollutants or pollutant classes that were chosen. See SELECTION PROCESS, supra note 160, at 19.
162. See SELECTION PROCESS, supra note 160, at 10. "This judgment is based on consideration of the quantities emitted, the persistence of the compounds in aquatic systems, their tendency to be stored in organisms used for human food, and available information on effective doses in animal tests." Appendix VI, supra note 160, at 403.
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 priority List II presented less compelling evidence of carcinogenicity, mutagenicity, or teratogenicity.163 In many cases, the potential for human exposure was also less than for those on List I.164 A few were chosen because they are toxic to aquatic organisms.165 The pollutants on Priority List III were "known to have serious toxic effects on humans or aquatic organisms, although generally at concentrations in water somewhat greater than those for compounds on Lists I and II."166 There was no significant evidence that they were carcinogens, mutagens, or teratogens.167 Taken together, these three lists produced the final group of 65 pollutants or classes of pollutants used in the consent decree.168

In implementing the consent decree, EPA further narrowed this group to 129 individual pollutants. Many of the pollutant classes contained in the original group of 65 contained dozens of individual compounds. Analyzing effluent samples for the thousands of individual pollutants covered would have placed an enormous strain on government and private laboratories.169 Regulating such a large number of pollutants also threatened to make the program unmanageably large and costly.170 The 129 pollutants that EPA finally selected had previously been detected in water, were produced in

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163. The evidence was based on similarity of the chemical structure of those pollutants to the chemical structure of the List I pollutants, or "upon mutagenic activity in bacterial screening systems, in the absence of adequate confirmation in mammalian systems." See SELECTION PROCESS, supra note 160, at 10. In some cases, where testing indicated that the pollutant is a carcinogen, mutagen, or teratogen, the testing was "incomplete or equivocal." Id.

164. "This judgment is based on relatively small volume of effluents, or relatively low propensity to persist in water or to accumulate in organisms." Appendix VI, supra note 160, at 403.

165. See SELECTION PROCESS, supra note 160, at 11.

166. Id.

167. See id.

168. The work group also developed a List IV of compounds presenting less direct hazards than those on the other lists, but whose derivative or breakdown products might pose human health hazards. See id. at 11. These were not listed as toxic pollutants. See Hall, supra note 14, at 96.

169. See Walter M. Shackelford & Lawrence H. Keith, Evolution of the Priority Pollutant List from the Consent Decree, PROCEEDINGS OF THE SECOND OPEN FORUM ON MANAGEMENT OF PETROLEUM REFINERY WASTEWATER 103, 103–04 (1978); see also Proposed Effluent Limitations, supra note 32, at 11,835 (explaining that "[e]ven the list of 65 toxic pollutants and classes of pollutants includes potentially thousands of specific pollutants").

large quantities, were chemically stable, and could be detected in effluent using readily available methods.\textsuperscript{171} This reduced list was ratified by Congress in the 1977 amendments to the Clean Water Act.\textsuperscript{172}

Under the Act, EPA may add and remove pollutants from the toxic pollutant list. In doing so, EPA must "take into account toxicity of the pollutant, its persistence, degradability, the usual or potential presence of the affected organisms in any waters, the importance of the affected organisms, and the nature and extent of the effect of the toxic pollutant on such organisms."\textsuperscript{173} In 1981, EPA deleted three pollutants from the list.\textsuperscript{174} The list of 126 pollutants has remained unchanged since then.

The 22 nonconventional pollutants began as part of a longer list that appeared in EPA's standard National Pollutant Discharge Elimination System permit application forms shortly after the Clean Water Act was adopted.\textsuperscript{175} EPA categorized some of these pollutants as toxic and removed them from this list. EPA also deleted additional pollutants when it revised its regulations after the 1977 amendments, and later added two more.\textsuperscript{176} The name "nonconventional pollutants" was created to distinguish them from the "conventional" pollutants. Although there does not appear to be a written justification for listing them as such, EPA thought it necessary to continue regulating them.\textsuperscript{177}
3. Hazardous Wastes

Under RCRA, a waste may be determined to be hazardous either by characteristic or by being listed as such. RCRA required EPA to adopt criteria for both. These criteria were to be based on the "toxicity, persistence, and degradability in nature, potential for accumulation in tissue, and other related factors such as flammability, corrosiveness, and other hazardous characteristics." The underlying analyses for hazardous waste characteristics and hazardous waste lists are different.

EPA initially considered several criteria for determining whether waste would be deemed hazardous by characteristic, criteria derived from experience with waste management problems and from the characteristics identified by the statute. EPA then narrowed the list by considering whether the characteristics could be measured by readily available protocols. As a result of this, the agency settled on four characteristics: ignitability, corrosivity, reactivity, and toxicity.

Each of these characteristics was intended primarily to protect human health. The ignitability characteristic identifies wastes that may ignite under routine conditions, creating fires and explosions and potentially spreading toxic pollutants to the surrounding area. The corrosivity characteristic identifies wastes with high or low pH officials have long believed to be important from a human health or environmental viewpoint.

178. 42 U.S.C. § 6921(a) (1994). These regulations were also required to be adopted within eighteen months after the act was signed into law. See id. EPA's inexperience with regulating hazardous waste, the lack of significant state or local experience on which it could rely, its small number of knowledgeable staff and the short deadline significantly affected the final result. See MARC K. LANDY ET AL., THE ENVIRONMENTAL PROTECTION AGENCY: ASKING THE WRONG QUESTIONS 89–132 (1990).

179. Among the candidate criteria that did not make the final cut were radioactivity, phytotoxicity (toxicity to plants), bioaccumulation potential, carcinogenicity, teratogenicity, and mutagenicity. See 43 Fed. Reg. 58,946, 58,950 (1978) (proposing hazardous waste guidelines and rules). EPA also looked to see whether a particular characteristic was generally applicable (not simply a source list), and whether there was a significant likelihood of that hazard developing if the waste was mismanaged. See id. In addition to corrosivity and flammability, the other characteristic for hazardous waste mentioned in RCRA is infectiousness. See 42 U.S.C. § 6903(5) (1994).

180. See 45 Fed. Reg. 33,084, 33,105 (1980). EPA did not adopt a broader list of characteristics "because of the lack of suitably uncomplicated test protocols, the difficulty of establishing numerical hazardous thresholds for these additional characteristics, and the failure of the available test protocols to fully incorporate all of the multiple factors bearing on the hazards presented by such characteristics." Id. at 33,106.

(a measure of acidity and alkalinity), as such wastes can harm human tissue and aquatic life and can promote the movement of toxic pollutants into groundwater by increasing their solubility.\textsuperscript{182} The reactivity characteristic identifies wastes that are extremely unstable or have a tendency to explode or react violently, potentially endangering human health and the environment by exposing them to toxic gases.\textsuperscript{183}

Because there is no test for overall toxicity, EPA defined toxicity in terms of a waste’s potential to contaminate groundwater that humans would use as drinking water.\textsuperscript{184} The test procedure EPA developed, known as the Extraction Procedure, identifies wastes that could leach 14 pollutants into groundwater if the waste is disposed of improperly.\textsuperscript{185}

In the Hazardous and Solid Waste Amendments of 1984, which amended RCRA, Congress expressed concern that the Extraction Procedure test understated the potential of the listed pollutants to leach into groundwater under certain conditions and that it did not include toxic organic compounds.\textsuperscript{186} The 1984 amendments required EPA to examine the “deficiencies” of the test and to change the toxicity characteristic so that it would more accurately predict “the leaching potential of wastes which pose a threat to human health and the environment when mismanaged.”\textsuperscript{187} As a result, EPA adopted a new test procedure, known as the Toxic Characteristic Leaching Procedure, and added 25 organic compounds to the existing list.\textsuperscript{188}

\textsuperscript{182} See 43 Fed. Reg. at 58,951. This characteristic also identifies wastes that can corrode metal over time, because such wastes can escape from their containers and then enhance the solubility of toxic pollutants in groundwater. See 40 C.F.R. § 261.22.
\textsuperscript{184} See 45 Fed. Reg. at 33,110.
\textsuperscript{185} See id. at 33,110–12. These 14 pollutants were the only ones then in the National Interim Primary Drinking Water Standards. See id. at 33,110. The pollutants included lead, several other metals, and several insecticides and pesticides. EPA believed them to be the only scientifically recognized standards for toxicity under conditions of chronic exposure. See 55 Fed. Reg. 11,798, 11,800 (1990).
\textsuperscript{188} See 40 C.F.R. § 261.24 (1995). EPA identified the additional compounds by reviewing Appendix VIII, a list of waste constituents with toxic, carcinogenic, mutagenic, or teratogenic properties that the agency uses in evaluating the potential hazardousness of a waste. See 55 Fed. Reg. at 11,801; 40 C.F.R. § 261.11(a)(3) & pt. 261, app. VIII [hereinafter Appendix VIII]. EPA then narrowed the list to those compounds for which there was sufficient information to establish chronic toxicity reference levels—concentrations of the compounds below which humans could be exposed for a life time with little or no risk. See 55 Fed. Reg. at 11,801. For noncarcinogens, the level is based on the
Despite these changes, EPA acknowledged that the toxicity characteristic was still based only on human health effects from drinking contaminated groundwater.\(^{189}\)

The lists of hazardous wastes, like the characteristics for hazardousness, were largely based on several hundred cases of improper waste disposal that had caused human health or environmental injury.\(^{190}\) Although the data on which it relied were incomplete, EPA found sufficient justification for the listed constituents and argued that delay for further study would be intolerable “in light of the urgent need for rapid implementation” of RCRA.\(^{191}\) Delays would have been unacceptable because EPA had already missed statutory deadlines for promulgating the lists and as a result had been sued by environmental groups.\(^{192}\)

In developing the lists, EPA articulated criteria that it intended to apply to any future additions to the lists.\(^{193}\) Like the characteristics for hazardousness, the criteria for the lists emphasize public health. On the “P” list are acutely hazardous chemical products, for which exists evidence that each constituent is fatal to humans in small doses; could kill laboratory animals exposed to the constituent through inhalation, ingestion, or skin contact; or “is otherwise capable of causing or significantly contributing to an increase in serious irreversible, or incapacitating reversible, illness.”\(^{194}\) The “U” list includes non-acutely hazardous chemical products, which

reference dose, the daily dose of a substance to which an individual human can be exposed for a lifetime with no observed adverse effect. For carcinogens, the level is based on the risk specific dose, the daily dose of a substance to which an individual can be exposed for a lifetime without exceeding a specific cancer rate, in this case 1 in 100,000. See id. at 11,801, 11,814–15. EPA also narrowed the list to compounds that show little or no hydrolysis, or chemical decomposition, in water. See id. at 11,803.

191. 45 Fed. Reg. 33,084, 33,113–14 (1980) (citing a report by a Senate subcommittee). In listing specific hazardous waste streams, EPA relied, not on “empirical testing of particular substances,” but rather “on a variety of information including knowledge of the substances that enter waste streams as a result of air and water pollution control efforts.” 43 Fed. Reg. at 58,948. EPA intended the lists to make it easier for generators to determine which wastes are legally hazardous without testing for the characteristics. See 43 Fed. Reg. at 58,953.
192. See LANDY ET AL., supra note 178, at 109–12.
193. See 40 C.F.R. § 261.11 (1995); 45 Fed. Reg. at 33,113. EPA based its listing decisions primarily on the concentration and toxicity of constituents in waste, and would likely list wastes as hazardous regardless of their fate in the environment unless they were incapable of migrating into groundwater even when improperly managed, or unless they broke down in groundwater. See id.
194. 40 C.F.R. § 261.11(a)(2); see also 45 Fed. Reg. at 33,113.
are toxic, carcinogenic, mutagenic or teratogenic;\textsuperscript{195} and which can pose substantial hazard to human health or the environment when mismanaged.\textsuperscript{196} The “F” and “K” lists of waste mixtures and combinations include wastes that meet the criteria for the other two lists or one of the four characteristics.\textsuperscript{197}

EPA may modify the rules for hazardous waste characteristics or listings on its own.\textsuperscript{198} It may also respond to petitions to add or delete wastes from a list,\textsuperscript{199} or to exempt a particular generator from regulation of a specific waste (i.e., to remove that waste from the list for that generator).\textsuperscript{200} The rationale for the latter option is that the listing of wastes as hazardous reflects the general properties of those wastes, but the wastes from a specific facility may not be hazardous.\textsuperscript{201} In evaluating a petition to delist waste from a particular facility, EPA must consider not only the factors that led to listing the waste in the first place, but also any other factors that “could cause the waste to be a hazardous waste.”\textsuperscript{202} EPA has delisted certain wastes from more than 90 facilities under these provisions.\textsuperscript{203}

4. Toxic Chemicals Requiring Public Reporting

In the late 1970s, the New Jersey Department of Environmental Protection began an industrial survey to establish a database concerning the manufacture, use, and release of carcinogenic or toxic chemicals. The state asked companies to report their use of 155 selected chemicals, including those that were on the Clean

\textsuperscript{195} The “U” list derives from Appendix VIII, \textit{supra} note 188. \textit{See} 40 C.F.R. § 261.33(f)(“U” list); 45 Fed. Reg. at 33,115 (criteria for “U” list based on 40 C.F.R. § 261.11(a)(3)); 40 C.F.R. § 261.11(a)(3) (requiring that a waste contain one or more constituents in Appendix VIII).

\textsuperscript{196} \textit{See} 40 C.F.R. § 261.11(a)(3) (requiring consideration of 10 specific factors concerning the constituent and “[s]uch other factors as may be appropriate”).

\textsuperscript{197} 40 C.F.R. § 261.30(a), (b) (describing hazard codes to indicate basis for listing of hazardous wastes); 261.31(a) (“F” list and hazard codes); § 261.32 (“K” list and hazard codes); § 261.11(a)(1) (authorizing listing based on characteristics); 45 Fed. Reg. at 33,113–14.

\textsuperscript{198} \textit{See} 42 U.S.C. § 6921(a) (1994) (authorizing EPA to revise criteria for characteristics of hazardous waste “from time to time as may be appropriate”); 42 U.S.C. § 6921(b) (authorizing EPA to revise lists).


\textsuperscript{200} \textit{See} 40 C.F.R. § 260.22.


\textsuperscript{202} 42 U.S.C. § 6921(f)(1); \textit{see also} 40 C.F.R. § 260.22(e)(2).

Water Act priority pollutant list. The rest were produced in commercial quantities in the United States, and there was evidence that they were carcinogenic, mutagenic, teratogenic, or had other chronic health effects. Similarly, Maryland surveyed companies about their use of certain toxic pollutants listed in the Clean Water Act; chemicals regulated under the Safe Drinking Water Act; hazardous air pollutants then regulated under the Clean Air Act; hazardous substances under Maryland law; and substances for which ACGIH had established a threshold limit value. Many of these chemicals were chosen for carcinogenicity. Maryland also included most of the 50 chemicals that had the largest United States production volume in 1985.

Congress combined the lists from New Jersey's and Maryland's surveys, and adopted them as EPCRA's original 329 chemicals and chemical categories requiring public reporting. When Congress adopted this combined list in 1986, it also authorized EPA to amend it by adding or deleting pollutants. Pollutants may be added if they cause or may cause (1) significant adverse human health effects beyond the site boundary because of continuous or frequently recurring releases, (2) cancer or other serious or irreversible health effects, or (3) significant adverse environmental effects because of their toxicity, persistence, or tendency to bioaccumulate in the environment. Pollutants may be deleted if there is

204. See New Jersey Department of Environmental Protection, New Jersey Industrial Survey Final Report 1, 3 (1986).
205. See id. at 3.
207. These chemicals had been listed by the National Toxicology Program as known or anticipated human carcinogens, or classified as such by the International Agency for Research on Cancer, the National Cancer Institute, or OSHA. See S. Rep. No. 100-231, at 223.
208. See Telephone interview with Awadarine Balram, Public Health Engineer, Maryland Department of the Environment (Mar. 6, 1996). Mr. Balram participated in the survey for the Department under its prior name, the Department of Health. See also David Webber, Top 50 Chemicals Production Dropped Moderately in 1985, Chemical & Engineering News, Apr. 21, 1986, at 12-13 (listing top 50 chemicals produced in the U.S. in 1985); Memorandum to author from Stephen Stein (Nov. 18, 1996) (on file with author) (stating that 37 of the 50 chemicals were included in the original EPCRA list of 329 chemicals and chemical categories).
211. See 42 U.S.C. § 11023(d)(2). The number of chemicals included for the third reason cannot exceed 25% of the chemicals on the list. See id.
insufficient evidence for any of these standards. Since 1986, many chemicals have been added to or removed from the Toxics Release Inventory lists singly or in small groups.

At the end of 1994, however, EPA added 286 chemicals and chemical categories to the list in a single rulemaking. In preparing this proposal, EPA compiled an initial list of candidates that included many pollutants covered by other environmental statutes. EPA then screened these chemicals for acute, carcinogenic, and chronic human health effects as well as for ecological effects. It eliminated from consideration "low priority" chemicals and chemicals for which no facility was likely to meet the minimum reporting threshold. After screening, EPA made a chemical-by-chemical determination of whether the statutory criteria were met, adding chemicals to the Toxics Release Inventory list only if it concluded that their adverse effects were "serious and significant."

A striking feature of the Toxics Release Inventory list is that regulation under any other program does not, by itself, determine whether a pollutant is listed here. It includes some but not all of the pollutants regulated under each of the other four statutes as well as a great many that are covered under none of them.

213. The list has been changed approximately two dozen times. See TRI PUBLIC DATA RELEASE, supra note 15, at 15. Most of these changes were for single chemicals or small groups. See, e.g., 60 Fed. Reg. 31,643 (1995) (listing acetone); 55 Fed. Reg. 31,594 (1990) (listing halon 1211, halon 1301 and halon 2402).
215. The initial list included particular categories from a variety of environmental statutes, including the Clean Air Act; CERCLA, 42 U.S.C. § 9602; RCRA; Appendix VIII, supra note 188; the California Safe Drinking Water and Toxic Enforcement Act of 1986, CAL. HEALTH & SAFETY CODE § 25249.5-.13 (West 1992), CAL. CODE REGS. tit. 26, § 22-12000(b) (1992); and others. See 59 Fed. Reg. 61,432 (amending list of chemicals for which reporting is required) (codified at 40 C.F.R. § 372.65).
217. See id.
218. A facility meets the threshold if it uses 10,000 pounds of a toxic chemical, or manufactures, imports, or processes 25,000 pounds. See id. at 61,434; see also 42 U.S.C. § 11023(f)(1)(A) (1994).
219. 59 Fed. Reg. at 61,433. EPA cautioned, however, that occurrence of adverse effects in any community will depend on exposure and dose. See id.
220. See supra text accompanying notes 78–79.
221. See supra notes 78–79.
5. Hazardous Air Pollutants

Congress initially developed the Clean Air Act's list of hazardous air pollutants from three other lists. As Congress debated amendments to the Clean Air Act in the late 1980s, a Senate Committee began with the 329 chemicals and categories of chemicals then regulated under EPCRA.\textsuperscript{222} Reports required by EPCRA revealed that larger volumes of toxic chemicals were being released into the air than had previously been recognized. This contributed to the Congressional decision to expand regulation of toxics.\textsuperscript{223} However, the EPCRA list omitted important air pollutants, particularly combustion byproducts. The Committee therefore added a partially overlapping list of 100 such air pollutants,\textsuperscript{224} comprising those hazardous substances found at Superfund sites posing the greatest threat to human health.\textsuperscript{225} To ensure that the final list captured only "high-priority air pollutants," the Committee then eliminated any chemicals for which no state had established a recommended acceptable concentration for use in permitting.\textsuperscript{226} Finally, the Committee added dibenzofurans to the list, bringing the total in the 1987 bill to 224.\textsuperscript{227}

By the time the bill became law in 1990, it included only 189 hazardous air pollutants. After the 1987 committee report, EPA had deleted some pollutants with relatively low toxicity or potential for air emissions and added some highly toxic pollutants.\textsuperscript{228} EPA determined whether a pollutant was highly toxic according to its

\textsuperscript{222} See S. REP. No. 100-231, at 223–24 (1987).
\textsuperscript{223} See Shenkman, supra note 11, at 21; see also S. REP. No. 101-228, at 128 (1989).
\textsuperscript{224} See S. REP. No. 100-231, at 224. This list had been prepared by the Agency for Toxic Substances and Disease Registry and EPA.
\textsuperscript{225} See id.; see also 42 U.S.C. § 9604(i)(2)(a) (1994).
\textsuperscript{226} See S. REP. No. 100-231, at 225. These recommended concentrations, in turn, were typically based on workplace exposure standards. See id.
\textsuperscript{227} See id.
\textsuperscript{228} See Memorandum from Scott Voorhees, Program Analysis and Technology Section, EPA to Stanley A. Meiburg, Director, Planning and Management Staff, EPA (Sept. 5, 1989) (on file with author). EPA's review occurred in two stages. First, it removed pollutants from the list that had low toxicity, were to be regulated as ozone depleters elsewhere in the legislation, had been delisted under EPCRA, were not produced domestically, had low air pollution potential, or were consolidated with other chemicals into a single chemical class. EPA also added pollutants that were highly toxic. EPA then revised this amended list based on toxicity and other data from various EPA offices. See id.; see also Letter from A. Scott Voorhees to David Blackmar (May 1, 1990) (on file with author) [hereinafter Voorhees Letter].
effects on human health, including carcinogenicity. The Committee accepted EPA's revisions in 1989, largely because of witnesses' testimony stating a preference for lists prepared by EPA's experts over those growing out of the legislative process. Two more pollutants were removed between committee approval of the bill and signing of the bill into law.

The Clean Air Act authorizes EPA to add or remove pollutants on its own or in response to a petition from any person. EPA is required to add a substance to the list if it is an air pollutant and "emissions, ambient concentrations, bioaccumulation or deposition of the substance are known to cause or may reasonably be anticipated to cause adverse effects to human health or adverse environmental effects." EPA is obliged to remove a substance if there are adequate health and environmental data showing that the substance may not reasonably be expected to cause such effects.

B. Limits of Risk in Explaining Inconsistencies among Lists

The internal logic of each story seems more or less reasonable by itself, whether or not the result is satisfactory. But the logic of the five stories taken together is incoherent. The lists were developed independently; they are directed primarily at pollutants released into particular media regardless of their ultimate fate; they place different emphasis on various environmental and human risks; and they exclude significant pollutants in order to keep program costs down.

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229. See Voorhees Letter, supra note 228, at 2. EPA estimated that 81% of the pollutants on the revised list were known, probable, or possible human carcinogens. Other health effects included "serious or irreversible developmental or reproductive effects, neurological disorders, mutagenicity, other chronic health effects, and adverse acute health effects." Id.; see also 42 U.S.C. § 7412(b)(2) (1994).
233. See 42 U.S.C. § 7412(b)(3)(C) (1994). EPA also must periodically review the list and add or remove pollutants based on essentially the same criteria. See 42 U.S.C. § 7412(b)(2). Ozone depleting chemicals regulated under the Act, 42 U.S.C. §§ 7671-7671q, may not be listed solely because of their environmental effects. See id. Nor may EPA add elemental lead to the list. See 42 U.S.C. § 7412(b)(7).
1. Independent Development

Each list was developed on its own, by separate organizations or groups of people, and in different contexts. The overwhelming majority of the occupational health standards were developed by ACGIH. A much smaller number were developed directly by OSHA itself. The toxic water pollutant list was developed by an EPA work group based on substantial input from environmental organizations that had sued EPA. The initial hazardous waste lists were prepared by EPA's Office of Solid Waste in response to a statutory deadline for developing such regulations. The initial EPCRA and hazardous air pollutant lists were developed as part of the legislation. The EPCRA list derived primarily from two state lists, and the air list was prepared mostly by EPA experts. Those developing later lists, including the multi-media Toxics Release Inventory, did not revisit earlier lists.

Independent development under diverse circumstances contributed to many of the differences among the lists. For example, 67 of the 189 Clean Air Act hazardous air pollutants are not regulated under the OSH Act. Yet a pollutant toxic in the outdoor air is surely just as toxic in the workplace. Better coordination of the development and implementation of these two statutes would likely have prevented such results.

Nor is the discrepancy limited to the division between EPA and OSHA, which are separate agencies and may be expected to operate somewhat independently. The four lists administered by EPA are equally insular. Each is administered by a separate program office whose operations are only slowly yielding to a more coordinated multi-media approach.

2. Single Medium Focus

The list makers focused primarily on the presence and toxicity of pollutants in a specific medium. Of the five lists, only the Toxics

234. See Toxic and Hazardous Pollutants, supra note 74, at 84, 85, 98–100.
Release Inventory list (under EPCRA) includes substances found in various media. The list makers of the other four lists ignored the fact that the same pollutants were present in other media and gave little attention to the likelihood that these pollutants would travel to other media after their release.

Yet pollutants routinely move between media. Pollutants released into outdoor air, for example, often fall to earth or water on their own or through precipitation.\(^\text{236}\) Pollutants disposed of on land may leach into groundwater and find their way to surface water or drinking water. Pollutants released into surface water may remain dissolves in the water, but they can also settle to the bottom or volatilize (or evaporate) into the air. In each case, significant and different risks may exist in the medium into which the pollutant is released and the medium in which the pollutant ultimately lands.\(^\text{237}\)

Fate and transport are of particular concern for toxic and hazardous pollutants that are persistent or bioaccumulative. Some pollutants degrade in the environment by exposure to water, air, ultraviolet light, or microorganisms. Persistent pollutants resist such chemical breakdown.\(^\text{238}\) Persistent pollutants that accumulate in fat

\(^\text{236}\) For example, pollutant metals that are emitted into the air most commonly end up in the soil. They are also deposited in surface water bodies where impacts are especially severe due to the greater sensitivity of aquatic organisms to toxic metals. \textit{See} Jerome Nriagu, \textit{Industrial Activity and Metal Emissions, in INDUSTRIAL ECOLOGY AND GLOBAL CHANGE} 279–80 (Robert H. Socolow et al. eds., 1994). The most well-known examples are sulfur dioxide and nitrogen oxides from the combustion of fossil fuels, which are the principal causes of acid precipitation. \textit{See} 42 U.S.C. § 7651(a)(1)–(2) (1994).

\(^\text{237}\) \textit{See} CONSERVATION FOUNDATION, \textit{CONTROLLING CROSS-MEDIA POLLUTANTS} 8–20 (1984); Roy E. Albert, \textit{Multimedia Risk Assessment, in MULTIMEDIA APPROACHES TO POLLUTION CONTROL, supra} note 138, at 89–92. Assessing exposure to particular chemicals is difficult because some organisms rely on different media at different stages in their lives. Amphibians, for example, breathe under water with gills as young and breathe out of the water with lungs as adults.

\(^\text{238}\) \textit{See} B. MAGNUS FRANCIS, \textit{TOXIC SUBSTANCES IN THE ENVIRONMENT} 97 (1994). Persistent pollutants include metals. \textit{See id.} at 138. A subset of these pollutants, persistent organic pollutants, are highly persistent and toxic. They are also semi-volatile, meaning that they tend to volatilize into the atmosphere in hotter temperatures and latitudes, and tend to condense in colder temperatures and latitudes. They thus tend to migrate to colder latitudes and stay there. \textit{See} L. Ritter et al., \textit{Persistent Organic Pollutants: An Assessment Report on Aldrin, Chlordane, DDT, Dieldrin, Dioxins and Furans, Endrin, Heptachlor, Hexachlorobenzene, Mirex, Polychlorinated biphenyls, and toxaphene at 3 (Sept. 18, 1995) (draft) [hereinafter Persistent Organic Pollutants]. A treaty is being negotiated to phase out some of these pollutants. \textit{See} Global Initiative in POPs Progressing: Format for Pact to be Approved in 1997, Intl. Env't. Daily (BNA), Mar. 15, 1996, \textit{available in LEXIS, Environment Library, BNAENV File.}
and whose concentration increases with the level of the food chain are bioaccumulative.\(^{239}\)

Several lists do reflect some consideration of the different media through which pollutants move after their initial release. RCRA's hazardous waste characteristic tests for ignitability and reactivity reflect an attempt to prevent movement of hazardous wastes from land to air, while its toxicity and corrosivity characteristics are designed to limit movement of hazardous wastes from land to groundwater or surface water. Such concerns also played a role in the multi-media Toxics Release Inventory list.

However, fate and transport problems did not influence the other programs. Although Congress was aware when it developed the Clean Air Act's hazardous pollutant list that these substances were ultimately deposited in surface waters,\(^{240}\) it focused on human health effects from inhalation to the exclusion of other considerations.\(^{241}\) The Clean Water Act and OSH Act lists, similarly, address only the effects of the listed pollutants in surface water and the workplace, respectively.

3. Human Health and Environmental Effects

Regulatory decision-making for regulating a particular pollutant typically involves a scientific assessment of the risk, and then a risk management analysis that determines what, if anything, to do about that risk.\(^{242}\) Risk assessment occurs within a context of such pervasive scientific uncertainty that scientists must make assumptions to fill data gaps and predict relationships.\(^{243}\) Assessments can nonetheless be useful and credible if they are conducted in a

\(^{239}\) See Francis, supra note 238, at 98.


\(^{241}\) See supra note 134 and accompanying text. After EPA adopts standards for hazardous air pollutants, it is obligated to adopt more stringent controls if those standards do not reduce the additional lifetime cancer risk for individuals who are “most exposed to emissions” from a regulated source to less than one in one million. See 42 U.S.C. § 7412(f)(2)(A) (1994).

\(^{242}\) See, e.g., COMMITTEE ON THE INSTITUTIONAL MEANS FOR ASSESSMENT OF RISKS TO PUBLIC HEALTH, NATIONAL RESEARCH COUNCIL, RISK ASSESSMENT IN THE FEDERAL GOVERNMENT: MANAGING THE PROCESS 18–19 (1983). Assessment of risk takes into account the effects of the pollutant at specific doses; the intensity, frequency, or duration of exposure to the pollutant; and estimated effects under likely exposure conditions. See id. at 19–37.

\(^{243}\) See id. at 11–12, 51–52 (discussing uncertainty in predicting human health effects).
manner that protects their accuracy and integrity.\textsuperscript{244} Risk management decisions, on the other hand, involve policy judgments based upon considerations such as the cost and effectiveness of various control strategies and the public’s perception of the risk.\textsuperscript{245}

A formal risk assessment/risk management process was not used to develop these lists. EPCRA did not even begin with an overall assessment of the risks presented by the listed pollutants, instead choosing many chemicals simply for their large production volume. In addition, while some form of risk assessment played a role in the development of most of the lists, the risks assessed were different in each case and each list weighed the risks in dissimilar ways. The air, water, and RCRA lists, for example, used a rough form of risk assessment that combined evidence of toxicity with high production volume or actual exposure data. The ACGIH list that OSHA adopted in 1971, by contrast, derived from an accumulated assessment of occupational health risks.

The five methods for choosing pollutants are among nearly 150 chemical ranking systems used in the United States and other countries to select pollutants for various regulatory purposes.\textsuperscript{246} A study of 51 such systems, including the one used for Clean Water Act priority pollutants, showed that no consensus exists concerning an appropriate method for selecting those chemicals that present the greatest risks to human health and the environment. The systems differed greatly in terms of the criteria they used, the types of risks that were included, how those risks were weighted, and the data that were used.\textsuperscript{247} The same kinds of differences occur among the five lists discussed in this Article. Although all five weigh effects on human health, they generally pay less attention to effects on the environment. They also reflect differing levels of attention to different specific human health effects, but tend to concentrate on carcinogenicity.

\begin{itemize}
\item \textsuperscript{244} See \textit{Science and Judgment}, supra note 134, at 156–57.
\item \textsuperscript{245} See \textit{Risk Assessment in the Federal Government}, supra note 242, at 49.
\item \textsuperscript{246} See \textit{Gary A. Davis, University of Tennessee Center for Clean Products and Clean Technologies, Comparative Evaluation of Chemical Ranking and Scoring Methodologies} 9 (1994).
\item \textsuperscript{247} See \textit{id. at} 46, A-75 to A-76.
\end{itemize}
One measure of the different approaches is the correlation between single medium lists and the multi-media Toxics Release Inventory list. Since the chemicals on that list generally meet certain criteria, it is revealing to see how many of the pollutants on other lists also meet those same criteria. The percentage varies significantly—from 40.9% (occupational health) to 45.6% and 58.1% (hazardous waste and water, respectively) to 94.2% (air).248

The Clean Water Act toxic pollutant list reveals the strongest emphasis on environmental effects. Toxic pollutants met at least one of three separate criteria, one of which was based exclusively on human health, and two of which were based on both environmental and human health effects. Pollutants were placed on the other lists almost exclusively for their human health effects. The original Toxics Release Inventory list reflects, on balance, an emphasis on human health. The additional criteria concerning carcinogenicity and probable carcinogenicity enhanced that emphasis.249 The limits for occupational health pollutants, of course, are intended exclusively to protect the health of humans in the workplace. The criteria for hazardousness under RCRA, too, center on human health, as ignitability, reactivity, and toxicity are based on the potential for fire, explosion, or leakage into drinking water, respectively. Although some hazardous wastes were listed under RCRA because of their environmental effects, the dominant concern in the RCRA listing process was human health.250 Listing of hazardous air pollutants under the Clean Air Act largely reproduced the Toxics Release Inventory list as well as state regulation, both of which tend to concern themselves with human inhalation. As a result, this list is also based primarily on human health.

The OSH Act list addresses the greatest range in human health effects. The ACGIH recommends threshold exposure levels for various pollutants based on their carcinogenicity as well as a variety of noncarcinogenic effects to the heart, lungs, liver, kidneys, skin, eyes, nervous system, and reproductive system.251 These non-

248. See Toxic and Hazardous Pollutants, supra note 74, at 2840 (dividing the number of common pollutants on paired lists by the total number of listed pollutants).
249. TRI “is concentrated on potential human health effects and gives little attention to environmental or ecological effects.” Kenneth Geiser, The Unfinished Business of Pollution Prevention, 29 GA. L. REV. 473, 480 (1995).
250. See supra notes 181–184 and accompanying text.
251. See supra note 142.
carcinogenic effects can be acute (occurring in a short time, such as poisoning) or chronic (occurring over a longer time, such as lung disease).

The primary human health concern reflected in the other lists, however, is carcinogenicity. Criteria for toxic water pollutants are dominated by concern about carcinogens, mutagens, and teratogens.\textsuperscript{252} Likewise, about half of the chemicals on the original Toxics Release Inventory list (and the hazardous air pollutant list, which closely mirrors it) were known, suspected, or probable human or animal carcinogens. More than half of the noncarcinogens exhibit acute or chronic toxicity.\textsuperscript{253} The human health effects underlying the definition of hazardous waste, however, appear to include a wider variety of carcinogenic and noncarcinogenic effects. The four characteristics are based largely on acute and chronic toxicity, and the lists reflect concern for carcinogenicity, mutagenicity, and teratogenicity as well as a variety of other toxic effects.

Even when the risk assessment factors were similar, the list makers did not necessarily have access to the same scientific information. None of the lists is based on a comprehensive analysis of all pollutants in a particular medium. No two lists are based on an analysis of the same subset of pollutants. Each was drawn from particular groups of pollutants that were identified by technical analysts, state regulatory programs, or combinations of various lists.\textsuperscript{254} Although the lists were based on an exhaustive investigation of data then available to those preparing them,\textsuperscript{255} new scientific information about the effects of particular pollutants became available during the two decades over which the lists were developed.\textsuperscript{256}

\begin{footnotesize}
\textsuperscript{252} Although the work group also looked at adverse effects of pollutants on reproduction, organ systems and behavior, it concentrated on carcinogenicity, mutagenicity, and teratogenicity because of the seriousness of those effects and the much greater availability of scientific literature concerning them. \textit{See SELECTION PROCESS, supra} note 160, at 12-13. The work group devoted little attention to acute hazards from water pollutants due to lack of time, scarcity of information, and because it believed that adverse effects from chronic exposure to pollutants were more likely. \textit{See id.} at 12.

\textsuperscript{253} \textit{See S. REP. No. 100-231,} at 224 (1987) (quoting summary of report on the combined Maryland/New Jersey list).

\textsuperscript{254} The work group that developed the list of 65 Clean Water Act toxic pollutants and pollutant categories observed that data on toxicity existed for as many as 100,000 unique substances. It concluded that “[a] list of this magnitude would, of course, be impossible for any group to work with, even in the most peripheral manner.” \textit{SELECTION PROCESS, supra} note 160, at 7.

\textsuperscript{255} \textit{See id.} at 16-18.

\textsuperscript{256} \textit{See infra} text accompanying note 288.
\end{footnotesize}
Finally, the listing decisions give insufficient weight to certain effects. EPA's Science Advisory Board has concluded, for example, that environmental and human health risks should be given equal weight. By that standard, at least three of the four EPA-administered lists are deficient. A growing body of information about the potential for pollutants to harm the human nervous, reproductive, and other systems makes it plain that the developers of the lists did not weigh these other effects adequately.

4. Program Manageability and Cost

Even where the risk assessment for a particular list concluded that certain pollutants presented significant human health or environmental risks, those pollutants were not necessarily included in the final list. The two phases, risk assessment and risk management, were intertwined from the start, with concerns about regulatory resources influencing the lists' scope. For example, EPA's decision to narrow the original list of 65 priority pollutants and pollutant families under the Clean Water Act reflected its concern that the number of individual pollutants represented on the original list was too large to regulate effectively.

The smaller size of the air and water lists, in fact, is likely due to the anticipated regulatory consequences of both lists. EPA must promulgate separate limitations for each class of industry based on the best technology available to that industry. Each additional pollutant on either list increases the magnitude and complexity of the task, the time needed to complete it, and the likelihood of litigation over the outcome.

Many pollutants did not enter the lists because technical tests to measure their presence or concentration in a particular medium were unavailable or too burdensome. This is particularly true of

257. See REDUCING RISK, supra note 245, at 17.
258. See infra note 290 and accompanying text.

The requirement for industry-by-industry best available technology limitations holds only for toxic and nonconventional water pollutants and for hazardous air pollutants. Under RCRA and the OSH Act, the agencies must set technology-based effluent limitations, but not industry-by-industry.
RCRA where, for example, the toxicity characteristic for determining the hazardousness of a waste does not measure toxicity at all. 260 Similarly, EPA found that it could not develop standardized tests for characteristics such as radioactivity, phytotoxicity, bioaccumulation potential, carcinogenicity, teratogenicity, and mutagenicity. The Clean Water Act provides another example. The list in the consent decree was reduced in part because of concern that laboratory analysis for hundreds or thousands of potential pollutants was not feasible. 261

Compliance costs to industry also limited the number and type of pollutants on lists, especially where a legislative process determined not only what to include in the list but what listing meant. The original OSH Act list was less influenced by such concerns because OSHA simply adopted existing voluntary industry standards that had not been intended to have legal consequences. Judicial concern over cost to industry, however, has restricted that list’s expansion. 262

Because the burden on government, technical feasibility, and cost to industry influenced the choice of pollutants, the pollutants on any given list are not necessarily the only pollutants presenting significant risks. Reduction of the 65 chemicals and chemical classes in the original priority water pollutant list to 129 (now 126) specific pollutants, for example, allowed many pollutants in those chemical classes to go unregulated even though they presented significant risks. The General Accounting Office has found that 98% of the pollutants discharged into the nation’s waterways are not priority pollutants, and that many of them pose significant risks. 263 Another study of pollutants released under the Clean Water Act found that priority pollutants comprised only 14 of the 50 most frequently occurring organic compounds. 264 Likewise, a large number of workplace air pollutants for which ACGIH has adopted

260. See supra text accompanying notes 184–189.
261. See supra note 169 and accompanying text.
262. See supra notes 149–156 and accompanying text.
264. Approximately 4000 wastewater samples from industrial facilities and publicly owned treatment works were analyzed for 114 organic priority pollutants as well as other organic compounds. See Walter M. Shackelford & David M. Cline, Organic Compounds in Water, 20 Envir. Science & Tech. 652, 655 (1986).
threshold limit values are not regulated under OSHA, in all likelihood imposing substantial risks on many workers. Such are the consequences of combining risk assessment and policy-driven risk management in one step.

C. Criteria for Amending the Lists

It is highly unlikely that the current system of amending the lists will allow greater consonance among them. The original lists were developed with the goal of launching entire regulatory programs, and so were developed in a sweeping manner. In contrast, the criteria for adding or deleting pollutants all but assure relatively few changes in the lists and impede efforts to coordinate their evolution.

The implementing agencies are responsible for making the requisite factual findings on a pollutant-by-pollutant basis to change any list. Procedurally, these changes are accomplished by rulemaking. The duty to develop a factual basis for its decision on each pollutant is part of the administrative agency’s duty to explain the relationship between the facts it finds and the decision it makes. Courts have specifically required such a finding under the OSH Act.

265. See Mendeloff, supra note 141, at 92–99.

266. For example, Congress authorized the adoption of a substantial list under the OSH Act without notice-and-comment rulemaking in order to begin the program right away. When EPA adopted the listing and characteristic rules for hazardous waste, it was under substantial political and legal pressure to get that program started. See supra text accompanying note 192. As for EPCRA, when Congress adopted the original list of toxic chemicals that must be reported, it did not want EPA to start developing a new list, preferring to adopt a ready-made one, regardless of its toxicological merits. See Telephone Interview with Ronald Outen, Vice President, Jellinek, Schwartz & Connolly, Inc. (Jan. 14, 1996). Mr. Outen was the professional staff member of the Senate Environment and Public Works Committee who was responsible for managing EPCRA when the legislation was being considered by Congress. The Conference Committee adopted the Senate requirement for reporting of 329 chemicals instead of the House requirement for reporting a handful of chemicals.

267. See, e.g., 40 C.F.R. § 260.20(c) & (e) (1996).


269. See supra notes 150–152 and accompanying text.
For the four medium-specific lists, moreover, the agency must also find that the pollutant presents a risk in the particular medium being regulated. The obligation to justify list changes on a pollutant-by-pollutant basis essentially re-enacts the situation that existed prior to the development of the lists, particularly in the air and water programs, when EPA was unable to regulate a meaningful number of pollutants.

Unfortunately, the release of toxic or hazardous pollutants from or within manufacturing facilities continues to pose a threat despite improvements in the past several decades. A great many toxic and other pollutants are still produced in manufacturing.\textsuperscript{270} Toxic pollutants are a problem in many urban areas and disproportionately affect people of color and low-income persons.\textsuperscript{271}

The listing process necessarily puts human health and the environment at risk because its primary response to pollutants occurs: (1) after they have been released from or within an industrial facility, (2) after considerable information has been gathered showing the risks they create, and (3) after Congress, EPA, or OSHA has decided to regulate. Humans and the environment are already adversely affected by toxic and hazardous pollutants by the time the listing process comes into play.\textsuperscript{272} The current procedures are unlikely to reduce the gap between the 50,000-plus chemicals in commerce\textsuperscript{273} and the 1134 chemicals and chemical categories cur-


\textsuperscript{271} See TOXICS WATCH, \textit{supra} note 270, at 371–89 (summarizing and analyzing various studies and concluding that, at a minimum, racial minorities are exposed disproportionately to air pollution and lead). For a thoughtful analysis of the problem, see Richard J. Lazarus, \textit{Pursuing “Environmental Justice”: The Distributional Effects of Environmental Protection}, 87 \textit{Nw. U. L. Rev.} 787 (1993).

\textsuperscript{272} See CARL F. CRANOR, REGULATING TOXIC SUBSTANCES: A PHILOSOPHY OF SCIENCE AND THE LAW 129–31 (1993). The ACGIH list of Threshold Limit Values ("TLVs") for the workplace states:

The list of TLVs is by no means a complete list of all hazardous substances or of all hazardous substances used in industry. For a large number of materials of recognized toxicity, little or no data are available that could be used to establish a TLV. Substances that do not appear on the TLV list should not be considered to be harmless or nontoxic.


\textsuperscript{273} \textit{See supra} note 5.
rently on at least one of the five lists. In fact, three of the lists have changed relatively little, if at all, since they were first developed. OSHA has been able to add only 28 chemicals to the occupational health standards it adopted by reference in 1971, and has deleted none. EPA has deleted three pollutants from the list of toxic water pollutants since 1976, and has added none. It is probably too soon to expect changes in the 1990 list of hazardous air pollutants; in fact, there have been none.

When major additions have occurred, they have been directed by Congress or eased by relatively insignificant regulatory consequences. An example of congressionally driven reform is the amendment of RCRA in 1984, after which EPA doubled the number of pollutants that could render a waste hazardous based on the toxicity characteristic. Examples of reforms that were possible because of narrow effects are decisions to delist wastes from approximately 90 firms, virtually all of which apply only to the firms involved. In another example, EPA almost doubled the number of chemicals on the Toxics Release Inventory list in a single action, which was probably eased by the fact that reporting places a lesser compliance cost on industry than pollutant limitations under any of the other lists.

Not only do the amendment criteria prevent changes, they also cause existing changes to be uncoordinated. The modification criteria of different lists give varying weight to environmental concerns and to human health concerns. To add a toxic chemical to the Toxics Release Inventory list, for example, EPA must find "sufficient evidence" that the pollutant poses significant health or

274. Cf. MENDELOFF, supra note 141, at 137–38 (arguing that the burden of proof impedes OSHA's ability to regulate more pollutants).
275. But see SELECTION PROCESS, supra note 160, at 19 ("[N]o claim is made by the work group of having selected and developed the permanent, definitive list of toxic pollutants from a point source water discharge perspective . . . .").
276. See supra notes 186–189 and accompanying text.
277. See supra note 203 and accompanying text.
278. See supra note 214 and accompanying text.
279. The disparate regulatory effects of inclusion on various lists suggest that cost and program manageability concerns are likely more important for some lists than for others. Unlike the four other programs, EPCRA requires no permitting, standard setting, or compliance with pollutant concentration limits. All other things being equal, it should be less costly for industry to report releases and transfers of an additional pollutant than to treat, store, dispose of, or transport an additional pollutant in specified ways. Although cost and program manageability influence the listing process in considerable but differing degrees, EPCRA is probably affected least by these concerns.
environmental effects or is carcinogenic.\textsuperscript{280} The Clean Water Act, by contrast, requires EPA to consider the toxicity of a chemical to aquatic organisms before adding or removing it.\textsuperscript{281}

As a result, the varying methodologies that contributed to inconsistency in the first place seem likely to enhance rather than to reduce it in the future.\textsuperscript{282} For example, when EPA added 286 chemicals to the Toxics Release Inventory list, it did so after concluding that many other pollutants regulated under the other four programs should not be listed under the Toxics Release Inventory.\textsuperscript{283} Differences in the list modification criteria mean that, as the lists slowly change, the discrepancies among them may actually multiply.

Oddly, the modification criteria are not necessarily the same criteria that were used to develop the lists in the first place.\textsuperscript{284} For one thing, those who developed the lists did not necessarily use any particular criteria to do so. This is particularly true of EPCRA, which combined chemicals from two state surveys of industrial facilities into an initial list.\textsuperscript{285} Even where development criteria were stated, the modification criteria often differ. For example, the considerations specified for modifying the toxic water pollutant list under the Clean Water Act are much less precise than the criteria used by the EPA work group to promulgate the initial list.\textsuperscript{286}


\textsuperscript{282} But see Section 6 of the Toxic Substances Control Act ("TSCA"), which authorizes EPA to regulate the existing use of chemicals in a variety of ways if EPA finds that such chemicals "present an unreasonable risk of injury to health or the environment." 15 U.S.C. § 2605(a) & (b) (1994). Coordination of the existing chemicals program under TSCA with other EPA programs or with OSHA is problematic. See Sussman, supra note 12, at 2.

\textsuperscript{283} See supra notes 215–219 and accompanying text. In another instance, greater coordination between two lists did occur. The Natural Resources Defense Council and the governor of New York petitioned EPA to add 80 chemicals plus two chemical categories to the Toxics Release Inventory list, claiming that each of the chemicals or chemical categories was a listed hazardous waste under RCRA. When EPA granted the petition for most of these chemicals, it did not do so because they were regulated under RCRA but because they met independent Toxics Release Inventory listing criteria. See 57 Fed. Reg. 41,020 (1992); 58 Fed. Reg. 63,500 (1993).

\textsuperscript{284} In developing its hazardous waste lists, EPA said it was following the same criteria that it would apply in modifying the lists. See supra text accompanying note 193. This evidently did not occur with the other lists.

\textsuperscript{285} See supra notes 204–209 and accompanying text.

\textsuperscript{286} Compare 33 U.S.C. § 1317(a)(1) (1994) and EPA's guidance on the subject,
teria for modifying the hazardous air pollutant list include both environmental and human health effects even though the initial list was based solely on the latter.287

Finally, the current system cannot respond coherently to new information about the toxicity of particular chemicals. The volume and quality of scientific information about pollutants continues to increase, as does the ability of toxicologists to differentiate among different kinds of effects.288 There is a growing scientific understanding, for example, concerning the ecological effects of chronic low-level exposures to toxic or hazardous pollutants.289 The ability of scientists to measure pollutants at smaller and smaller concentrations enables detection and analysis of increasingly subtle environmental and human health effects. Scientific evidence increasingly reveals the impact of chronic exposure to low levels of toxic chemicals on, among other things, sexual development, reproductive ability, the immune system, and the development and function of the nervous system of birds, fish, mammals and humans.290 Yet existing procedures make it impossible to incorporate newly available knowledge into a dynamic and consistent regulatory system.

IV. ADVERSE EFFECTS OF INCONSISTENT LISTS

A. Incentive for Cross-Media Transfers

As practicing attorneys know well, industries affected by environmental and occupational health laws can comply with those laws in two basic ways. They can engage in a regulated activity and follow the prescribed requirements, or they can make the law inapplicable to them by not engaging in the regulated activity. If a law requires a permit for facilities constructed in a wetland, for

supra note 203, with the criteria used by the EPA work group, supra notes 160–161 and accompanying text.

288. See Telephone Interview with Robert K. Tucker, Director, Division of Science and Research, New Jersey Department of Environmental Protection (Aug. 25, 1995).
290. See Theo Coburn et al., OUR STOLEN FUTURE: ARE WE THREATENING OUR FERTILITY, INTELLIGENCE AND SURVIVAL?—A SCIENTIFIC DETECTIVE STORY 252–255 (1996); see also Persistent Organic Pollutants, supra note 238, at 3, 6–7.
example, a company might avoid the permitting requirement by constructing the facility elsewhere. This kind of avoidance behavior is common among regulated industries and, if properly directed, can benefit human health and the environment.291

Inconsistent listing of toxic and hazardous pollutants, however, encourages a harmful type of avoidance behavior—moving pollutants to media where they are not regulated. The single-media control programs work by limiting the release of the listed pollutants into a particular medium. These limits impose costs on the facility. Because the facility’s managers seek to minimize costs, they will ordinarily release or transfer pollutants in the least expensive manner that is technically feasible. Pollutants can be released to air or water, disposed of on land, or sent to a publicly owned treatment works.292 Process engineers can often select the medium into which waste or residue will be discharged.293 If a pollutant is not regulated in a particular medium, the cost of releasing it there is likely to be minimal. Inconsistent lists encourage industrial process engineers to design and operate manufacturing and pollution control systems so that toxic and hazardous pollutants are discharged into media where they are not regulated.294

The phenomenon of cross-media transfers in environmental regulation is well known but not well understood.295 Many of the hazardous wastes that are discharged into publicly owned treatment works as part of industrial waste water volatilize into the air during treatment, creating air pollution.296 The most widely used means of controlling workplace exposure to chemicals is probably by vent-

291. See E. DONALD ELLIOTT, THE FUTURE OF ENVIRONMENTAL LAW 4–5 (stating that avoidance incentives are the most important part of regulatory programs).
292. See TRI Public Data Release, supra note 15, at 10–13. They can also be injected underground or sent off-site for treatment, recycling, or energy recovery. See id. These are the basic TRI reporting categories.
294. These cross-media transfers of pollutants occur prior to their release within or from industrial facilities.
ing them to the outdoor air. In fact, Congress has recognized that unregulated media invite the transfer of pollutants. When Congress passed RCRA, for example, it was aware that the Clean Air Act and the Clean Water Act were leading many companies to dispose of their wastes on land instead. RCRA, Congress thought, would close that loophole.

If the pollutants regulated under each of these statutes as toxic or hazardous were essentially the same—an assumption that is easy to make because of the similarity of their names—that conclusion might be appropriate. The assumption is wrong, of course. As a result, the statutory programs often have the effect of controlling pollutants in a particular medium by increasing them in media where they are not regulated.


In one instance, Congress intentionally directed cross-media transfers. By banning the land disposal of many hazardous wastes, 42 U.S.C. § 6924(d)-(k), the 1984 RCRA amendments encouraged alternatives to disposal, especially incineration. Incineration creates air pollutants no matter how well the operation is controlled. See Greenpeace, Inc. v. Waste Technology Industries, 37 Env't Rep. Cas. (BNA) 1736, 1748–52 (N.D. Ohio 1993) (discussing air pollution from proposed hazardous waste incinerator), rev'd for lack of jurisdiction, 9 F.3d 1174 (6th Cir. 1993).

299. See supra text accompanying notes 16–17. Although the list of RCRA pollutants now includes the great majority of toxic water pollutants and hazardous air pollutants, it does not include all of them. In addition, the majority of RCRA pollutants are not regulated as toxic or hazardous under either of the two other statutes. See Figure 1 accompanying note 80. Thus, the net effect of RCRA, after passage of the 1990 Clean Air Act Amendments, is to reduce some inconsistencies among the lists but to increase others.

300. Cross-media transfers can also occur for other reasons. Cross-media transfers could occur between regulated media, for example, where the greater stringency of one law encourages movement of pollutants to the medium regulated by the other. See Hahn & Malès, supra note 295, at 25. In other cases, cross-media transfers occur because the pollution control system creates or cannot treat pollutants that require additional regulation in another medium. See U.S. CONGRESS, OFFICE OF TECHNOLOGY ASSESSMENT, FROM POLLUTION TO PREVENTION 44 (1987). To prevent the transfer to land or air of pollutant metals discharged to POTWs, EPA in 1993 adopted regulations limiting the concentration of certain metals and other pollutants in sewage sludge that is land applied, landfilled, or incinerated. See 58 Fed. Reg. 9248 (Feb. 19, 1993) (codified at 40 C.F.R. pt. 503 (1995)); see also 33 U.S.C. § 1345(e) (1994). The sewage sludge limits are intended, in large part, to give POTW operators an additional incentive to ensure that proper pretreatment actually occurs.

In 1990, Congress required EPA to consider the potential for cross-media transfers when it adopts regulations. See 42 U.S.C. § 13103(b)(2) (1994). EPA has also initiated a Source Reduction Review Project to develop regulations in multi-media “clusters” for certain industrial sectors, clusters, and resources. Among other things, the project is intended to avoid cross-media transfers. See Wendy Cleland-Hamnett & Joe Retzer, Crossing Agency Boundaries, ENVTL. F., Mar.–Apr. 1993, at 17; see also THE SOURCE REDUCTION REVIEW PROJECT, supra note 295. The likelihood that this problem can be
The control of toxic and nonconventional water pollutants under the Clean Water Act provides an example. At the author’s request, Hampshire Research Institute divided the Toxics Release Inventory pollutants into two categories—those that are also listed as toxic and nonconventional pollutants under the Clean Water Act (Clean Water Act pollutants) and those that are not (other pollutants). The Hampshire Research Institute then analyzed the national Toxics Release Inventory data base for releases and transfers of pollutants in both categories.301

Direct surface water discharges and discharges to publicly owned treatment works are much lower for Clean Water Act pollutants than they are for other pollutants. An average of only 93 pounds per Clean Water Act-regulated pollutant was discharged into surface waters in 1993, compared to an average of 4,737 pounds per pollutant for other pollutants. An average of 397 pounds per Clean Water Act pollutant was discharged to publicly owned treatment works, which is much lower than the 5,373 pound average for other pollutants.302 Although the Toxics Release Inventory data cannot provide a baseline for measuring the effect of the Clean Water Act, because such reporting was not required in 1976, pollutants were listed as toxic under the Clean Water Act because they were likely to be present in point source effluent in significant quantities.303 That they are now discharged in amounts that are more than ten times lower on average per pollutant than other pollutants indicates what the Clean Water Act has achieved.304

These improvements appear to have come with a price, however. The percentage of Clean Water Act pollutants directly discharged to surface waters and discharged to publicly owned treatment works is much less than the percentage of other pollutants

patched on a regulation-by-regulation basis is minimal, however, because of the sheer scale of the differences among the lists. In addition, the government’s regulation writing process is much slower than industry’s ability to innovate cross-media transfers. See generally Eric W. Orts, Reflexive Environmental Law, 89 NW. U. L. REV. 1227, 1238-39 (1995) (regulations often fail to keep pace with technical change). As long as differences among the lists remain, EPA’s ability to prevent or control cross-media transfers will be limited. 301. See Miller, supra note 95. For the past several years, Hampshire Research has analyzed the TRI data for EPA. 302. See id. 303. See supra text accompanying note 171. Similarly, nonconventional pollutants were likely regulated because of their prevalence in industrial discharges. 304. But see NATIONAL WATER QUALITY INVENTORY, supra note 15, at 86-87 (15% of monitored river miles and 39% of monitored lakes have elevated levels of toxic water pollutants).
that were discharged or disposed of in that manner. On the other 
hand, air emissions of Clean Water Act pollutants are higher than 
air emissions of other pollutants. Total air emissions represented 
28.3% of all releases and transfers of Clean Water Act pollutants 
in 1993, compared to 20.4% of all other pollutants. Although 
these releases cannot be compared to those in 1976, a more specific 
and stringent program existed for Clean Water Act pollutants than 
for air pollutants until at least 1990. This analysis indicates the 
futility of protecting the environment or human health from a 
pollutant by limiting its release into a single medium.

Because the toxic and nonconventional water pollutant list was 
developed from a single-medium focus, these differences were nei­ 
ther intended nor within the scope of the analysis used to develop 
the list. Subsequent lists have also affected the release of these 
pollutants in ways that were not intended. That 81.6% of the toxic 
and nonconventional water pollutants are also RCRA hazardous 
wastes, for example, helps explain the lower likelihood of land 
disposal for those water pollutants than for other TRI chemicals.

Cross-media transfers of toxic and hazardous pollutants could 
have significant adverse effects on human health or the environ­ 
ment. When a pollutant that would otherwise be discharged to 
water is instead emitted to the air, a risk reduction in one medium 
is offset to a greater or lesser degree by a risk increase in another. 
The same result ensues when a pollutant that would otherwise be 
discharged to air is instead transferred off-site for energy recovery, 
though to a lesser degree. Because of inconsistent listing, the con­ 
trols companies purchase tend to achieve less human health and 
environmental protection than intended and may even have adverse 
consequences.

Significantly, the absence of regulatory gaps appears to en­ 
courage a more desirable kind of avoidance behavior—pollution 
prevention. The four single-medium statutes control or limit the 
release of a pollutant after the pollutant is produced. A manufac­

305. See Miller, supra note 95. The difference is statistically significant. See id.
306. Nor is it certain that implementation of the hazardous air pollutant program 
will change this result. Only 66 of the 147 toxic and nonconventional water pollutants, or 
44.9%, are also hazardous air pollutants. See Toxic and Hazardous Pollutants, supra note 
74.
307. See id.
308. See Hahn & Malès, supra note 295, at 25 (“Cross media shifts are particularly 
important for toxics because even small, inconspicuous shifts can create sizable effects.”).
turer could design and implement water pollution controls, air pollution controls, occupational health controls, and a hazardous waste management system for pollutant X, for example, which is listed under all five statutes. In this approach, pollution control, the manufacturing process and the pollution control systems are generally separate. The company would also be required to report annual releases of pollutant X under EPCRA. Alternatively, the company could redesign its manufacturing process to avoid releasing pollutant X in the first place. If the manufacturer chooses this approach, the laws regulating pollutant X will be inapplicable and the controls required for pollutant X will thus be unnecessary. This alternative method, pollution prevention, involves changes in the manufacturing process so that pollutants are no longer generated, or are generated in much lower quantities. Pollution prevention includes “equipment or technology modifications, process or procedure modifications, reformulation or redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control.”

The likelihood that a manufacturer will find pollution prevention economically more attractive for a pollutant than pollution control appears to be greater when the pollutant is regulated under most or all media. As a result of the 1990 Pollution Prevention Act, which amended EPCRA, facilities filing TRI forms must state whether they are using pollution prevention to limit reported pollutants. EPA's TRI report for 1994 identifies the top 50 pollutants for which facilities reported pollution prevention in that year. A clear majority of the pollutants on this list (30 of 50, or 60%) are directly regulated as toxic or hazardous under at least four of the five regulatory statutes discussed in this Article. Although many

309. 42 U.S.C. § 13102(5)(A) (1994) (defining source reduction). Source reduction and pollution prevention are used here as equivalent terms. Conventional pollution control or treatment systems—which are not integral or necessary to the manufacturing process—are not pollution prevention. See id.
311. See TRI PUBLIC DATA RELEASE, supra note 15, at 152.
312. See Memorandum to the author from Stephen Stein (Oct. 1, 1996). The memorandum compares the 50 TRI pollutants with the pollutant analysis in Toxic and Hazardous Pollutants, supra note 74. Of the 50 TRI pollutants, 16 are on all five of the regulatory lists, 30 are on four or more lists, 37 are on three or more lists, and 44 are on two or more lists. See generally OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS, SERIOUS REDUCTION OF HAZARDOUS WASTE 49 (1986) (greater levels of regulation encourage pollution prevention).
different factors influence pollution prevention decisions, regulation under most or all media is evidently important. Regulatory gaps, by contrast, encourage cross-media transfers.

B. Incomplete Information about Pollutant Releases

Inconsistent lists impede a complete understanding by facility operators, government agencies, and the public of the toxic and hazardous pollutants released within and from those facilities. Each program (except the OSH Act) requires that a facility report its releases of regulated pollutants on an ongoing basis and, when applicable, as part of a permit application. The facility provides this information to the government, and it is also available to the public. However, because only regulated pollutants must be reported, and because the lists of what is regulated are so inconsistent, no one (except perhaps the facility’s managers) knows the facility’s total overall releases.

A permit applicant under the Clean Water Act is required to characterize a wastewater discharge, for example, not by identifying all the pollutants in the discharge, but rather by identifying the pollutants that are legally labelled toxic, conventional, or nonconventional. If the permit is issued, the facility must submit to the state regulatory authority periodic discharge monitoring reports describing the concentration of regulated pollutants discharged. The same pattern occurs under the other statutes. Under EPCRA,

313. See 40 C.F.R. § 122.21(g)(7)(i) (conventional and nonconventional pollutants); 40 C.F.R. § 122.21(g)(7)(iii)(A) (toxic water pollutants). The toxic pollutants referred to in this regulation do not include asbestos. Compare tbls. III and IV in 40 C.F.R. pt. 122, app. D (listing 125 of 126 toxic or priority pollutants) with tbl. V (listing asbestos).

Whole effluent toxicity testing is also required for POTWs and is sometimes used for direct industrial discharges to surface waters. See supra notes 116, 120 and accompanying text.

314. See 40 C.F.R. § 122.41(1)(4)(i).

315. In RCRA, too, reporting requirements generally follow the regulatory program. Industrial generators must determine whether their waste is regulated as hazardous waste under RCRA. If it is, they must submit a report to EPA detailing the weight and type of hazardous waste they generated in the previous year. See 40 C.F.R. § 262.11 (hazardous waste determination); 40 C.F.R. § 262.41 (biennial report). Owners or operators of treatment, storage, and disposal facilities must also submit biennial reports to EPA describing, among other things, the type and quantity of each hazardous waste they received in the past year. See 40 C.F.R. § 264.75. A person filing a permit application for such a facility must estimate the composition, quantity, and concentration of hazardous waste that the proposed facility will treat, store, or dispose of. See 42 U.S.C. § 6925(b)(1) (1994).
of course, the whole point of listing a particular pollutant is to ensure public reporting of its releases and transfers.

It is virtually impossible to piece together such reports into a complete picture of the hazardous and toxic pollutants released within and from a facility. Regulated pollutants other than the Toxics Release Inventory chemicals are not reported on a multimedia basis. Although the concentration of a given pollutant being discharged into surface water from permitted facilities under the Clean Water Act must be reported, for example, release of the same pollutant to the air may not be reported because it is unregulated under the Clean Air Act (or because its release to the air is reported merely as particulate or volatile organic compound). In addition, much hazardous waste is reported according to its origin in an industrial process (e.g., electroplating bath wastes, wastewater sludges), or by characteristic, which does not enable comparison with the pollutant-by-pollutant reporting in other programs.

The difficulty in assembling an overall picture of releases from existing data is well illustrated by a joint study by EPA and Amoco Corporation of Amoco’s refinery in Yorktown, Virginia. Although the Toxics Release Inventory is known as the nation’s best source of multimedia release information, the report for that facility accounted for only 2.4% of total releases to air, water, or land. 316 The study found that the Toxics Release Inventory report was based on estimates that were substantially lower than actual releases in some cases, did not include many chemicals that this refinery released, including the most commonly regulated (or criteria) air pollutants, and excluded some activities that account for significant releases. 317

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Under the new permitting program for hazardous air pollutants, an application must include a description of hazardous air pollutants emitted from a facility. See 40 C.F.R. § 70.2 (definition of regulated air pollutant); 40 C.F.R. § 70.5(c)(3)(i). The permittee must conduct sufficient monitoring to ensure compliance with the terms and conditions of the permit, including its emission limitations, and submit reports of required monitoring to EPA or the state environmental agency at least every six months. See 40 C.F.R. §§ 70.6(a)(3)(iii)(A), 70.6(c)(1).

Employers are obliged to monitor for a small number of hazardous materials in the workplace air under the OSH Act. See, e.g., 29 C.F.R. § 1910.1028(e) (benzene). But see 29 C.F.R. § 1910.1200(b)(2) (hazard communication standard for “any chemical which is known to be present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency”).

316. See Amoco Corp. & U.S. Environmental Protection Agency, Amoco-U.S. EPA Pollution Prevention Project, Yorktown, Virginia 1-3 to 1-7 (1992) [hereinafter Yorktown Study].

317. See id. at 1-6 to 1-7.
Reporting requirements under other laws were similarly inadequate. Effluent reporting under its Clean Water Act permit and internal solid waste reporting showed only 11% of the total releases, and the data did not adequately characterize the chemicals in these waste streams.318

Without such information, industry, regulators, and the public cannot properly assess the actual or potential environmental or human health effects of individual facilities. In a system that is ostensibly based on risk, ironically, regulatory agencies routinely approve permits for industrial facilities even though they generally are not fully aware of the risks those facilities could create.

That is precisely what happened in Atlantic States Legal Foundation, Inc. v. Eastman Kodak Co.319 In 1984, the New York Department of Environmental Conservation issued a permit to an Eastman Kodak manufacturing plant. The permit contained effluent limitations for 25 pollutants and required the company to submit monthly discharge monitoring reports to the Department.320 The Atlantic States Legal Foundation sought an injunction against the plant based not on its Clean Water Act discharge monitoring reports but rather on its Toxics Release Inventory report. Atlantic States claimed that the plant discharged substantial quantities of 16 chemicals into the water, and that the discharge of these chemi-

318. See id. at 1-4. For individual media such as air and water, reporting is directed toward compliance with specific effluent or emission standards rather than the actual amount of a particular pollutant being emitted. The lack of TRI-type data on actual emissions of non-TRI hazardous air pollutants makes a complete characterization of the risks of such air pollutants impossible. See SCIENCE AND JUDGMENT, supra note 134, at 148–49.

Even for pollutants that are regulated pervasively at a facility, it is not possible to assemble an inventory of all releases by compiling reports required under different pollution control laws. The reporting requirements include differences between actual and potential releases, differences in time frames used for measurement, differences in facility locations from which releases are reported, and incomplete tracking of raw materials. See Telephone Interview with Stephen Anderson, Project Manager for Facility-Wide Permit Program, New Jersey Department of Environmental Protection (Sept. 1, 1995); see also NATIONAL ADVISORY COUNCIL FOR ENVIRONMENTAL POLICY AND TECHNOLOGY, ENVIRONMENTAL PROTECTION AGENCY, USING INFORMATION STRATEGICALLY TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT 5 (1994) (EPA cannot “combine data on ecosystems, industrial sectors, chemicals, and facilities across programs.”).

319. 12 F.3d 353 (2d Cir. 1994).

320. Discharge monitoring reports have been a fruitful source of citizen suits by individuals and organizations who seek to force compliance with permits and often to collect civil penalties. See generally JEFFREY G. MILLER, CITIZEN SUITS: PRIVATE ENFORCEMENT OF FEDERAL POLLUTION CONTROL LAWS (1987).
cals was unlawful because it was not specifically authorized in the permit.\textsuperscript{321}

The court decided that these unauthorized discharges were not prohibited under the permit. Although the chemicals were toxic under EPCRA, they were not toxic under the Clean Water Act. The court reasoned, in part, that the regulatory scheme as a whole was designed to control directly the most toxic pollutants and to subject certain other chemicals merely to reporting requirements.\textsuperscript{322} The court concluded that "toxic chemicals" could be discharged into a river because the state had determined that they were not actually toxic. Most of the chemicals at issue, however, had not even been brought to the Department's attention during the permit application review.\textsuperscript{323} Neither the state nor the public had been aware of these other chemicals when the permit was approved.

The public trust doctrine underscores the importance of such information to regulatory agencies. The government holds certain natural resources in trust for the public, including outdoor air, surface water, the bottom of navigable waters, and public lands. State agencies must take the public trust into account in making decisions and protect public trust resources whenever feasible.\textsuperscript{324} Virtually every manufacturing facility releases pollutants that will initially or eventually be deposited in or on public trust resources and that may significantly change or reduce the uses to which these public resources can be put.\textsuperscript{325} Air and water pollutants, for example, are discharged directly into the ambient air or into lakes and rivers, which are public trust resources. Many air pollutants are deposited eventually in lakes and rivers or on public lands. Because the operation of these facilities is subject to a legislatively authorized permitting process under the Clean Air Act, the Clean Water Act, and RCRA, it is appropriate for the permitting agency to

\textsuperscript{321} See Atlantic States, 12 F.3d at 356.
\textsuperscript{322} See 12 F.3d at 357.
\textsuperscript{323} The company identified seven of these chemicals in its permit application, but DEC set no effluent limitation for them. The other nine were not even mentioned in the permit application. See id. at 356 n.7.
\textsuperscript{325} See supra notes 236–239 and accompanying text.
ensure that the public is provided with explicit information about releases and their potential effect on public trust resources.326

Inconsistent lists also mean that the information being provided confuses the public and damages the credibility of the overall program. The nation’s environmental laws provide a wide range of opportunities for public participation, and depend on that participation for their effectiveness.327 But participation requires that the public have access to reliable and accurate information. Chemicals not on any list can easily be perceived as nontoxic or nonhazardous. Yet the public lacks information on the health and environmental effects of most chemicals; and unlisted pollutants could have substantial effects at specific facilities.328 For chemicals on one list but not on another, the probability of public confusion is particularly high.329

For industry, inconsistent lists undermine a pillar upon which any legal system must ultimately rest: its ability to be understood by those it affects. In many ways, the pollution control laws have grown in complexity beyond the ability of regulated parties, their attorneys, the public, and even the government to understand them.330 Although much of that complexity is due to the manner in which regulation is conducted, including differences in deadlines, permit-

326. Whether a court would invalidate an agency action for failure to require the preparation and public disclosure of that information would depend on the seriousness of the encroachment, among other things. At a minimum, however, the doctrine suggests an additional reason for disclosure—protection of public resources. In the case of Mono Lake, for example, the California Supreme Court held that the state had an affirmative duty to consider the human and environmental uses of the lake before making water resource planning and allocation decisions. See 33 Cal. 3d at 419.

327. These include public notice of permit applications, the ability of citizens to review permit applications and comment on them, public hearings or meetings on permit applications, and public notice of the government’s decision to approve or deny a permit application. Facility operators are required to supply the government with periodic reports about environmental releases as well as other matters. Citizens are specifically authorized to sue the government for failure to perform required duties and to sue facilities for violating the various statutes and regulations. Employees of these facilities are entitled to basic information about the condition of the indoor air, among other things.

328. See supra notes 133–140, 263–265 and accompanying text.

329. The neat black-and-white world of toxicity and hazardousness suggested by the names of the lists (a pollutant either is or is not hazardous) is also contradicted by modern toxicology, which recognizes a thousand shades of gray. Substances have widely varying degrees of toxicity; the risk of injury depends on the duration, type, and level of exposure; and individuals exhibit widely divergent levels of sensitivity to particular pollutants. See SCIENCE AND JUDGMENT, supra note 134, at 43–66.

330. See Orts, supra note 300, at 1258.
ting, and other requirements, inconsistencies in what is regulated greatly contribute to that complexity. Inconsistent lists make it difficult for companies to track, control, and report on pollutants that are released into different media. Such difficulties are particularly burdensome for small- to medium-sized companies that often lack the resources to hire compliance personnel. Inconsistent lists also undermine compliance efforts because more people will comply with simple rules than with complex ones. Inconsistent lists, in short, do not provide the information needed to support these statutory programs.

V. A Framework for Change

The evidence in this Article indicates two distinct types of problems. On the one hand, inconsistent lists have limited the ability of the programs to reduce toxic and hazardous pollutants. These inconsistencies also demonstrate that there are no black-and-white distinctions between the risks of regulated and unregulated pollutants. On the other hand, inconsistencies among the lists cause the programs to be economically inefficient. They encourage companies to think about their pollutants solely in terms of whether the pollutants are on medium-specific lists. They also limit the control of pollutants to specific media regardless of other releases of the same pollutants from the same facility and regardless of their eventual fate in the environment, and they encourage the use of pollution control expenditures to push pollutants into unregulated media. The process of list development betrays a constant tension between the greater protectiveness of longer lists and their greater cost.

A more focused approach to toxic and hazardous pollutants would help resolve this tension, reducing both costs and risks. The reduced costs of compliance made possible by more consistent regulation could allow a broader, more comprehensive program, and provide the basis for limiting all significant releases from or within industrial facilities.
A. From Pollution Control to Pollution Prevention

Although a variety of means might reduce compliance costs and improve the protectiveness of existing statutes, pollution prevention offers the most substantial opportunities. Pollution prevention reduces environmental and health risks by targeting pollutant generation throughout the manufacturing process instead of only at the point of release. Because pollution prevention involves changes in production and management integral to the manufacturing process, it is more efficient than pollution control devices, which ordinarily contribute little to the process itself. In addition, the materials and energy saved are likely to mean that a company gets a return on its investment. Pollution prevention is marginal-

331. 42 U.S.C. § 13101(a)(2) (1994) (finding “significant opportunities for industry to reduce or prevent pollution at the source through cost-effective changes in production, operation, and raw materials use”). Congress also has declared pollution prevention to be preferable to pollution control. In the Pollution Prevention Act of 1990, Congress declared it to be the “national policy of the United States that pollution should be prevented or reduced at the source whenever feasible.” 42 U.S.C. § 13101(b). The Act then states a hierarchy of preferred options if pollution prevention is not feasible:

[P]ollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.

Id. For a useful discussion of this legislation, see Stephen M. Johnson, From Reaction to Proaction: The 1990 Pollution Prevention Act, 17 Colum. J. Envtl. L. 153 (1992); see also 42 U.S.C. § 6902(b) (1994) (hazardous wastes generation should “be reduced or eliminated as expeditiously as possible”); 42 U.S.C. § 7401(c) (1994) (encouraging use of pollution prevention to achieve clean air); 33 U.S.C. § 1251(b) (1994) (supporting pollution prevention to protect water quality). But see Jeffrey M. Gaba & Donald W. Stever, Law of Solid Waste, Pollution Prevention and Recycling § 9.01 (1993) (describing such statements as “platitude[s]” and “lip service”).

332. Pollution prevention is a better means than pollution control of reducing human health and environmental risks from pollutants. See Reducing Risk, supra note 245, at 22 (arguing that pollution prevention is the preferred option for reducing risk). Pollution prevention also addresses the problem created by lawful releases of certain regulated pollutants, which then accumulate over time and adversely affect aquatic ecosystems. “Preventing pollution altogether is far safer than settling on an acceptable level of pollution and running the risk of underestimating the subsequent adverse effects of the pollution that has been allowed.” Id. at app. C, 122–23; see also Ellen K. Silberfeld, Investing in Prevention: Opportunities to Reduce Disease and Health Care Costs Through Identifying and Reducing Environmental Contributions to Preventable Disease 14–25 (1993) (asserting that prevention programs for environmental pollutants could reduce incidence of low birth weight and asthma as well as attendant health care costs).

ized by the single-medium focus of the control laws, the considerable enforcement machinery that backs them, and by the many ways in which required actions (compliance) crowd out desirable actions (pollution prevention). Because pollution prevention is most attractive to businesses when it is less costly than other choices, moreover, the availability of unregulated media in which to release a pollutant impedes its more widespread use. Differences among reportable pollutants under various statutes also make it difficult for companies to track the flow of materials or pollutants through their processes, and thus to understand or measure the benefits of pollution prevention. The laws, in short, do not provide much direct support or encouragement for pollution prevention.

The problem of inconsistent single-media lists, including the limits they imposes on the effectiveness of medium-specific regulation, strongly supports the case for adopting a prevention approach. Lack of coordination in list-making has produced gaps that leave nearly all controlled pollutants unregulated in at least one medium. Prevention, by targeting pollutants at their manufacturing source, can effect reductions of pollutants even in those media where they are not now controlled. The resulting reductions in pollutants emitted within and from these facilities could produce significant human health and environmental benefits.

The following example illustrates the advantages of this approach. A manufacturing facility uses pollutant Y, which is a regulated hazardous waste and a regulated OSH Act toxic pollutant, but is not directly covered under the other three statutes. Under current practice, the facility might decide to comply in a variety of ways, each of which could produce additional risks. It might send some waste containing pollutant Y off-site for treatment, discharge some waste containing pollutant Y into the nearby publicly owned treatment works, ensure the health of its workers by venting pollutant Y from the workplace into the outdoor air, or discharge it directly into the air or water. Using a prevention strategy, the facility

334. See generally The Source Reduction Review Project, supra note 295.
335. Pollution prevention also makes it possible to reduce or eliminate pollutants that are unregulated in any medium.
336. This point is usually made with success stories from individual facilities that have already implemented pollution prevention. See, e.g., Joseph J. Romm, Lean and Clean Management: How to Boost Profits and Productivity by Reducing Pollution 4–5 (1994).
337. Depending on its physical and chemical characteristics, a pollutant may or may
might instead decide to comply by discontinuing its use of pollutant $Y$ in the manufacturing process. Pollutant $Y$ would then not be emitted into any medium.

In addition to producing more comprehensive protection from environmental and health risk, pollution prevention allows protection to be achieved at lower cost. One way prevention does this is by reducing the inefficiency resulting from cross-media transfers of pollutants from regulated to unregulated media. As already shown, such transfers reduce the level of protection obtained from pollution control expenditures because reductions in one medium are offset by increased releases in another. By reducing the release of pollutants into all media, prevention techniques can eliminate these wasted expenditures.

Pollution prevention can also reduce compliance costs for industry by avoiding the expense associated with adopting new or additional control techniques whenever a pollutant is regulated in a new medium. Consider the case of a facility that in 1978 installed a wastewater treatment system to control the release of pollutant $Z$ (a newly listed toxic pollutant under the Clean Water Act) into the nearby river. The system removed pollutant $Z$ from the water and allowed it to be released into the air, where it was not then regulated. With the passage of the 1990 Clean Air Act amendments, however, pollutant $Z$ has become a hazardous air pollutant. The facility must now install controls to prevent the release of pollutant $Z$ into the air. If the facility had decided in 1978 to continuously recycle pollutant $Z$ within the plant as part of its manufacturing process—a pollution prevention approach—it would not have incurred these additional costs.

B. Multiple Media Priority List

Congress should adopt a list of pollutants that present substantial risks in multiple media. This multi-media list would resolve inconsistencies in the lists and provide for more thorough regulation of toxic and hazardous pollutants. In addition, a program based on this list would aim at ambitious pollution prevention and would demonstrate means of achieving pollution prevention that could be applied to other pollutants. While it may be necessary to backstop the list by closing regulatory gaps for pollutants not
controlled in particular media, pollution prevention would be the primary focus of this list.

A practical starting point for the development of such a list is the multi-media list created under EPCRA. Use of this list would offer several advantages. The fact that the release and transfer of pollutants on the EPCRA list are publicly reported provides a baseline from which to measure reductions and gauge achievement of reduction goals. Use of an existing list would also be less disruptive and confusing to business, the public, and government agencies.

Congress could select those Toxics Release Inventory pollutants presenting the greatest risks to both human health and the environment in multiple media, based on recommendations from EPA and OSHA. Such a process would likely result in the selection of many metals, persistent and bioaccumulative organic chemicals and carcinogens, among others. Congress might consider adding pollutants important to particular ecosystems, such as the Chesapeake Bay or the Great Lakes. In addition, Congress could include a process for developing specialized lists for particular industries. At least initially, however, the effectiveness of the list in focusing industry reduction efforts will likely be enhanced by development of a relatively short list. An overly long list could overwhelm the capacity of regulatory agencies and impose unacceptably high costs on industry.

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not be regulated indirectly under the Clean Air Act or Clean Water Act. See supra notes 104–111 and accompanying text.

338. The development of such a list would not be easy. It would require comparing and weighing different types of human health and environmental effects. It would necessarily rely on data of inconsistent quality, leading to conclusions with different levels of certainty. See DAVIS, supra note 246. Nevertheless, a multi-media list is preferable. In addition, it would represent a starting point for a multi-media approach to all pollutants released from or within a facility. See infra Part V.E. See generally Paul A. Locke, The Limitations of Comparative Risk Assessment, 2 SHEPARD'S EXPERT AND SCIENTIFIC EVIDENCE (1994); Donald T. Hornstein, Reclaiming Environmental Law: A Normative Critique of Comparative Risk Analysis, 92 COLUM. L. REV. 562 (1992).


In order to remain effective over time, the legislation should require periodic review, updating, and expansion of the list. Chemicals or chemical classes should be added based on their toxicity and persistence in multiple media, including their ability to bioaccumulate. Equal weight should be given to human health and ecological effects, and consideration given to long-term impacts on human health. The list also should be updated to respond to new information about the effects of particular pollutants.

Creation of a focused multi-media list would encourage the use of pollution prevention by identifying a relatively narrow set of pollutants as the primary targets of prevention efforts. It would also remove the single-medium compliance options available under current law that act as disincentives to pollution prevention. A Business Roundtable study of companies with the greatest commitment to pollution prevention found that their prevention projects had to compete with other capital projects for funding, while compliance projects did not. This occurred even though the companies currently spent more on traditional forms of compliance than on prevention, and despite the fact that the companies indicated a preference for devoting these resources to prevention techniques. Regulation based on a multi-media list would provide a strong incentive to choose pollution prevention, at least with respect to this group of pollutants.

The complexity of managing such a significant change in regulatory practice also supports an initial effort based on a relatively short multi-media list. A national program to encourage pollution prevention will force state regulatory agencies and the EPA to substantially rethink their traditional roles. On a practical level, pollution prevention will require agencies to create new methods for conducting inspections and issuing permits. This will include the development of new technical expertise among agency staff. More broadly, the switch from single-medium pollution control to facility-wide prevention is likely to present enormous administrative, technical, and legal challenges for affected parties. While a

341. See Business Roundtable, Facility Level Pollution Prevention Benchmarking Study 10, 12 (1993); see also From Pollution to Prevention, supra note 300, at 1 ("Industry's attention and resources go primarily to industrial compliance.").
342. See generally Yorktown Study, supra note 316.
facility-wide approach can produce substantial benefits,\textsuperscript{343} it would be appropriate to begin with a smaller list of pollutants.\textsuperscript{344}

Once begun, the information and experience gained from such an effort should make later regulation of additional substances more manageable and less costly. For example, many industrial facilities currently have only rudimentary techniques for tracking and measuring pollutants emitted during the course of production.\textsuperscript{345} A modest list of pollutants would provide an opportunity to develop and perfect these systems. In general, progress on a relatively short list will allow industry to build on what it already knows about pollution prevention, and to develop the additional expertise it needs to implement a broader program of prevention cost effectively.

A focused multi-media list would thus create a platform for a program to reduce pollution risks through the use of prevention techniques, as well as for demonstrating the legal and technical feasibility of the prevention approach. The effect would be to give greater emphasis to the development and implementation of ecologically efficient solutions, encourage their use on a broader scale, and move pollution prevention from the margins to the center of the nation’s environmental protection efforts.

\textbf{C. Reduction Goals}

Environmental and occupational health programs succeed to the extent that they reduce pollutants. Paper measures, such as the number of permits issued or denied, or the number of enforcement actions taken, should be secondary to actual reduction.\textsuperscript{346} Congress

\begin{footnotesize}
\textsuperscript{343} Facility-wide approaches are commonly held to promote administrative efficiency, simplification and standardization of requirements, lower costs, reduction in cross-media transfers, and greater pollution prevention. \textit{See, e.g.}, \textsc{General Accounting Office, Environmental Management: An Integrated Approach Could Reduce Pollution and Increase Regulatory Efficiency} (1996); \textit{see also} \textsc{National Commission on the Environment, Choosing a Sustainable Future} 97–104 (1993); Lakshman Guruswamy, \textit{The Case for Integrated Pollution Control}, 54 \textsc{Law \& Contemporary Prob.} 41 (1991); Frances H. Irwin, \textit{An Integrated Framework for Preventing Pollution and Protecting the Environment}, 22 \textsc{Envtl. L.} 1 (1991).

\textsuperscript{344} \textit{See} James E. Krier \& Mark Brownstein, \textit{On Integrated Pollution Control}, 22 \textsc{Envtl. L.} 119 (1992); \textit{see also} \textsc{Charles Lindblom, The Policy Making Process} (1968) (advocating incremental development of policies based on experience over time).

\textsuperscript{345} \textit{See, e.g.}, Yorktown Study, \textit{supra} note 316, at 1–17.

\textsuperscript{346} \textit{See} \textsc{Governmental Performance and Results Act of 1993, Pub. L. No. 103-62},
should thus direct that pollutants on the list (or lists) be subject to steep reductions in their generation as well as their release into all media. The reductions in this multi-media program would be expressed in the form of percentage decreases in the generation and release of pollutants by specific dates. At a minimum, these goals should effect reductions in the generation and release of pollutants from or within manufacturing facilities. The percentage reductions should be great enough to reduce significantly the risks presented by these pollutants, but over a long enough period of time (say five to ten years) to allow industry to meet the goals with minimal disruption. The reductions could also be expressed as reductions in the amount or toxicity of pollutants generated per unit of product produced; they could be uniform or could vary by industry. We do not know how much loading of these pollutants the environment or human health can withstand without significant damage. A long-term goal, then, of not generating or releasing any of these pollutants would also be wise.

The directness and relative simplicity of this approach are attractive. Statutory goals for reductions demonstrate a clearer public commitment to improved environmental quality than best avail-


347. The goals could be set directly by Congress, or Congress could authorize EPA to set the goals, perhaps using a process involving stakeholders, such as regulatory negotiation.

348. One form of pollution prevention, toxics use reduction, is often urged as an alternative to other types of pollution prevention. As its name suggests, toxics use reduction focuses on reducing the use of toxic or hazardous pollutants at manufacturing facilities, regardless of whether they are released directly to the environment from the facility.

349. It is possible to develop an index showing the relationship between production and releases by using current reporting requirements. See 42 U.S.C. § 13106(b)(1)–(5) (1994). Such an index would not be reliable, however, because it would not reflect substitution of raw materials, product redesign, or changes in estimation methods from year to year. Because TRI reporting is based on aggregate releases and transfers from a facility, such an index also would not show changes in one line of production at a facility that has two or more lines of production. See Office of Pollution Prevention and Toxics, Environmental Protection Agency, Issues Paper #2: Expansion of the Toxics Release Inventory (TRI) to Gather Chemical Use Information 12–13 (1995) [hereinafter Issues Paper #2].

able technology and related requirements. They would also be more understandable to industry than the current matrix of control laws, and could provide a stable basis for long-term planning. The legislation could give EPA, states, and companies great flexibility in the means chosen to achieve these goals. Because of this flexibility, and because pollution prevention offers a direct opportunity for returns on investment, companies are likely to see economic benefits or, at worst, relatively low costs. When companies can choose among pollution prevention options, they are likely to choose those that provide the greatest economic return. If higher costs do occur, such expenses would at least be more cost-effective because the company would have invested in more efficient manufacturing processes and would not have moved pollutants to another medium. In addition, such goals are also likely to foster better protection of human health and the environment by controlling pollutants in all media, including those in which they are not now regulated.

Incentives would play a substantial role in ensuring the effectiveness of this proposal. An existing incentive, of course, is avoidance of regulatory requirements. To the extent that facility operators stop generating pollutants, they no longer have the related set of requirements with which to comply. Technical assistance as well as loans or small grants, standard features of state and federal pollution prevention programs, should also be provided to help meet these goals. Such assistance especially should be directed to small- and medium-sized companies that release these pollutants. These incentives should be supplemented with whatever other

351. See Ackerman & Stewart, supra note 259, at 1351–55.

352. Inevitably, some facilities would respond to this new system by attempting to increase releases of pollutants that are not on the multi-media list. Such releases would be prohibited if they would cause existing standards under any of these statutes to be violated. In some cases, though, the increase would be in releases of pollutants that are not regulated in the medium to which they are released. When that occurs, the increase should be prohibited unless, at a minimum, the facility operator clearly and convincingly demonstrates that the newly introduced pollutant poses less risk to human health and the environment than the pollutant it is replacing. In a limited way, this procedure shifts the burden of proof on unregulated chemicals from government to industry. This procedure is analogous to the burden-shifting provision in California’s Safe Drinking Water and Toxic Enforcement Act of 1986, CAL. HEALTH & SAFETY CODE § 25249.9 (West 1992). The discharge of any chemical listed under that statute is prohibited unless the operator shows the discharge to be limited in amount and otherwise lawful. See id.

inducements are reasonable and effective. As others have recognized, pollution prevention approaches tend to involve government, industry, labor, and citizens as partners rather than as adversaries.  

Finally, EPA and OSHA should be obliged to conform new and existing regulations to the goals of this reduction program. Conforming activities would include standardizing requirements now established for individual media, and repeal or modification of regulations that interfere with the achievement of these goals. The legislation should also authorize EPA and OSHA, in cooperation with the states, to adopt, modify, or repeal regulations when necessary for achievement of deep reductions in existing releases.  

Fortunately, the nation has some experience with chemical-specific multi-media programs. The most prominent of these is the 33/50 program, in which EPA sought to persuade industry to voluntarily reduce its releases and off-site transfers of 17 EPCRA chemicals by 33% in 1992 and by 50% in 1995. A company’s decision to participate in the 33/50 program, although voluntary, did not oblige the company to reduce its releases or transfers in any particular way; it could do so in whatever way seemed most appropriate. Companies reported a 50.7% reduction in releases and transfers of the 17 target chemicals in 1994, meeting the final goal a year early.  

The reduction program proposed here has many of the characteristics of the 33/50 program. First, it would target a specific

354. See ROMM, supra note 336, at 51–58; EPA's Five Year Strategic Plan, supra note 235, at 20–21.  
355. In May 1995, EPA started to develop a series of pilot projects (called XL projects) in which a limited number of regulated entities will be allowed to replace or modify existing requirements if they produce greater environmental benefits. See 60 Fed. Reg. 27,282, 27,283 (1995); National Science and Technology Council, Bridge to a Sustainable Future 30 (1995) (stating that Project XL program “will require reductions in discharges below current regulatory standards in exchange for greater flexibility in achieving environmental objectives”). The multi-media approach proposed here differs from Project XL in that EPA (as well as OSHA) would have statutory authority to waive or modify requirements that interfere with statutory goals.  
356. The baseline from which reductions were to be calculated was 1988 levels. See TRI Public Data Release, supra note 15, at 273. The 33/50 goals apply to off-site transfers for treatment and disposal, but not for recycling or energy recovery. The latter were not reportable in 1988, the first reporting year for the program. See id. at 274.  
357. See id. at 274–75. By 1992, releases and transfers were reduced by 40.2%, significantly exceeding the interim goal. See id.  
358. Other pollutant-specific reduction programs have also been effective. See, e.g., Dallas Burtraw & Byron Swift, A New Standard of Performance: An Analysis of the Clean Air Act's Acid Rain Program, 26 Envtl. L. Rep. (Envtl. L. Inst.) 10,411 (1996) (describing significant reductions in sulfur dioxide emissions at “remarkably low compliance costs”
list (or lists) of chemicals at their source. Second, it would seek reduction in the release and generation of these chemicals by a specific amount by a set date. Unlike the single-medium statutes, the proposal would limit the overall amount of toxic and hazardous pollutants being generated and released, thus effecting true reductions in pollutant loading. This approach is particularly important for pollutants, such as those on the multimedia list, that do not break down over time. Third, no particular method of achieving a reduction of these pollutants would be required. Companies would be encouraged to find ways of preventing pollutants as cost-effectively as possible.

Unlike the 33/50 program, however, statutory reductions would appear to be preferable to voluntary reductions. Voluntary programs simply do not command the same respect or attention as do statutory programs. As already explained, the existing regulatory framework’s fragmented single medium focus marginalizes pollution prevention. Without statutory goals mandating a change in approach, pollution prevention will likely remain at the sidelines. Of equal importance, a statute would facilitate needed changes in requirements under the single medium statutes to ensure that prevention goals are not undermined. Unlike the requirements in single medium statutes, however, achievement of these goals would be encouraged by significant technical or financial incentives.

resulting from a Clean Air Act program); Barry Commoner, Failure of the Environmental Effort, 18 Envtl. L. Rep. (Envtl. L. Inst.) 10,195 (1988) (describing success of several government programs to reduce or prohibit specific pollutants, including lead in gasoline, DDT, and PCBs).

359. See supra note 334 and accompanying text.

360. The program would also have a narrower focus than 33/50. Because pollution prevention means the reduction in overall generation of waste that requires treatment, recycling, disposal, or release into the environment, see 42 U.S.C. § 13102(5) (1994), it does not include off-site recycling or energy recovery, and it does not include end-of-pipe control technologies. Yet the great majority of the 33/50 program reductions are based on those methods rather than on pollution prevention. See TOXICS WATCH, supra note 270, at 499, 511–12. Although a reduction in the amount of toxic chemicals released is a positive development, off-site recycling and energy recovery present risks to workers and to the environment. See SERIOUS REDUCTION OF HAZARDOUS WASTE, supra note 312, at 105. Achievement of goals for reducing the release and transfer of pollutants will help protect human health and the environment, but achievement of pollution prevention goals is preferable.
D. Public Reporting of All Toxic or Potentially Toxic Pollutants

A basic way of including pollutants in a regulatory program—and a prerequisite for the success of a pollution prevention program—is to require public reporting of their generation and release. The Toxics Release Inventory has already led to lower levels of releases and transfers for most reported chemicals, whether they are otherwise regulated or not. The Toxics Release Inventory's ability to reduce environmental releases, its multi-media nature, and its relatively limited regulatory consequences make it a logical and attractive vehicle for implementing a more comprehensive approach. Further expansion of the Toxics Release Inventory would likely help shift the emphasis of the other four programs toward pollution prevention.

Although some companies have developed information about all environmental releases from specific facilities (e.g., Amoco's Yorktown refinery), they appear to be the exception rather than the rule. A major objection is cost, particularly at large, complex facilities. The program, therefore, should focus initially on developing a cost-effective system for reporting releases that would address these concerns. The consolidation of reporting requirements from various programs would be a major step in that direction. The expanded Toxics Release Inventory should be directed at several additional endpoints.

An expanded Toxics Release Inventory should include all toxic or potentially toxic pollutants generated by a facility. Chemicals would not need to be reported if the facility has fewer than ten employees, the current Toxics Release Inventory reporting threshold. In addition, chemicals would not need to be reported if they were used in lower quantities than the present reporting thresholds, or if the facility operator demonstrated that they pose no

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362. See Yorktown Study, supra note 316, at 1-4 to 1-5.


364. See supra notes 84-86 and accompanying text.
meaningful risk to human health or the environment. An expanded inventory of toxic or potentially toxic pollutants would be helpful to industrial facility operators because they would find inefficiencies in their processes and better understand where materials are being lost.

An expanded inventory would also provide the public and government agencies with a better opportunity to understand releases than is currently available. Public information about pollutants in permit applications would be consistent with the expanded Toxics Release Inventory data, thus enabling easy comparison of releases among various media. When approving such applications, the regulatory agency would at least be fully aware of the releases that it is authorizing, and would have disclosed that to the public. Such an inventory would provide a more informed basis on which to make permitting and enforcement decisions, to recognize cross-media trade-offs, to reduce risk from the facility, and to measure progress in reducing pollutant generation and releases.

In addition to requiring expanded information, the Toxics Release Inventory should encourage pollution prevention by requiring facilities to report the extent to which they have reduced or eliminated pollution at the source. Thus the Toxics Release Inventory would directly quantify pollution prevention. The expanded Toxics Release Inventory should also include materials accounting information, such as the quantities of toxic chemicals brought to a site, consumed or produced there, and shipped off site in the product or another form. Materials accounting can substantially enhance the

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365. See supra note 352. A duty to report the total amount of exempted chemicals might be helpful, however.

366. Compare Atlantic States Legal Foundation, Inc. v. Eastman Kodak Co., 12 F.3d 353, 357–58 (2d Cir. 1994) (NPDES permittee may lawfully discharge pollutants even though it was not authorized in permit) with Sierra Club, Lone Star Chapter v. Cedar Point Oil Co., 73 F.3d 546 (5th Cir. 1996) (NPDES permittee may not discharge pollutants unless expressly authorized).

367. Facilities are not currently required to report this information. See Issues Paper #2, supra note 349, at 9–13; Toxics Watch, supra note 270, at 169–77.

368. Materials accounting uses best engineering judgment to estimate all inputs and outputs of materials into a facility, including raw materials purchases, inventory stocks, sales, and environmental releases. See Shelley Hearne, Materials Accounting as a Potential Supplement to the Toxics Release Inventory for Pollution Prevention Measurement Purposes: A Case Study of New Jersey Throughput and TRI Data 54 (1993); see also Toxics Watch, supra note 270, at 415–90 (discussing materials accounting data from New Jersey and Massachusetts).
quality of pollution prevention at a facility with little additional cost.\textsuperscript{369}

Another goal for the expanded Toxics Release Inventory should be to provide better information about exposure to pollutants in the workplace. Because the Toxics Release Inventory data are based on releases or transfers of pollutants from a facility, they do not measure releases within a facility, which would affect those working there. A facility-wide approach to toxic and hazardous pollutants requires the integration of environmental and occupational health reporting.\textsuperscript{370}

\textit{E. Reduction of Other Pollutants}

Because the federal government's unwillingness or inability to list a particular pollutant does not necessarily reflect the risk it may present to human health or the environment, unregulated pollutants should be a source of concern. An expanded and modified Toxics Release Inventory would provide additional information about the generation and release of such pollutants, but it would not provide any long-term direction for what should be done about them.

The human health and environmental risks of this unregulated pollution are not likely to be trivial. The disparities among the lists provide a way of understanding how much pollution is still unregulated. Congress should thus, at a minimum, set a long-term goal of using facility-wide pollution prevention to reduce generation and release of such pollutants to as close to zero as possible. Congress also should encourage and support the development of facility-specific reduction goals for such pollutants. Facility-wide pollution prevention appears to be the best way of protecting human health and the environment against releases from or within a facility. A facility-wide approach would help ensure the reduction

\textsuperscript{369} See \textit{Toxics Watch}, supra note 270, at 148–51. See generally \textit{Committee to Evaluate Mass Balance Information for Facilities Handling Toxic Substances, Tracking Toxic Substances at Industrial Facilities: Engineering Mass Balance Versus Materials Accounting} (1990) (concluding that materials accounting approach would further purposes of EPCRA but recommending pilot study). \textit{But see Toxics Watch, supra} note 270, at 13–16 (explaining that requirements for materials accounting data in New Jersey and Massachusetts, which can be understood as pilot studies, show that materials accounting data are essential for pollution prevention planning).

\textsuperscript{370} See \textit{Issues Paper \#2, supra} note 349, at 20–21 (discussing data collection options for occupational exposure to TRI pollutants).
of pollutants about which there is inadequate information to support listing under the multi-media list or under any of these statutes. The reality, again, is a plethora of chemicals about which we have little basic human health information, much less information about synergistic, ecological, or long-term noncarcinogenic human health effects. The efficient regulation of a relatively short list of pollutants has little meaning without steady and inexorable progress toward pollution prevention based reductions for all pollutants at a facility.

The information and experience developed in implementing pollution prevention for pollutants on the multi-media list and the expanded and modified Toxics Release Inventory program should help provide the basis for facility-wide pollution prevention efforts for pollutants generated at a facility. For example, Congress could direct the creation of facility-wide goals for all pollutants released from or within particular types of industrial facilities. This process could continue until all facilities were subject to such goals. Alternatively, the expanded and modified Toxics Release Inventory, coupled with voluntary goal setting by individual facilities with the participation of affected citizens, could lead to reductions independent of any additional regulatory activity. Either approach, of course, would require incentives.

VI. Conclusion

We all learn, or should learn, from experience. Even as we answer problems, we gather information that we can use later to solve similar problems or to revisit previous answers to the same problem. In response to human health and environmental risks created by toxic and hazardous pollutants, Congress adopted or authorized the adoption of separate lists of such pollutants for each of five statutes—the Clean Water Act, the Clean Air Act, the Resource Conservation and Recovery Act, the Occupational Safety and Health Act, and the Emergency Planning and Community Right-to-Know Act. To a great extent, the lists were developed in response to EPA’s inability to regulate toxic and hazardous pollutants on a pollutant-by-pollutant basis. They provide a means for substantial environmental and human health protection because they
direct particular regulatory programs at hundreds of individual pollutants.

The success of these programs is limited, however, by the lists on which they are based. The overwhelming majority of pollutants that are regulated as toxic or hazardous in at least one environmental or occupational health program are virtually unregulated in others. Some of these inconsistencies are due to differences in effects of individual pollutants in different media (water, land, indoor air, outdoor air). The procedures used to develop the lists are so different from one another, however, that they cannot be reconciled to form a coherent system. Many significant pollutants were omitted from the lists to keep program costs manageable. Perhaps the single most important lesson from an analysis of inconsistent lists is that there is no bright line separating the regulated and unregulated pollutants. Because the list modification criteria are both inconsistent and difficult to meet, prospects for more coherent regulation under the current approach are dim.

Inconsistencies among the lists also create two additional problems. They create an incentive to push pollutants into the environment in media where they are not regulated. They also lead to substantial ignorance of what pollutants are being released by a facility. This lack of information compromises both the public’s ability to understand and participate in these programs as well as the government’s and the facility operator’s ability to make knowledgeable decisions to protect human health and the environment. The sheer scale of inconsistencies in the five lists indicates that these problems are substantial.

A facility-wide or cross-media approach based on pollution prevention provides an attractive foundation for a legislative response to this problem. The legislation would target a specified list of the most toxic and hazardous pollutants in all media. Facilities emitting these pollutants would be required to reduce the generation and release of these pollutants by substantial amounts over a specified period, but would be given great flexibility in doing so. In addition, the public reporting of pollutant generation and releases under the Emergency Planning and Community Right-to-Know Act would be expanded to include all toxic or potentially toxic pollutants generated by a facility. These changes would focus the nation’s programs for toxic and hazardous pollutants and simultaneously ensure that information about the generation and
release of other pollutants is available and understandable. They would provide the basis for a long-term and even more protective approach—preventing any pollutants from being generated at a facility.

In the final analysis, the debate should not be about success or failure of current approaches, but about what we have learned and how to improve. We are unlikely to reduce toxic and hazardous pollutants further, or to decrease the costs of regulation, until we do both together. When we focus on the pollutants themselves, we have that opportunity.