BEYOND THE SMOKESTACK: ENVIRONMENTAL PROTECTION IN THE SERVICE ECONOMY

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When our pollution control statutes were drafted in the 1970s, smokestack sources sat squarely in these laws' regulatory cross hairs. Over the past few decades, however, manufacturing's relative importance has declined while the service sector has ascended to a position of dominance in America's economy. Yet consideration of services remains almost entirely absent from environmental law and policy scholarship. In this Article, Professor James Salzman addresses the implications for environmental protection of the service sector's ascent.

Commentators have suggested that the ascent of services provides an important path toward sustainable development. In Part I of this Article, Salzman examines the phenomenon of deindustrialization, analyzing statistics on employment, productivity, and economic activity over the last three decades to describe the relative fortunes of the service and manufacturing sectors. He explores the physical implications of these developments and demonstrates two key findings at odds with common wisdom. First, despite the undeniable growth of services in employment and economic activity, manufacturing in America has not declined. Indeed, in absolute terms we are manufacturing more than ever before. Second, improvements in material intensity have been offset by increasing levels of economic activity.

In Part II, Salzman considers how best to reduce the environmental impacts of specific services, delineating two categories of services with distinct implications for law and policy—"smokestack services" and "cumulative services." In Part III, he employs a fundamentally different type of approach, focusing not on the impact of the services themselves but on their ability to reduce environmental impacts throughout product life cycles. Such "leverage services" raise intriguing possibilities for environmental protection because, while not necessarily causing significant

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environmental impact in their immediate activities, their commercial links provide a uniquely effective fulcrum to leverage environmental improvements upstream and downstream in the life cycle. This strategy of focusing on leverage services instead of the polluting activities themselves presents a novel vision of environmental protection, moving from a narrow focus on production and disposal to energizing the web of commercial relationships.

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INTRODUCTION

Sometimes new notions capture our fancy, resonate to some element of our experience, and color the way we see the world. The concept of a post-industrial society is just such a notion. It gives voice to our experience of big changes, shapes our perceptions of their tone and texture, and organizes our understanding of their direction. But the notion obscures the precise location of those changes and their meanings.¹

[T]he service-oriented economy—the Information Revolution—and sustainability are synergistic. . . . [G]reater environmental efficiency will require as an enabling capability the Information Revolution, while the latter will in turn be strongly encouraged by the need for the former, and . . . the two will be integrated into an economic structure heavily focused on services.²

Picture a dirt-streaked factory shrouded in smoke, leaking effluent, churning out drums of waste. To most people, such stark images evoke the classic environmental problems of our economy. And for good reason. When the drafters of our pollution control statutes surveyed the landscape in the 1970s, smokestack industries filled their frame. But what if this vision of environmental threats, still resonant today, has become largely irrelevant? What if we have transformed from a manufacturing-based to a service-based economy?

This is no idle speculation, for the service sector now dominates America's economy, supplying more than three-quarters of our gross domestic product (GDP) and four-fifths of our employment.³ Over the past few decades, manufacturing's relative economic importance has dramatically declined (a phenomenon known as "deindustrialization"). In 1970, roughly one in four workers was employed in manufacturing. By the year 2005, not one in eight will be.⁴ Over the same period, employment in services has

1. STEPHEN S. COHEN & JOHN ZYSMAN, MANUFACTURING MATTERS: THE MYTH OF THE POST-INDUSTRIAL ECONOMY 26 (1987).

2. Brad Allenby, *Clueless*, ENVTL. F., Sept.–Oct. 1997, at 26, 36.

3. See Dorothy I. Riddle, *The Role of the Service Sector in Economic Development: Similarities and Differences by Development Category*, in THE EMERGING SERVICE ECONOMY 83, 86 (Orio Giarini ed., 1987); *The Manufacturing Myth*, ECONOMIST, Mar. 19, 1994, at 91, 91.

4. See BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, STATISTICAL ABSTRACT OF THE UNITED STATES, 1997, at 416 [hereinafter 1997 STATISTICAL ABSTRACT]. Manufacturing's share of national employment has been in a steady decline since the 1970s—26.4 percent in 1970 compared to 16.4 percent in 1995. See *id.* at 415. A similar phenomenon has taken place in other

correspondingly increased, and not just in flipping burgers. Most often the jobs have been knowledge-based, marking a shift from material-processing to information-processing activities.⁵ Just think of the transformations of Pittsburgh and Cleveland from dirty centers of steel and chemical production to hubs of clean, high-tech services. As *The Economist*, hardly a radical publication, has bluntly asserted: "It is still common to refer to [Organization for Economic Cooperation and Development] members as the 'industrialized economies.' Common, yet quite wrong."⁶

What are the environmental implications of this transition? Does the rise of services pose important new challenges, or perhaps powerful opportunities, for environmental protection? Surprisingly, no one seems to know. More surprisingly, almost no consideration has been given to these questions. While literally thousands of books and articles have explored the implications of smokestack industries for environmental law and policy, a mere handful have considered the service sector. No legal scholarship has focused on the subject.⁷

This is not a trivial oversight. The advent of a new economic order has broad policy implications for environmental protection. It is widely believed that services are displacing and substituting for manufacturing activity. Some scholars view this as an environmentally benign development, presaging a significant shift from transformation of materials to processing

modern industrial economies. See ROBERT ROWTHORN & RAMANA RAMASWAMY, INTERNATIONAL MONETARY FUND, DEINDUSTRIALIZATION—ITS CAUSES AND IMPLICATIONS 8 (International Monetary Fund Econ. Issues Series No. 10, 1997).

5. See Thomas A. Stewart, *The New Era: Welcome to the Revolution*, FORTUNE, Dec. 13, 1993, at 66, 76.

6. *The Manufacturing Myth*, *supra* note 3, at 91. The Organization for Economic Cooperation and Development (OECD) is an international governmental organization dedicated to the promotion of policies that expand growth in market-based economies. Its 29 members include all of the major industrialized modern economies.

7. As the EPA's Office of Policy has stated, "[t]he U.S. pollution control system is primarily focused on primary production industries such as manufacturing, mining, and agriculture. Comparatively little analysis exists regarding the environmental impacts of service sector industries." U.S. Env'tl. Protection Agency, *Environmental Implications of the Service Sector* (visited Oct. 31, 1999) <<http://www.epa.gov/opesdweb/implicate.html>>. An April 6, 1999, LEXIS/NEXIS search of "environmental protection and service sector" produced 269 articles, none of which focused on the implications of the service sector for environmental protection. The failure of environmental scholars to consider these issues is shared by other disciplines as well. Jonathan I. Gershuny writes that services "dominate the modern economy, but yet are almost completely absent from economic theorizing." Jonathan I. Gershuny, *The Future of Service Employment*, in THE EMERGING SERVICE ECONOMY, *supra* note 3, at 105, 106.

For thoughtful reflections on the environmental implications posed by the ascent of the service economy, see generally Allenby, *supra* note 2, David Rejeski, *An Incomplete Picture*, ENVTL. F., Sept.-Oct. 1997, at 26, and Bruce Guile & Jared Cohon, *Sorting Out a Service-Based Economy*, in THINKING ECOLOGICALLY: THE NEXT GENERATION OF ENVIRONMENTAL POLICY 76 (Marian R. Chertow & Daniel C. Esty eds., 1997).

of information.⁸ It may be that Karl Marx's basic insight—that the means of production drive the forms of social relations—is relevant.⁹ If the rise of services signals a fundamental change in means of production and patterns of consumption, then the law must adapt accordingly. Otherwise environmental law's focus on smokestack sources risks "becoming a Maginot Line: strong, powerful, bristling with legalistic weaponry, providing comfortable but illusory control and dominance—and increasingly irrelevant."¹⁰

The contrast between environmental law's treatment of smokestack industries and its treatment of services certainly could not be more stark. Pollution from manufacturing is easy to identify, well characterized, and well understood. Years of regulatory experience supported by countless research studies have assembled a sophisticated arsenal of policy weapons to reduce smokestack emissions. And services? They seem largely forgotten. Perhaps it is assumed that they are clean, that they have an insignificant impact. Yet we ignore the environmental impacts of services at our peril, for they power economic activity in developed countries and will increasingly do so. Serious, explicit consideration of the service sector—the other 75 percent of the economy—and its many implications for environmental protection is long overdue. This Article thus addresses two related issues: (1) whether the rise of the service sector has been environmentally benign or malign, and (2) how government should best shape regulatory policy to address specific services.

Part I of the Article explores the phenomenon of deindustrialization. Few would deny that big—some would say tectonic—economic changes are

8. As I explain in Part I.C, this theory has been proposed by a number of scholars. See, e.g., Graciela Chichilnisky, *The Global Environment in the Knowledge Revolution*, in MANAGING HUMAN-DOMINATED ECOSYSTEMS (forthcoming 1999) (on file with author); Allenby, *supra* note 2, at 35; Mark Sagoff, *Do We Consume Too Much?*, ATLANTIC MONTHLY, June 1997, at 80.

9. The materialist aspect of Marxist thought argues that the economic substructure determines the legal and intellectual superstructure. In a typical passage, Marx argues that [i]n the social production of their life, men enter into definite relations that are indispensable and independent of their will, relations of production which correspond to a definite stage of development of their material productive forces. . . . The mode of production of material life conditions the social, political, and intellectual life process in general.

Karl Marx, *Preface to A Critique of Political Economy*, in KARL MARX: A READER 187, 187 (Jon Elster ed., 1986). Marx was writing about more dramatic economic transformations (e.g., feudalism to capitalism) and, were he reading this Article, might well argue that the service economy does not require entirely new relations of production. The law's evolution in response to moderate changes in economic relations, though, is well established. As an example studied by most first-year contracts students, consider the famous holding in *Hadley v. Baxendale*, 156 Eng. Rep. 145 (1854) (limiting expectation damages for consequential harm). Charles Knapp and Nathan Crystal describe "the now conventional notion that the *Hadley* decision was more or less consciously an attempt to protect infant industries in the early stages of the industrial revolution." CHARLES KNAPP & NATHAN CRYSTAL, PROBLEMS IN CONTRACT LAW, CASES AND MATERIALS 920–21 (3d ed. 1993).

10. Allenby, *supra* note 2, at 35.

afoot. While trendy labels such as “the information economy,” “the service economy,” “the postindustrial economy,” and “the information revolution” joust for paradigmatic pride of place, the nature of these changes and their interconnections have not been clearly articulated. Part I examines the phenomenon of deindustrialization, exploring it in the larger context of other current economic transformations. It describes the shape and content of the heterogeneous collection of enterprises comprising the service sector, identifying the activities and forces that have spurred the uninterrupted expansion of the service sector over the past five decades. Part I also explores the physical implications of these findings. If information and services are substituting for material processing and polluting activities, we would expect to see “dematerialization” of the economy—a reduction of energy and material input per unit of GDP. Part I assesses, at a macro level, the evidence supporting this contention and explores the linkages between increased access to information, the growth of services, and consumption of resources.

The analysis in Part I demonstrates two key findings at odds with common wisdom. First, despite the undeniable growth of services in employment and economic activity, manufacturing in America has *not* declined. Indeed, in absolute terms we are manufacturing more than ever before. Rather than becoming substitutes for manufacturing, services have more generally become closely integrated *complements* to manufacturing, greatly increasing productivity. Second, there is indirect evidence of an “environmental bonus” from the growth in services and other facets of the information revolution through reduced material and energy input per unit of economic activity. This improvement in material intensity, however, has been offset by increasing levels of economic activity. In fact, a plausible interpretation of the data suggests a counterthesis, a correlation between the rise of services and *increased* resource consumption.

The Article then turns in Parts II and III from macroeconomic analysis to the implications of the ascendant service sector for environmental law. Despite the unprecedented growth of services, environmental law and policy seem almost oblivious to services’ existence.¹¹ Indeed we do not even know how to *think* about the connections between services and environmental law. Parts II and III develop a theoretical model in this policy *terra incognita*,

11. The EPA’s two flagship reinvention initiatives, Project XL and the Common Sense Initiative, virtually ignore services. None of the implemented Project XL projects has focused on service companies, and only one of the six Common Sense Initiative sectors could be considered a service (printing). See U.S. Env’tl. Protection Agency, *Project XL* (visited Aug. 2, 1999) <<http://www.epa.gov/projectxl/>> [hereinafter EPA, *Project XL*]; U.S. Env’tl. Protection Agency, *Common Sense Initiative* (visited Aug. 2, 1999) <<http://www.epa.gov/commonsense/>> [hereinafter EPA, *Common Sense*].

dividing the service sector into separate categories with distinctly different implications for environmental law and policy.

Part II considers how best to reduce the environmental impacts of specific services. A focus on direct environmental impact identifies a group known as “smokestack services.” These include traditional companies such as electric utilities, airlines, and hospitals—operations with large physical plants that emit significant quantities of air pollutants or solid waste. Strategies for controlling industrial sources of pollution go to the very core of environmental protection, but they may poorly match smokestack services. The regulatory mindset that “when you have a hammer, everything looks like nails” poses real problems because services often are not nails.

A second dimension of analysis identifies a category known as “cumulative services.” These services do not cause significant environmental harm at the level of individual operation but collectively have important impacts. They include a wide range of companies such as dry cleaners, dentist offices, and fast-food chains, posing the difficult policy challenge of a “nonpoint source world” in which a universe of diffuse sources threatens to exceed the capacities of command-and-control regulation.

Part III employs a fundamentally different type of approach, focusing not on the impact of the services themselves but on their ability to reduce environmental impacts throughout product life cycles. Such “leverage services” include large retailers such as Walmart and Sears as well as utilities and financial institutions. These services act as a funnel through which products, electricity, and financing must flow to end-users. They raise intriguing possibilities for environmental protection because, while not necessarily causing significant environmental impact in their immediate activities, their commercial links provide a uniquely effective fulcrum to leverage environmental improvements upstream and downstream in the life cycle. This focus on services instead of the actors directly responsible for pollution and resource consumption presents a novel vision of environmental protection, moving from a narrow focus on production and disposal to energizing the web of commercial relationships.¹²

This Article therefore explores the implications for environmental law and policy of the new millennium’s economy. It examines the challenges and opportunities of a setting not envisaged by the framers of our national pollution laws thirty years ago—a setting in which services have become

12. This vision builds on the systems approach developed in the nascent field of industrial ecology. See generally BRADEN R. ALLENBY & THOMAS E. GRAEDEL, *INDUSTRIAL ECOLOGY* (1995); Daniel Esty & Michael Porter, *Industrial Ecology and Competitiveness*, 2 J. INDUS. ECOLOGY 35 (1998).

the dominant economic activity, control and management of information the source of wealth, and commerce a necessarily global activity.

I. DEINDUSTRIALIZATION AND THE ENVIRONMENT

A. The Information Revolution

We live in an age of instant reflection. While historians generally mark the beginning of the industrial revolution in the 1820s, the term "industrial revolution" was not actually used until the 1870s.¹³ Yet today, in the last year of the twentieth century, it has become commonplace for economists and social commentators to speak of a fundamental transformation now shaping our economy. The labels vying to capture this era include the "service economy" and the "postindustrial society," but the most commonly used name is the "information revolution," hailed as the third great economic revolution of human history.¹⁴ The agricultural revolution generated wealth from plowed fields, the industrial revolution from the mechanized production of material goods. Observers of the information revolution claim that wealth derives from the management, creation, and ownership of knowledge.¹⁵ Famed management guru Peter Drucker has succinctly

13. See Melvin Kranzberg, *The Information Age: Evolution or Revolution?*, in INFORMATION TECHNOLOGIES AND SOCIAL TRANSFORMATION 35, 36 (Bruce R. Guile ed., 1985). "[S]cholars delight in labeling an era by its most advanced technology, even when that technology is at first very limited in its application." *Id.* at 36. For example, the steam age is said to have begun with James Watt, but for the next century more power in England came from hydropower in dams than from steam engines. See *id.*

14. A December, 1997, LEXIS/NEXIS database search found 125 separate newspaper and magazine stories contrasting the information and industrial revolutions. The following passage from *Foreign Affairs* is embellished but typical of these references:

We are now living in the midst of the third great revolution in history. When the principle of the lever was applied to make a plow, the agricultural revolution was born, and the power of nomadic tribal chiefs declined. When centuries later, men substituted the power of water, steam, and electricity for animal muscle, the Industrial Revolution was born. Both of these massive changes took centuries to unfold. Each caused a shift in the power structure. Today, the marriage of computers and telecommunications has ushered in the Information Age, which is as different from the Industrial Age as that period was from the Agricultural Age. Information technology has demolished time and distance.

Walter B. Wriston, *Bits, Bytes, and Diplomacy*, FOREIGN AFF., Sept.-Oct. 1997, at 172, 172.

15. As Manuel Castells describes, "[t]he second feature of the new world economy—and another secular trend that has accelerated in recent years—is the shift, in advanced capitalist societies, from material production to information-processing activities, both in terms of proportion of GNP and in the proportion of the population employed in such activities." Manuel Castells, *The Informational Economy and the New International Division of Labor*, in THE NEW GLOBAL ECONOMY IN THE INFORMATION AGE: REFLECTIONS ON OUR CHANGING WORLD 15, 17 (Martin Carnoy et al. eds., 1993).

described such an economy as one in which "knowledge (not labor, land, or other forms of capital) has become the planet's primary resource."¹⁶

To be sure, the term "information revolution" is a trendy label, suggesting the increasingly central role of information in how we think of ourselves and our society,¹⁷ but it also describes very real transformations. While this Article's primary focus is the service sector, the analysis must reach beyond deindustrialization because the current shape and content of the service sector derives from other changes underway. The parts that follow lay out the facts behind deindustrialization and the three related economic trends that bear most on environmental impact.

It is worth noting that for the first time ever the wealthiest person in the world, Bill Gates, is a "knowledge worker," not a sovereign, a railroad baron, or a petroleum or coal magnate. See Lester C. Thurow, *New Rules*, 20 HARV. INT'L. REV. 54, 54 (1997). The explosive growth of information technologies has been equally vivid in the stock value of internet bookseller Amazon.com, which, in a matter of months after its first public offering, had amassed a market capitalization 10 times greater than venerable manufacturing giants such as U.S. Steel. On April 13, 1999, Amazon.com had a market capitalization of \$29.108 billion while U.S. Steel had a market capitalization of \$2.269 billion. See *Yahoo! Finance* (visited Apr. 13, 1999) <<http://finance.yahoo.com/q?s=AMZN&d=t>>; *Yahoo! Finance* (visited Apr. 13, 1999) <<http://finance.yahoo.com/q?s=X&d=t>>.

16. *Post-Capitalist Society*, KIRKUS REV., Feb. 1, 1993 (reviewing PETER F. DRUCKER, *POST-CAPITALIST SOCIETY* (1993)). Consider the central role of information in the descriptions below:

[I]n the changed world economy, the sources of higher productivity are increasingly dependent on knowledge and information applied to production, and this knowledge and information is increasingly science-based. Production in the advanced capitalist societies shifts from material goods to information-processing activities . . . that focus on symbol manipulation in the organization of production and in the enhancement of productivity.

Martin Carnoy et al., *Introduction to THE NEW GLOBAL ECONOMY IN THE INFORMATION AGE: REFLECTIONS ON OUR CHANGING WORLD*, *supra* note 15, at 1, 5.

"With rare exceptions, the economic and producing power of a modern corporation or nation lies more in its intellectual and systems capabilities than in its hard assets of raw materials, land, plant, and equipment." JAMES BRIAN QUINN ET AL., *INNOVATION EXPLOSION* 20 (1997).

A pre-industrial sector is primarily *extractive*, its economy based on agriculture, mining, fishing, timber, and other resources such as natural gas or oil. An industrial sector is primarily *fabricating*, using energy and machine technology, for the manufacture of goods.

A postindustrial sector is one of *processing* in which telecommunications and computers are strategic for the exchange of information and knowledge.

DANIEL BELL, *THE COMING OF POST-INDUSTRIAL SOCIETY* xii (1976).

"Where the industrial revolution was about applying physical leverage, a multiplier for the power of human muscle, the information revolution is about intellectual leverage, a multiplier for the human mind." John G. Falcioni, Editorial, *Preparing for the Next Revolution*, *MECHANICAL ENGINEERING*, Mar. 1997, at 4, 4.

17. In his thoughtful book on this subject, James Boyle points out numerous examples in which we now think of objects as vessels of information rather than as physical substances. To take just one illustration, "[w]e have already reached the point where genetic information is thought of primarily as information. We look at the informational message—the sequence of As, Gs, Cs, and Ts—not the biological medium." JAMES BOYLE, *SHAMANS, SOFTWARE, AND SPLEENS* 4 (1996).

1. Deindustrialization

While the consequences of deindustrialization have engendered heated debate,¹⁸ the basic facts are clear. The unrelenting growth of the service sector, and apparently corresponding decline of the manufacturing sector, has continued for decades in the United States, Europe, and Japan. The service sector has expanded in all but one quarter over the last fifty years.¹⁹ Between

18. Two decades ago, a group of economists alarmed over the steady fall in manufacturing employment, stagnant real wages, and earning inequality argued that deindustrialization was symptomatic of a widespread disinvestment in the nation's productive capacity. There was serious concern that as important sectors of manufacturing weakened, the U.S. economy would falter. As Stephen S. Cohen and John Zysman argued at the time in their influential book *Manufacturing Matters: The Myth of the Post-Industrial Economy*, "Manufacturing matters. Manufacturing is critical to the health of the economy; lose manufacturing and you will lose—not develop—high-wage service jobs. The wealth and power of the United States economy would decline drastically if major segments of manufacturing were to shut down or to move offshore." COHEN & ZYSMAN, *supra* note 1, at xiii. In a nutshell, Cohen and Zysman argued for government intervention to promote "reindustrialization," demonstrating that an industrial base is a prerequisite to a strong economy because of linkages. Services are complements to manufacturing, they claimed, not substitutes. The United States could not become a world-class service provider because shedding manufacturing jobs would also shed tightly linked service jobs. By their calculations, an estimated 25 percent of gross national product (GNP) came from services providing inputs to manufacturing, and another 24 percent was added to the GNP by manufacturing; thus almost half of the nation's GNP was embodied in manufacturing. See *id.* at 23.

Dismissing these cries of doom, others viewed the decline in manufacturing and growth of services as a natural, indeed welcome, economic evolution. The Office of the U.S. Trade Representative, voicing the Reagan Administration's position, stated in 1984 that "[t]he move from an industrial society toward a 'postindustrial' service economy has been one of the greatest changes to affect the developed world since the Industrial Revolution. The progression of an economy such as America's from agriculture to manufacturing to services is a natural change." OFFICE OF THE U.S. TRADE REPRESENTATIVE, ANNUAL REPORT OF THE PRESIDENT OF THE UNITED STATES ON THE TRADE AGREEMENTS PROGRAM, 1984-1985, at 43; see also Jagdish Bhagwati, *International Trade in Services and Its Relevance for Economic Development*, in THE EMERGING SERVICE ECONOMY, *supra* note 3, at 3, 9-18 (describing the 1930s and 1940s work of economists Allan Fisher and Colin Clark, who proposed stages of economic development).

19. See Rejeski, *supra* note 7, at 27. From 26 percent of the nation employed in manufacturing in 1960, the Bureau of Labor Statistics predicts that only 12 percent of the U.S. work force will be in manufacturing by the year 2005. By comparison, in 1950 over half the nation's workers were employed in services, increasing to two-thirds in 1980, and three-quarters in 1995. Indeed, the 1950s marked the first decade when employment in services outnumbered employment in agriculture and manufacturing. See *id.* at 26; see also COHEN & ZYSMAN, *supra* note 1, at 54; BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, STATISTICAL ABSTRACT OF THE UNITED STATES, 1995, at 416 [hereinafter 1995 STATISTICAL ABSTRACT]. The table below shows the U.S. work force distribution from 1880 to 1975:

	1880	1920	1955	1975
Agriculture and extractive	50 %	28 %	14 %	4 %
Manufacturing, commerce, industry	36 %	53 %	37 %	29 %
Other services	12 %	10 %	20 %	17 %
Information, knowledge, education	2 %	9 %	29 %	50 %

Harlan Cleveland, *The Twilight of Hierarchy*, in INFORMATION TECHNOLOGIES AND SOCIAL TRANSFORMATION, *supra* note 13, at 55, 57 tbl.1. This is a widespread phenomenon in industrialized

1955 and 1980, the U.S. economy added forty million jobs, yet only one in ten of these was in manufacturing. Over the same period, the health sector added more jobs than all of manufacturing combined.²⁰ Most services, such as communications, wholesale trade, finance, insurance, and real estate have grown steadily. In recent years, the health care and computer systems fields have been among the fastest growing sectors in the entire economy for both employment and revenue.²¹ The graphs on the next page show the key pieces of evidence in the deindustrialization debate—the steady decline of manufacturing and corresponding growth of services (to show the importance of the recent decline in manufacturing employment, manufacturing data are broken out separately after 1960).²²

countries rather than solely a U.S. phenomenon. An International Monetary Fund (IMF) study found that from 1970 to 1994, manufacturing employment in the 23 most developed economies fell from 28 to 18 percent of the total work force. See ROWTHORN & RAMASWAMY, *supra* note 4, at 7.

20. See COHEN & ZYSMAN, *supra* note 1, at 54. In absolute terms, from 1970 to 1996 employment in services more than doubled, from 20 million to 45 million workers. See 1997 STATISTICAL ABSTRACT, *supra* note 4, at 415.

21. The 1995 *Statistical Abstract* lists the fastest growing occupations as home health aides, computer engineers and scientists, physical therapists, systems analysts, and corrections officers. See 1995 STATISTICAL ABSTRACT, *supra* note 19, at 415. In terms of financial growth, the health care, financial and business services, retailing sectors, and computer service sectors have increased the fastest. See *id.* In specific sectors, from 1970 to 1996, employment in finance, insurance, and real estate grew from 3.945 million to 8.076 million, business and repair services from 1.403 million to 8.087 million, personal services from 4.276 million to 4.358 million, entertainment/recreation from 717,000 to 2.386 million, professional and related services from 12.904 million to 30.085 million, and health, social services, and legal public administration from 4.476 million to 5.802 million. See 1997 STATISTICAL ABSTRACT, *supra* note 4, at 415.

In Britain,

[a]bout a quarter of the 13.5 million service workers are in the retail or wholesale trades. Another third are in health, education or public administration; 14% work in financial and business services (banks, insurance, etc); 10% are in transport and communication; and the rest work in hotels and restaurants or provide various personal services from haircuts to cleaning windows.

Servicing the Economy, ECONOMIST, Nov. 30, 1985, at 62, 62.

22. See QUINN ET AL., *supra* note 16, at 23; ROBERT ROWTHORN & RAMANA RAMASWAMY, DEINDUSTRIALIZATION: CAUSES AND IMPLICATIONS 7-9 (International Monetary Fund Working Paper 97/42, 1997).

Figure 1

Figure 2

To complete the picture of services' role in the economy, the chart below sets out the major service sectors and their contribution to the 1992 GDP (in billions of dollars).²³ These service sectors alone represent two-thirds of the nation's economic activity.²⁴

	<u>1992 income</u>	<u>Percent of</u> <u>GDP</u>
transportation and public utilities	529	9 %
wholesale and retail trade	952	16 %
finance, insurance, and real estate	1106	18 %
business services	221	3.7 %
health services	364	6 %
legal services	89	1.5 %
government services	756	12.5 %

2. The Digital Explosion

The second trend of the information revolution is the digital explosion—the increasing technological capacity to store and manipulate large amounts of data, to transform information into knowledge.²⁵ The consequence of

23. The following chart shows the percent contributions to gross domestic product (GDP) of various service sectors since 1960:

	<u>1960</u>	<u>1970</u>	<u>1980</u>	<u>1994</u>
Transportation	4.4 %	3.9 %	2.7 %	2.2 %
Communication	2.1 %	2.4 %	2.5 %	2.7 %
Utilities	2.5 %	2.3 %	2.5 %	2.8 %
Wholesale and retail trade	16.7 %	16.4 %	16.3 %	15.4 %
Finance, insurance, and real estate	13.8 %	14.3 %	15.1 %	18.4 %
Services	9.7 %	11.5 %	13.0 %	19.4 %
Government services	10.5 %	13.1 %	11.7 %	13.4 %

BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, STATISTICAL ABSTRACT OF THE UNITED STATES, 1998, at 448; BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, STATISTICAL ABSTRACT OF THE UNITED STATES, 1985, at 433; BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, STATISTICAL ABSTRACT OF THE UNITED STATES, 1980, at 441. The *Statistical Abstract* series only began identifying the contribution to GDP of the individual components of the broad service category (legal, business, health care, and the others) in the 1990s.

24. In some respects, the importance of services is self-evident. Consider that when you pay \$15 for a compact disc, "only about \$1.20 pays for the labor and raw materials used to produce the CD. The rest goes for taxes (government services) and for developing, designing, transporting, marketing, and selling it." Guile & Cohon, *supra* note 7, at 77.

25. Information becomes knowledge when it has been organized into a useful form. Data from a satellite is information. It becomes knowledge once transformed into pixels on a screen or part of a map. See generally Paul Ehrlich et al., *Knowledge and the Environment*, 30 ECOLOGICAL ECON. 267 (1999).

Moore's Law, the doubling of computational power every eighteen months, has spurred ever-expanding applications to employ information and communications technology in virtually all aspects of life.²⁶ Increases in knowledge have always underpinned technological and economic development, but the more complex an economy the greater its information demands. At a certain point, management's application of knowledge to increase the effectiveness of traditional production factors, such as labor and capital, becomes the critical determinant of competitive advantage.²⁷ In 1991, for the first time, business investment in information processing hardware, such as computers and telecommunications equipment, surpassed investment in industrial and construction equipment.²⁸

A related trend has been the shift in proportion of value added to goods. By lowering transaction costs at every point in the product chain, materials and their manipulation have become ever cheaper (in some cases trivially cheap). As a result, a product's value has increasingly come from its information content. Consider that when you pay \$15 for a compact disc, "only about \$1.20 pays for the labor and raw materials used to produce the CD."²⁹ James Boyle has called this the "values shift," and, as we shall see in Part I.D, it has played an important role in driving resource consumption.

26. In 1965, Gordon Moore predicted that the computing power of silicon chips would double every 18 to 24 months. See, e.g., Michael Harvey, *Click for the New Automated Car*, FIN. TIMES, Aug. 21, 1999, at 20, 20; John Markoff, *A Renaissance in Computer Science: Chip Designers Search for Life After Silicon*, N.Y. TIMES, July 19, 1999, at C1. His prediction remains valid today. The cost of performance has dropped at a similarly remarkable rate. From 1975 to 1995, the cost of performing one million instructions fell from \$1 million to \$45. See THE INFORMATION INDUS. TASK FORCE, AUSTRALIAN DEP'T OF INDUS., SCIENCE AND TOURISM, *THE GLOBAL INFORMATION ECONOMY 1* (1997). If the aviation industry had increased its performance and lowered its cost at comparable rates to microprocessors, "according to a Boeing estimate, a single jumbo jet would carry 500,000 people, travel at 20 million miles an hour and a round-the-world ticket would cost one cent." Stephen G. Minter, *Editor's Notebook: Reinventing Our World*, OCCUPATIONAL HAZARDS, July 1997, at 6, 6.

27. The quote below sets out more precisely how this increased capability to manage data can result in unprecedented efficiencies, by

(1) capturing knowledge more rapidly and accurately than ever before, (2) enabling analysis of more complex problems than humans can handle alone, (3) controlling physical processes under harder conditions and more accurately than humans can, (4) allowing remote monitoring of physical and intellectual processes without human intervention, (5) searching a broader range of information sources and interconnecting far more human minds—enabling creative solutions that would otherwise be impossible, and (6) diffusing knowledge more widely, efficiently, and effectively than any other means.

QUINN ET AL., *supra* note 16, at 2–4; see also Castells, *supra* note 15, at 16–17.

28. See Stewart, *supra* note 5, at 66.

29. Guile & Cohon, *supra* note 7, at 77.

3. Consolidation

While the growth of services has generally led to many more enterprises,³⁰ in a few sectors it has concentrated market share. Thus large retailers such as Walmart, Target, and K-Mart account for roughly one dollar out of every ten spent by shoppers.³¹ Home Depot holds even more market share in the hardware retail sector.³² The unceasing growth of health maintenance organizations and the merger mania among banks present similar attempts to amass market share.³³ Whether this consolidation is evidence of what economists call “winner-take-all markets” remains unclear,³⁴ but it clearly has been driven by advances in information technology, facilitating rapid integration of formerly separate corporate information and management systems into greater economies of scale. As we shall see in Part III, such concentration gives these services enormous influence to leverage behavioral changes both upstream and downstream.

4. Globalization

The last trend is globalization—the increasing interconnectedness and interdependence of commerce and culture across national borders. Intensified competition across borders over traditionally domestic markets for capital, labor, manufacturing, information, and other factors of production increases growth through market expansion and greater efficiencies. Technological advances and decreased prices for communication and transport have enabled the creation of international networks for fabrication, assembly, distribution, and maintenance of goods as never seen before.³⁵ As a

30. The number of corporations filing tax returns increased from 2.7 million in 1980 to 3.9 million in 1992. See 1995 STATISTICAL ABSTRACT, *supra* note 19, at 547.

31. See Guile & Cohon, *supra* note 7, at 77. The toy retailer, Toys R Us, has greater sales than its two largest suppliers combined. See *id.* at 79.

32. In 1996, Home Depot controlled a 16.9 percent market share of the retail home improvement industry. See ROBERT S. LAZICH, THE MARKET SHARE REPORTER 1999, at 295 (1998).

33. See, e.g., John Buell, *Corporate Power, Merger Mania*, BANGOR DAILY NEWS, May 26, 1998, available in LEXIS, News Library, Bgrdly File; *Fear and Fashion Means Further Consolidation for Multi-Nationals*, CORP. MONEY, Feb. 11, 1998, at 3.

34. See, e.g., Cass Sunstein, *Vanity Fair*, NEW REPUBLIC, Mar. 29, 1999, at 42 (reviewing ROBERT H. FRANK, LUXURY FEVER: WHY MONEY FAILS TO SATISFY IN AN ERA OF EXCESS (1999)).

35. “Information technologies are not the sole enablers in this respect. Improved transportation, materials handling, storage, producing, farming, communication, and management technologies enhance the potential production and sale of virtually all products and services anywhere in the world.” QUINN ET AL., *supra* note 16, at 32.

result, foreign direct investment has exploded, more than doubling in the last decade.³⁶ Arbitrage, the search for the lowest costs to buy and the highest prices to sell, now routinely occurs in a global marketplace and throughout a product's life cycle. It no longer merits even a raised eyebrow to learn that the separate stages in your car's life cycle—extraction, smelting, assembly, distribution, use, and disposal—may each take place in a different country.³⁷

Importantly, all of these trends—deindustrialization, rapid information technology advances, consolidation, and globalization—are locked together in positive feedback loops. One cannot cogently discuss them in isolation (which explains, in part, why the “new economy” labels blur into one another). The growth in international commerce, for example, has been accelerated by technical advances in microprocessing, telecommunications, and data management that, in turn, have driven the burgeoning global market for services that now demands further rapid technical advances.³⁸ While many tend to think of service jobs as merely flipping burgers—low-skill and low-wage employment—this is an outdated notion. The digital explosion has been a main driver behind the growth of services. As David Rejeski describes, the service sector's “mantra is not, ‘do you want fries with that?’ as the conventional wisdom would have it but, instead, ‘Do you want to download that off our web site or should we FedEx you our CD-ROM?’”³⁹

B. An Environmental Bonus?

There has been a rich body of scholarship on the environmental implications of globalization, largely centered on the trade and environment debate.⁴⁰ Yet the environmental consequences of deindustrialization, consolidation, and the digital revolution remain largely unexplored. The little that *has* been written has generally been positive, contending that as infor-

36. “The market value of U.S. foreign direct investment abroad rose 35%, to \$776 billion, from 1987 to 1992, while the value of foreign direct investment in America more than doubled, to \$692 billion.” Stewart, *supra* note 5, at 67. Perhaps surprisingly, the most rapid growth in foreign direct investment has been in the service sector. See Robert J. Fowler, *International Environmental Standards for Transnational Corporations*, 25 ENVTL. L. 1, 5 (1995) (demonstrating that the most rapid growth in recent foreign direct investment has been in the service sector, expanding from 31 percent in 1970 to 50 percent in 1990).

37. See Thurow, *supra* note 15, at 54.

38. Almost four-fifths of information technology purchased in the United States is bought by the service sector. See Rejeski, *supra* note 7, at 26.

39. *Id.*

40. Since the first tuna/dolphin decision in 1991, there have been scores of articles and books on the intersection of international trade law and environmental protection. See generally DANIEL C. ESTY, *GREENING THE GATT* (1994); ERNST-ULRICH PETERSMANN, *INTERNATIONAL AND EUROPEAN TRADE AND ENVIRONMENTAL LAW AFTER THE URUGUAY ROUND* (1995); TRADE AND THE ENVIRONMENT: LAW, ECONOMICS, AND POLICY (Durwood Zaelke et al. eds., 1994).

mation rather than raw material becomes the critical input for wealth creation, the environment is better off. The argument is that information acts as a complement to other factors of production, enabling cleaner and smarter manufacturing with less material throughput.⁴¹ Indeed, in some cases, intellectual capital and information may permit services to replace manufactured goods entirely.

Intuitively, the substitution of services for products makes sense. After all, at a basic level, people do not want products, they want the *services* that products provide. They do not want light bulbs, they want light; they do not want cars, they want physical access to other locations. Think of e-mail replacing letters, envelopes, and postal mail; telecommuting and subways replacing cars and traffic congestion; genetically engineered crops reducing the need for pesticides. More services and fewer smokestacks ought to mean less pollution and less environmental impact.⁴²

Indeed, a number of well-known scholars claim the economic changes underway provide a clear pathway toward sustainable development.⁴³ For

41. See Cleveland, *supra* note 19, at 58. Engineers often say that the “smarter” the metal, the less it weighs.

42. As a General Electric Lighting manager has observed, “There are just two people between me and a salesman—information technology replaced the rest.” Stewart, *supra* note 5, at 72.

By using high speed data communications networks to track production, stock, and orders, GE Lighting has closed 26 of 34 U.S. warehouses since 1987 and replaced 25 customer service centers with one new, high-tech center. In effect, those buildings and stockpiles—physical assets—have been replaced by networks and databases—intellectual assets.

Id. at 76.

43. The industrial ecology scholar, Brad Allenby, argues that the substitution of information for energy and materials

raises the interesting possibility that the service-oriented economy—the Information Revolution—and sustainability are synergistic: that greater environmental efficiency will require as an enabling capability the Information Revolution, while the latter will in turn be strongly encouraged by the need for the former, and that the two will be integrated into an economic structure heavily focused on services.

Allenby, *supra* note 2, at 36. Professor Dick Stewart writes that “[s]ome economists . . . have argued that economic development could enhance environmental quality by shifting the composition of output away from heavy industry to the high tech, light industry and service sectors . . .” Richard B. Stewart, *Environmental Regulation and International Competitiveness*, 102 YALE L.J. 2039, 2099 n.316 (1993) (citing Robert E.B. Lucas et al., *Economic Development, Environmental Regulations and the International Migration of Toxic Industrial Pollutions: 1960–88*, in INTERNATIONAL TRADE AND THE ENVIRONMENT 67, 72–73 (World Bank Discussion Papers No. 159, 1992)); see also GENE M. GROSSMAN & ALAN B. KRUEGER, ENVIRONMENTAL IMPACTS OF A NORTH AMERICAN FREE TRADE AGREEMENT (Woodrow Wilson School, Princeton University, Discussion Paper No. 158, 1992).

At the extreme, Professor Mark Sagoff, an environmental philosopher, concludes that [i]t is simply wrong to believe that nature sets physical limits to growth—that is, to prosperity and the production and consumption of goods and services on which it is based. . . . Although raw materials will always be necessary, knowledge has become the essential factor in the production of goods and services.

Sagoff, *supra* note 8, at 80, 83; see also Minter, *supra* note 26, at 6.

example, the UNESCO Professor of Economics at Columbia University, Graciela Chichilnisky, has argued that

[h]umans could achieve a new form of economic organization where the most important input of production is no longer machines, as in an industrialized society, but rather human knowledge. From the environmental perspective, instead of burning fossil fuels to power machines, the knowledge society 'burns' information technology to power knowledge The data show that knowledge sectors [almost exclusively services] are becoming an increasingly important part of economic output. Furthermore, the data show that these sectors use progressively less materials, indirectly and directly, than the old industrial sectors.⁴⁴

The authoritative Organization for Economic Cooperation and Development (OECD) has similarly asserted that "[g]lobalisation can promote a more efficient and less-environmentally damaging pattern of economic development by shifting production from raw materials-based manufacturing to knowledge-based service industries. . . . In these ways, globalisation could help uncouple economic growth from pollution generation and resource consumption, and, thereby, foster sustainable development."⁴⁵ In fact, as discussed in Part I.D.1, the data on deindustrialization in developed countries suggest this may already be happening.

These conclusions are both provocative and comforting, suggesting that the growing dominance of services and the prevalence of information technologies hold the solutions to many of the environmental challenges we face. While these conclusions are widely held, evidence to date indicates that they are also wrong. As Part I.C will demonstrate, although manufacturing's *relative* share of GDP and employment has declined, in *absolute* terms it has grown. Part I.D disentangles the environmental implications of the slowly rising manufacturing and rapidly rising service sectors.

C. The Myth of Manufacturing's Decline

"The report of my death was an exaggeration."⁴⁶

The claim by Chichilnisky and others that the rise of low-impact services represents a path toward sustainable development rests on a central

44. Chichilnisky, *supra* note 8 (manuscript at 10).

45. GLOBALISATION AND THE ENVIRONMENT: PERSPECTIVES FROM OECD AND DYNAMIC NON-MEMBER ECONOMIES (Chris Chung ed., 1998) (noting the beneficial effects of globalization's promotion of cleaner technologies, alleviation of poverty, and generation of additional wealth for environmental investments).

46. JOHN BARTLETT, FAMILIAR QUOTATIONS 1528 (Justin Kaplan ed., 16th ed. 1992) (quoting Mark Twain).

assumption—that manufacturing activity is actually declining. A visit to the Rust Belt certainly appears to provide strong evidence. Consider Pittsburgh, once the heart of the steel industry. Throughout much of this century, it was said you needed to floss after breathing in Pittsburgh. Despite the loss of much of its steel production in the 1970s and 1980s, the city has rejuvenated itself through the growth of its service sector. It is now consistently ranked as one of the nation's "most livable cities," a center for medicine, education, and technology, boasting over 410 high-tech firms established since 1980.⁴⁷ Or take Cleveland, another center of steel and chemical manufacturing. In 1969, its Cuyahoga River was so polluted it actually caught on fire.⁴⁸ The city's shift toward services, particularly health care, has successfully transformed the area's economic base.⁴⁹ Formerly the center of smokestack industries, these cities now vie for the role of poster child for the service economy.⁵⁰

If Cleveland's and Pittsburgh's renaissances are representative, then policy analysts need to know more precisely how the economy of today differs from the smokestack economy of the 1970s. As the graphs in Part I.A make clear, services are on the rise. But in what respects has manufacturing correspondingly declined? And what has taken its place? These questions are of fundamental importance to the allocation of environmental protection resources and the proper focus of the law.

1. Imprecise Accounting and Outsourcing

The graphs in Part I.A⁵¹ have formed the starting point for much of the deindustrialization debate, and it is fitting we start by examining them because

47. See Amy V. Roberts, *Quality Programming, Quality Town*, ASS'N MGMT., Mar. 1991, at 89, 90.

48. This was the basis for the quip of Bill Ruckelshaus, former EPA administrator, that though "the waters may not be fishable or swimmable, at least they're no longer flammable." William K. Reilly, *The Turning Point: An Environmental Vision for the 1990s*, FED. NEWS SERVICE, Nov. 27, 1989, available in LEXIS, Genfed Library, Fednew File.

49. See Donald W. Nauss, *Reindustrialized Heartland Points Way to Better Times*, L.A. TIMES, May 9, 1993, at A1.

50. Similar transformations were occurring in Canada as well. As the Great Lakes Commission found:

[B]etween 1984 and 1995 Ontario's total real (adjusted for inflation) gross domestic product rose by 31 percent from \$162 billion to \$213 billion. Yet, manufacturing rose by only 25 percent over the same period, notwithstanding the strong role of the automotive industry in Ontario, which declined from 27 percent to just over a quarter of the Ontario economy. Sectors with significantly greater growth rates included wholesale trades, communications, business services, health, finance and insurance, and transportation sectors.

U.S. Env'tl. Protection Agency, *State of the Lakes Ecosystem Conference 1996 Background Paper* (visited Aug. 2, 1999) <<http://www.epa.gov/grtlakes/solec/96/landuse/Lu-printversion.htm>>.

51. See *supra* p. 422.

they can obscure more than they clarify. Services have, of course, always been an important sector of organized economic activity. The rise of the industrial revolution could not have occurred absent the rise of capital markets. Yet economists have traditionally given short shrift to services. In 1848, John Stuart Mill wrote that economic activity derived exclusively from manufacturing "utilities fixed and embodied in outward *objects*."⁵² Adam Smith, the founder of modern economics, was equally dismissive in his judgment, writing in the *The Wealth of Nations* that "the labour of manufacturing adds, generally, to the value of the material which the labourer works upon. . . . The labour of the menial servant, on the contrary, adds to the value of nothing."⁵³

While services are now universally regarded as important contributors to GDP and intuitively seem easy to identify, a sharp definition remains elusive. Beyond being remarkably heterogeneous, what do a car wash, an appendectomy, a wedding or divorce, a computer program, a lawsuit, a football game, a baby shower, and a funeral have in common? Writing over three decades ago, Nobel laureate economist George Stigler concluded that "[t]here exists no authoritative consensus on either the boundaries or the classification of the service industries."⁵⁴ Indeed, the most important trade agreement

52. JOHN STUART MILL, *PRINCIPLES OF POLITICAL ECONOMY* 73 (D. Appleton & Co. 1920) (1848) (emphasis added).

53. ADAM SMITH, *THE WEALTH OF NATIONS* 430 (Andrew Skinner ed., Penguin Classics 1974) (1776). Smith distinguished between productive workers (i.e., those producing objects) and those in the unproductive services of whom

in the same class must be ranked, some of the gravest and most important, and some of the most frivolous professions: churchmen, lawyers, physicians, . . . players, buffoons, musicians, opera singers . . . Like the declamation of the actor, the harangue of the orator, or the tune of the musician, the work of all of them perishes in the very instant of its production.

Id. at 431. Smith based his distinction on the permanence of the good produced. Hence the labour of the manufacturer fixes and realizes itself in some particular subject or vendible commodity, which lasts for some time at least after the labour is past. It is, as it were, a certain quantity of labour stocked and stored up to be employed, if necessary, upon some other occasion. . . . The labour of the menial servant, on the contrary, does not fix or realize itself in any fixable or vendible commodity. His services generally perish in the very instant of their performance.

Id.

54. GEORGE STIGLER, *TRENDS IN EMPLOYMENT IN THE SERVICE INDUSTRIES* 47 (1956). There are four nontechnical definitions of services in the literature. The first focuses on the simultaneity and transience of the economic transaction. In most cases, the consumption of the service occurs practically at the same time as its provision because, in contrast to goods, services neither are tangible nor can be stored. The second definition relies on a residual category—services are what remains after you subtract manufacturing and farmworkers. The third definition is functional. "Services industries allow the management and financing of a nation's productive system and are the way an economy organizes itself to meet essential needs such as health care, transportation, communications, education, and the distribution of goods." Bruce R. Guile, *Intro-*

ever negotiated on services, the 1995 General Agreement on Trade in Services (GATS),⁵⁵ nowhere contains a definition of the word, "service."⁵⁶

This imprecision becomes important when analyzing economic trends. The best snapshot of the nation's economy comes from the U.S. Bureau of the Census, published annually in its *Statistical Abstract of the United States* (*Abstract*). In more than a thousand pages crammed with tables and numbers, the *Abstract* provides detailed analysis of the entire economy, including sectoral employment. The bureau determines company activity through the Standard Industrial Classification (SIC) Index. Industries are broken down into detailed categories and assigned an SIC code.⁵⁷ To obtain employment data, each company's facility is asked on the census form what its "primary" activity is and told to select one of the SIC codes.

Because the firm determines its classification, it becomes difficult to distinguish between service and manufacturing activities. To take a simple example, a hamburger tastes the same in a McDonald's and a Ford auto plant cafeteria. But for statistical purposes, did a service or a manufacturing worker cook it? If you flip burgers at McDonald's, your job is clearly considered a service. But if you flip burgers at the Ford auto plant cafeteria, is your job in manufacturing or services? The McDonald's employees and the Ford cafeteria employees, despite carrying out the same activities, would be classified as service and manufacturing employees, respectively.⁵⁸ As a result, the *Abstract's* distinction between services and manufacturing is, to put it mildly,

duction to *Services Industries Policy Issues*, in *TECHNOLOGY IN SERVICES: POLICIES FOR GROWTH, TRADE, AND EMPLOYMENT* 1, 1 (Bruce R. Guile & James Brian Quinn eds., 1988) [hereinafter *TECHNOLOGY IN SERVICES*]. The last definition, while decidedly untechnical, is perhaps the easiest to apply. *The Economist* calls a service "those fruits of economic activity that you can't drop on your toe." *Servicing the Economy*, *supra* note 21, at 62. See generally COHEN & ZYSMAN, *supra* note 1, at 51-54; Bhagwati, *supra* note 18, at 4-6.

55. General Agreement on Trade in Services, Apr. 15, 1994, 36 I.L.M. 354 (entered into force Jan. 1, 1995).

56. See *id.*

57. Manufacturing is broken down into 20 separate divisions (codes 20-39). The food and kindred products division, for example, is given code 20, meat products code 201, and meat-packing plants code 2011. Services are set out in codes 70-89, including, e.g., health services (code 80), legal services (code 81), educational services (code 82), and social services (code 83). See Telephone Interview with Karen Harshbarger, Bureau of the Census (July 13, 1998).

58. Richard McKenzie describes a similar scenario:

According to government statisticians, a hamburger sold at a fast-food restaurant is part of a service, whereas hamburger meat sold at a grocery store is a good. Similarly, a computer is a manufactured good when sold to a household but is part of a service when leased by a time-sharing firm.

RICHARD B. MCKENZIE, *THE EMERGENCE OF THE SERVICE ECONOMY: FACT OR ARTIFACT?* 4-5 (Cato Inst. Policy Analysis No. 93, 1987).

inexact.⁵⁹ At a minimum, the deindustrialization graphs in Part I.A should have error bars.

More specifically, reliance on SIC codes likely overstates the growth of services through its treatment of outsourcing. Suppose, for instance, that in a cost-cutting move Ford Motors decides no longer to employ cafeteria workers but, instead, brings in an outside catering firm. The *Abstract's* tables will show a decrease in manufacturing employment and an increase in services. The same would happen as a result of outsourcing any service previously conducted by a company (particularly a vertically integrated firm) whether that be product research and development, maintenance, accounting, distribution, logistics, or billing. Therefore, because of accounting procedures, though neither creating nor destroying jobs, outsourcing of employment from manufacturing firms contributes to the impression of a manufacturing decline.⁶⁰

59. The U.S. Bureau of the Census is cognizant of this problem and has provided notice in the *Federal Register* to adopt the Standard Occupational Classification (SOC) system that solves the dilemma of classifying the same activity as a service or as manufacturing depending upon the employer. See 1998 Standard Occupational Classification Revision, 63 Fed. Reg. 41,895, 41,900 (1998) (to be codified at unspecified C.F.R.) (proposed Aug. 5, 1998).

The services-manufacturing distinction becomes even more difficult when one realizes that traditional manufacturing companies are moving into the services market. IBM now makes more money providing services for its computers than producing them. See Telephone Interview with David Rejeski, Council on Environmental Quality (May 28, 1998). Similarly, the chemical company, Monsanto, claims that it is moving from the manufacture of pesticides to the servicing of healthy crops (the provision of information through bio-engineered crops that resist pests).

What biotechnology represents in this—as in so many other areas—is a potentially sustainable solution to the issue, not only of feeding people, but of providing the economic growth that people are going to need to escape poverty. One of the fundamental tenets of the application of biotechnology is essentially the substitution of information coded in genetic form for a lot more stuff. Most of our agriculture today is based on adding stuff to the land and to crops, with all the sustainability questions that raises. If, instead, one substitutes information for all that stuff, you have the potential, of not only increasing yields and outputs, but doing so in a sustainable way.

Robert B. Shapiro, *Before the Biotechnology Industry Organization* ("BIO '98") (visited Sept. 28, 1999) <http://www.monsanto.com/monsanto/mediacenter/speeches/98jun17_shapiro.html>. Indeed, at the extreme one can describe virtually every activity as delivery of a service. That is, the customer ultimately wants the benefits of a service but may need products to obtain them. "The more we think in terms of end-user satisfaction, the more we comprehend production processes as the early parts of service processes. The 'services' of providing agreeable warmth, illumination, [t]aste satiation, entertainment, security and so on should dominate the production philosophy, not the other way round." ERNST VON WEIZSÄCKER ET AL., *FACTOR FOUR: DOUBLING WEALTH—HALVING RESOURCE USE* 275 (1997).

60. In fact, outsourcing reinforces this process. As independent service firms achieve greater economies of scale they become even more efficient than in-house service providers. If one looks at value-added statistics, the growth of outsourcing is also evident. McKenzie argues that the decline in the ratio of value added in manufacturing to manufacturing shipments, from 47.3 in 1970 to 41.5 in 1981, is evidence of outsourcing because value formerly added in-house has been lost. See MCKENZIE, *supra* note 58, at 19. But see James Brian Quinn, *Technology in Services: Past*

2. Offshore Production

It is widely assumed that the main cause of deindustrialization has been the significant flight of manufacturing abroad, both passively through loss of domestic market share to foreign competitors and actively through corporate strategy. The clearest aspect of globalization has been increased international trade. This creates opportunities for arbitrage markets for products, labor, capital, and services, driving both the convergence and the reduction of prices and making offshore trade both easier and attractive. Not surprisingly, South Korea, at the expense of Pittsburgh, has become a leading producer of steel.⁶¹ Thailand, at the expense of North Carolina, has become a leading producer of textiles. The occurrence of this shift is undeniable. An article in *Fortune* magazine claims that "three out of ten large U.S. industrial companies outsource [both domestically and abroad] more than half their manufacturing."⁶² Some of this shift has been in response to economic pressures,⁶³ some to regulatory demands,⁶⁴ but the net effect has been an outflow of domestic manufacturing activity.

Myths and Future Challenges, in TECHNOLOGY IN SERVICES, *supra* note 54, at 16, 32 (arguing that the economic impacts of services are understated).

61. For crude steel production from 1980 to 1993, total U.S. production declined from 101.5 million metric tons to 88.8 million metric tons. Over the same period, the drop in U.S. production was more than accounted for by steel production increases in China (production from 39.0 to 88.7 million metric tons) and South Korea (from 14.4 to 33.0 million metric tons). See 1995 STATISTICAL ABSTRACT, *supra* note 19, at 867.

62. Stewart, *supra* note 5, at 66. As a measure of world output, offshore production from 1970 to 1995 grew from 4.5 percent to over 7 percent. See ROBERT E. LIPSEY, INTERNATIONALIZED PRODUCTION IN DEVELOPED AND DEVELOPING COUNTRIES AND IN INDUSTRY SECTORS (National Bureau of Econ. Research Working Paper No. W6405, 1998). This has been most significant in the manufacturing sector. See *id.* Thanks to telecommunication advances, it is also happening in the service sector, in which foreign programmers develop software for U.S. companies or, as in the case of the popular cartoon, "The Simpsons," the animation is done in southeast Asia for broadcast in the United States. See Bhagwati, *supra* note 18, at 31.

63. A common aspect of globalization is the dispersion of a vertically integrated firm to an international horizontal network. As a small example in the auto industry, the accelerometer is a semiconductor chip that controls airbags. This chip not only costs less than one-tenth the mechanical sensors it replaced but travels the world before it is used, dispersing the impacts geographically. The chips are

assembled in the United States by skilled labor, shipped to the Philippines for testing, re-exported for packaging by mid-skill workers in Taiwan, and then sent to Germany where they are installed in BMW's, some of which are shipped to Singapore for final sale. . . . BMW manufactures each component of its vehicles wherever it can be most cheaply produced, regardless of national boundaries.

Thurrow, *supra* note 15, at 54. The same is true for Ford, General Motors, and Chrysler. See *id.*

64. Arsenic smelting provides a clear example of a dirty industry that moved offshore. Traditionally, arsenic has been produced as a by-product of copper mining for use in pesticides and desiccants. The EPA banned these uses of arsenic in 1987 and 1993, and now arsenic is used almost entirely as a wood preservative compound, chromated copper arsenate, in pressure-treated lumber.

3. Differential Relative Productivity

The greatest factor driving the growth in services and the decline in manufacturing employment, though, has been largely ignored by commentators. It is the tremendous increase in productivity of U.S. manufacturing. Because labor productivity has risen faster in the manufacturing sector than in services, employment has fallen while production has increased. The *Abstract* bears this out for discrete manufacturing and service sectors. From 1970 through 1996, total manufacturing output per hour more than doubled, while manufacturing's share of national employment dropped 10 percent.⁶⁵ In the textiles sector, for example, the amount of cotton broadwoven goods manufactured in 1978 was virtually the same as the amount manufactured two decades later, but the industry employed one-third fewer workers.⁶⁶ There were similar improvements in the steel and automotive sectors.⁶⁷

Every year the United States consumes the equivalent of a cube of pressure-treated lumber 15 miles on each side. In fact, U.S. consumption of pressure-treated lumber accounts for 90 percent of the world's arsenic use. Remarkably, none of this arsenic is produced in the United States. U.S. consumption is met primarily through large-scale arsenic production in Chile and China. A dirty industry was forced offshore, with the result that we now import the product but not the pollution from its manufacture. See David Rejeski, *Mars, Materials, and Three Morality Plays*, 1 J. INDUS. ECOLOGY 13, 15 (1998); see also Nick Harder, *Misunderstood Wood Is Under a Lot of Pressure*, SAN DIEGO UNION-TRIB., Mar. 17, 1996, at H18; Office of Indus. Techs., U.S. Dep't of Energy, *Arsenic* (visited Sept. 1, 1999) <<http://www.oit.doe.gov/mining/materials/arsenic.html>>.

65. From 1970 to 1996, manufacturing output per hour more than doubled from 55 to 113.1 (index of 100 set at 1992 levels). See 1997 STATISTICAL ABSTRACT, *supra* note 4, at 428. For specific industries, from 1975 through 1992, productivity increased: for motor vehicles and equipment from 69.6 to 104.8, for industrial organic chemicals from 64.9 to 92.2, and for steel from 61.3 to 116.1. See 1995 STATISTICAL ABSTRACT, *supra* note 19, at 429. Nor is this just happening in the United States. A study by the IMF concluded that from 1970 to 1994 differential productivity rates in the manufacturing and service sectors accounted for almost two-thirds of the deindustrialization in developed countries. See ROWTHORN & RAMASWAMY, *supra* note 4, at 6-7.

66. In 1978, 899,100 employees produced 5,085,200,000 square yards of cotton broadwoven goods. In 1997, 607,600 employees produced 5,078,400,000 square yards. See FAIRCHILD'S TEXTILE & APPAREL FINANCIAL DIRECTORY 1986 (13th ed. 1986); U.S. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PUB. NO. MQ-22T, CURRENT INDUSTRIAL REPORTS: BROADWOVEN FABRICS, (GRAY) SUMMARY FOR 1981, at 1 tbl. 1A (1982); see also James Franklin, *Industry Output and Employment Projections to 2006*, BUREAU LAB. STAT. MONTHLY LAB. REV., Nov. 1997, at 42, 44-49.

67. While the total steel production in America has not equaled the levels of the 1970s, the U.S. steel industry has the highest productivity in the world. U.S. producers require 6.5 hours of labor to produce a metric ton of steel, while the Japanese require 7.1 hours and the South Koreans 9 hours. See BRYAN JOHNSON, HERITAGE FOUND. NO. 146, ENDING AMERICA'S 20-YEAR ADDICTION TO STEEL IMPORT RESTRICTIONS 6 (1989); Steel Mfrs. Ass'n, *Growth of EAF Steel Production in the U.S. 1970-1997* (visited Sept. 29, 1999) <<http://www.steelnet.org/sma/eafgrowth.html>>; Christopher Saunders, *Steelmakers' Fatal Addiction*, J. COM., July 1, 1993, at 6A.

In 1980, U.S. manufacturers produced 8,010,000 vehicles. Fifteen years later this had increased by 50 percent to 11,986,000 motor vehicles. Over the same time period, the number of production employees fell by 2.5 percent, and the time to build a car fell by almost one-third. See

Much of this increased productivity has been due to greater reliance on services. For example, the innovative management practice of just-in-time inventory, an increasingly dominant aspect of manufacturing activity, is only possible because of sophisticated express carrier services.⁶⁸ While the fastest growing employment fields since 1980 have been in technology-intensive and knowledge-based fields such as data processing services and a range of health care services, they have not matched the productivity gains of manufacturing.⁶⁹ Recent research has identified specific instances of productivity gains for services but confirmed that overall productivity growth in the sector has been poor.⁷⁰

Thus the graphs presented in Part I.A mask a fundamental point. Contrary to popular wisdom and the experiences of Pittsburgh and Cleveland, it is *not* the case that there is less manufacturing than three decades ago or that America has deindustrialized, in the sense of an absolute decline in industrial activity. Far from it. We are producing *more* than ever before in

1997 STATISTICAL ABSTRACT, *supra* note 4, at 425, 627; Frederick Gluck, *Recreating the American Dream*, MCKINSEY Q., Sept. 22, 1992, at 38. From 1973 to 1986, the average new US-made car became twice as efficient, from 13 to 27 miles per U.S. gallon. See WEIZSÄCKER ET AL., *supra* note 59, at 4.

68. As Frederick Smith, the founder of Federal Express, has observed:

The concept of just-in-time (JIT) inventory management, in which the materials of production are scheduled to arrive when they are needed in the production process, is a simple idea with enormous implications. In an economy focused on keeping inventory lean, air cargo transportation equipment and systems become "flying warehouses"—accessible, secure, 500-mile-an-hour storage facilities for those items somebody wants to use tomorrow. . . . The possibilities boggle the mind. Components made in Chicago today could be on a merchant's shelf in Frankfurt, Germany, in 48 hours—routinely.

Frederick Smith, *Air Cargo Transportation in the Next Economy*, in TECHNOLOGY IN SERVICES, *supra* note 54, at 160, 160–61.

69. See Peter F. Drucker, *The Age of Social Transformation*, ATLANTIC MONTHLY, Nov. 1994, at 53, 56. Alan Blinder, former vice chairman of the Federal Reserve, and Richard Quandt write that

[a]s the government measures it, productivity growth has not accelerated since the information revolution got going. In fact, except in manufacturing, it has decelerated. And productivity performance has been downright dreadful in some of the areas in which innovations in [information technology] might have been expected to yield the most dramatic dividends—such as the financial sector.

Alan S. Blinder & Richard E. Quandt, *The Computer and the Economy*, ATLANTIC MONTHLY, Dec. 1997, at 26, 26. This may also indicate that there are productivity improvements that are second-order effects that traditional measurements do not adequately capture.

70. Researchers from Columbia Business School conducted detailed studies of the insurance and phone company sectors. While they found examples of impressive productivity gains in each sector (mostly involving large-scale transaction-processing activities), they concluded that the overall poor performance was due to lack of sustained management attention to efficiency of basic operations. See Michael van Biema & Bruce Greenwald, *Managing Our Way to Higher Service-Sector Productivity*, HARV. BUS. REV., July–Aug. 1997, at 87, 88.

terms of both dollar value and absolute production.⁷¹ Despite the fact that some sectors have lost out to foreign competition and that industrial outsourcing now routinely takes place in different countries, U.S. manufacturing remains a powerful player in the global economy.⁷²

D. Assessing Environmental Impact

The preceding analysis of economic indicators has revealed two broad trends at work over the last few decades. First, there has been sustained growth in the service sector such that in relative terms it now dominates our nation's economic activity. Second, this rise of services has masked significant productivity gains and an absolute increase in manufacturing activity. These results should not, upon reflection, be surprising. Seventy years ago, one in five U.S. employees worked in agriculture. The figure is now less than one in thirty but with more output than ever before. Over the long term, agriculture has sustained the highest productivity rate of any sector.⁷³ The need for food did not go away at the end of the agricultural

71. Measures of manufacturing capacity from 1970 to 1994 (indexed against the estimated quantity of capacity output in 1967) for the current stock of plant and equipment in manufacturing industries demonstrate an increase from 71 to 144. See 1995 STATISTICAL ABSTRACT, *supra* note 19, at 759. From 1972 to 1992, the value of manufacturing shipments grew from \$757 billion to \$3.006 trillion. See *id.* at 748. One of the reasons these findings fly in the face of the conclusions of many commentators is that the deindustrialization debate is often incorrectly framed as a question of manufacturing versus services. This obscures the two activities' interdependence. See Guile, *supra* note 54, at 2.

72. In the mid-1970s, U.S. manufacturing accounted for 12.4 percent of world exports. Nearly two decades later in 1993, in a much larger and more competitive export market, its share had expanded to 12.7 percent. See 1995 STATISTICAL ABSTRACT, *supra* note 19, at 760. And this was not just for computers and software. From 1980 to 1994, shipments of durable goods increased from \$929 billion to \$1813 billion, fabricated metal products from \$116 billion to \$182 billion, industrial machinery and equipment from \$181 billion to \$330 billion, and computer and office equipment from \$30 billion to \$89 billion. See *id.* at 770. As one might expect from increased productivity, during this period of increasing production manufacturing employment remained roughly the same (decreasing from 20.746 million workers in 1970 to 20.518 million in 1996). See 1997 STATISTICAL ABSTRACT, *supra* note 4, at 415.

73. See COHEN & ZYSMAN, *supra* note 1, at 6; see also 1995 STATISTICAL ABSTRACT, *supra* note 19, at 675 (Farm Output Indexes 1970-1991) (showing crop production gains of over 40 percent).

Stephen Jay Gould's essays on evolution provide a useful analogy. In one essay, Gould reviews visual depictions of evolution over the last 130 years. The diagrams have shared a common feature over time—depicting an evolutionary tree with humans atop the highest branch. Portraying humans as the most advanced species evolution has yet produced, of course, serves as a useful justification for a range of behaviors, but Gould contends that the view is scientifically wrong. Rather than evolution leading to a single apex, humans represent the farthest branch to date of the simians, one of many parallel lines of species development. See STEPHEN JAY GOULD, *FULL HOUSE: THE SPREAD OF EXCELLENCE FROM PLATO TO DARWIN* 9-16 (1997). In the same manner, while it is empowering to think of the information revolution as the linear apex of economic

revolution, nor has industrial activity dimmed in the brilliance of the information revolution's dawn.

Econometric analysis does not in and of itself tell us whether these developments are environmentally benign or malign. This can only be determined by measuring the physical impact of the growth of services and manufacturing innovations (such as outsourcing, material substitution, and increased efficiencies). Part I.D thus turns to an analysis of measures that bear directly on domestic environmental protection: pollution and resource consumption.

Recall the core thesis of Drucker's and others' writings—that knowledge is replacing natural and human-made capital as factors of production and that value is increasingly being delivered by services rather than goods. One would expect that increasing use of e-mail will reduce the environmental impact from overnight express and postal mail, that telecommuting and video conferencing will reduce the transport impacts from traveling to work, and that bio-engineered crops will reduce the need for pesticides and fertilizer.⁷⁴ Such examples surely suggest an “environmental bonus.” But is this happening? Can we move beyond in-flight magazine stories replete with enticing anecdotes and find empirical data on the reduced environmental impacts one might expect from services in an information economy? Part I.D shows that while the economy is becoming cleaner and more efficient per dollar of activity, in absolute terms we are moving in the wrong direction.

1. Dematerialization

The examples cited above of e-mail, telecommuting, and bio-engineered crops all share one common trait. Each causes a reduction in the quantity of energy, natural capital, and material (and therefore attendant pollution) required to serve an economic function. This phenomenon is known as “dematerialization,” a decoupling of economic activities from resource consumption.⁷⁵ If information truly is substituting for physical materials, if the economy is increasingly burning knowledge instead of natural resources,

development, the agricultural, industrial, and digital sectors can also be thought of as parallel activities each enabled to achieve greater efficiency and productivity by technical advances.

74. The material requirements of a transatlantic business trip have been estimated at roughly a hundred-fold greater than those of a six-hour videoconference (one ton versus 10 kilograms). See WEIZSÄCKER ET AL., *supra* note 59, at 114.

75. Some of the leading researchers in the field define dematerialization as “the absolute or relative reduction in the quantity of materials required to serve economic functions.” Iddo K. Wernick et al., *Materialization and Dematerialization: Measures and Trends*, DAEDALUS, Summer 1996, at 171, 171.

one would expect that the information revolution would lead to reductions in resource consumption and pollution per unit of economic activity.⁷⁶

A series of studies have examined material flow through the U.S. economy. The most ambitious was recently conducted by the World Resources Institute (WRI).⁷⁷ The graph below shows the results for U.S. material intensity, measuring Total Material Requirement (TMR) per unit GDP.⁷⁸ In mathematical terms, improving measures of material intensity

76. The seminal research of Kenneth Boulding provides a helpful model to understand the three stages of economic growth in moving toward sustainable development. The first stage of development is known as the "frontier economy" and is characterized by short-term profit maximization. See David Rejeski, *Metrics, Systems, and Technological Choices*, in *THE INDUSTRIAL GREEN GAME: IMPLICATIONS FOR ENVIRONMENTAL DESIGN AND MANAGEMENT* 48, 51 (Deanna J. Richards ed., 1997) (citing MICHAEL E. COLBY, *ENVIRONMENTAL MANAGEMENT IN DEVELOPMENT: THE EVOLUTION OF PARADIGMS* 9 (World Bank Discussion Paper No. 80, 1990)). With a goal of rapid economic growth, the government supports resource-intensive economic activities and enforces few regulations aimed at reducing emissions or capturing environmental externalities. GDP growth is tightly coupled with pollution and resource consumption. This model explains well the growth of the U.S. economy in the 19th and early 20th centuries as well as the development of Eastern European countries, such as the Czech economy from 1970 to 1990.

The second stage of development is associated with the creation of institutions and laws to control pollution. See *id.* In many countries, this occurred around the time of the Stockholm Conference on the Human Environment in 1972. In this model, pollution becomes decoupled from GDP and resource consumption. The United States and most developed countries certainly seem to have achieved this level of development.

The third stage of development is dematerialization, in which both pollution and resource consumption become decoupled from GDP. See *id.* at 32.

77. The World Resources Institute (WRI) sought to quantify all the natural resources directly and indirectly consumed by economic activity in four major industrialized nations (the United States, the Netherlands, Germany, and Japan). Based on the industrial ecology principle of material flow accounting, the study tracked the consumption of natural resources in the economy, from the extraction of raw materials through to their ultimate disposal. Importantly, the study sought to track the entire life cycle, capturing material flows overseas as well as domestically. Thus, to take the example of arsenic smelting, the data would include the material consumed by the arsenic production in China or Chile if it ended up in pressure-treated lumber in the United States. See ALBERT ADRIAANSE ET AL., *RESOURCE FLOWS: THE MATERIAL BASIS OF INDUSTRIAL ECONOMIES* (1997).

78. The WRI researchers developed a new measurement unit of Total Material Requirements (TMR). This quantifies both the direct and the indirect use of natural resources flowing through an economy. Direct material requirements include feedstock resources in the production process such as grain, copper, coal, and gas. Indirect material requirements include so-called hidden flows. These are natural resources that are not sold as commodities and never enter the economy, such as overburden and waste from extractive activities, biomass from crop harvesting and logging, soil erosion from agriculture, and earth moved during construction.

The inclusion of indirect material requirements in measures of environmental impact is controversial. Not surprisingly, it dominates the TMR. In the United States, the hidden flows of indirect material requirements account for almost 77 percent (by weight) of material use. For countries such as Japan and Germany, much of the hidden flow occurs abroad where resources are extracted and transformed. See ADRIAANSE ET AL., *supra* note 77, at 1.

One could argue that the TMR is not a useful measure, because the environmental impacts of a pound of dirt and a pound of plutonium are obviously very different. The researchers chose not

should show decreasing slopes. The study found that TMR material intensity has improved, as has the measure of direct material intensity.⁷⁹ These data therefore are consistent with the thesis that knowledge is replacing physical inputs as factors of production, that services are replacing resource intensive activities.⁸⁰ If one looks at pollution, the improvements are even more striking.⁸¹

to account for materials differently, however, claiming that it was not possible to know in advance which flows will be harmful. As an example, the impacts differ considerably depending on whether construction earth is moved into a wetland or a gravel pit. "We are moving the earth. We humans move more earth than do volcanoes and the weather combined. By moving things around we do a lot of damage. We overstress the earth's capacity safely to absorb thousands of millions of tonnes that we return as waste or as overburden." WEIZSÄCKER ET AL., *supra* note 59, at 237 (citation omitted).

79. See ADRIAANSE ET AL., *supra* note 77, at 8. "Direct material intensity" refers to traditional material inputs such as oil, copper, or water and does not include the hidden flows captured in the measure of TMR.

80. A number of studies have shown similar results, describing the relationship between economic development and resource consumption as an example of the environmental Kuznets Curve. The Kuznets Curve is generally applied in the pollution context to demonstrate that while pollution rises in the early stages of industrialization, once per capita income exceeds a certain level resources are directed toward environmental protection and pollution levels fall. Graphing pollution against per capita income produces an inverted "U," known as a Kuznets Curve. See Cutler J. Cleveland & Matthias Ruth, *Indicators of Dematerialization and the Materials Intensity of Use*, 2 J. INDUS. ECOLOGY 15, 25-26 (1998). Oliviero Bernardini and Riccardo Galli, among others, have argued that material intensity exhibits the same behavior, rising at early stages of development (as infrastructure is built) but reversing as income increases. See *id.* at 25 (citing WILFRED MALENBAUM, *WORLD DEMAND FOR RAW MATERIALS IN 1985 AND 2000* (1978); Oliviero Bernardini & Riccardo Galli, *Dematerialization: Long-Term Trends in the Intensity of Use of Materials and Energy*, 25 FUTURES 431, 435-36 (1993)).

81. By most measures, over the last three decades America's environmental quality has improved in absolute terms. Looking at the Clean Air Act's National Ambient Air Quality Standards (NAAQS) criteria pollutants as an example, only nitrous oxides have increased in ambient concentration despite significantly more economic activity (figures measured in thousands of tons).

<u>National Air Pollutant Emissions:</u>	<u>1970</u>	<u>1995</u>
PM-10	13,044	3050
sulfur dioxide	31,161	18,319
nitrogen dioxide	20,625	21,779
VOCs	30,646	22,865
CO	128,079	92,099
lead	219,471	4986

See 1997 STATISTICAL ABSTRACT, *supra* note 4, at 234 No. 380. It should be noted that not all pollutants have decoupled from GDP. Carbon dioxide, for example, seems tightly linked to GDP, as does generation of solid waste. See Rejeski, *supra* note 64, at 52.

Figure 3

Obviously, though, these material intensity results can be explained by many other factors as well. The first of these is input substitution—the use of new materials as efficient replacements for current materials. Fiber optics, for example, are replacing old copper wire communication lines, using less material and increasing the carrying capacity by thirty to fifty times.⁸² A second factor is resource productivity—increased production efficiency that conserves materials. This can occur through redesign of the process, closed loop recycling, and other pollution prevention techniques.⁸³ A third factor is product design. This may be as simple as lightweighting. Beverage cans, for example, have become much smaller and lighter, moving from glass to steel to aluminum, and then reduced in weight a further 25 percent. As in the case of pollution reductions, these changes may also be driven by command-and-control regulations, market prices reflecting scarce resources, changes in market demand, and environmental regulations that implicitly or explicitly change relative prices.

Regardless of the precise cause for reduced material intensity, there has been little improvement in the measure of material consumption per cap-

82. See Cleveland & Ruth, *supra* note 80, at 18. Similarly, the amount of steel in a car has decreased by over a third since the early 1970s, while the amount of plastics and composites has increased. See Wernick et al., *supra* note 75, at 177.

83. See, e.g., Esty & Porter, *supra* note 12, at 36.

ita.⁸⁴ In fact, in Japan, Germany, and the Netherlands, material consumption per capita has increased. The important corollary is that because of population growth and increasing economic activity, absolute resource consumption has actually *increased*, despite reductions in material intensity. As the WRI study concluded, "meaningful dematerialization, in the sense of an absolute reduction in natural resource use, is not yet taking place."⁸⁵ These findings have been confirmed by other research in the field.⁸⁶

2. Mixed Messages

So what does it all mean? The data are both promising and troubling. They are promising because improvements in material intensity and pollution reductions are consistent with the theses that services are substituting for manufacturing and that knowledge is in certain instances replacing inputs of natural capital. The improvements in material intensity, though,

84. Put another way, GDP has grown faster than population. Thus, measures of material intensity will be more impressive than measures of per capita consumption. What matters for the environment, of course, is total consumption.

85. ADRIAANSE ET AL., *supra* note 77, at 2. In fact, direct inputs have been growing in parallel with economic growth. See *id.* at 14.

86. A study at the Rockefeller Institute concluded that "an assessment of consumption per unit of economic activity shows a dematerialization in physical materials of about one-third since 1970." Wernick et al., *supra* note 75, at 176. "[I]ndividual items in the American economy may be getting lighter but the economy as a whole is physically expanding." *Id.* at 179. "We see no significant signs of *net* dematerialization at the level of the consumer or saturation of individual material wants." *Id.* at 194 (emphasis added). Since 1950, per capita consumption of copper, steel, energy, timber, and meat has doubled; consumption of plastic has increased five-fold, and aluminum by seven-fold. While America has the highest per capita consumption levels in the world, the resource consumption in Western Europe and Japan is only slightly less. See ALAN DURNING, *HOW MUCH IS ENOUGH?* 32 (1992).

A 1997 study examined the consumption of a range of metals, minerals, agricultural chemicals, and petroleum products in 32 countries over 21 years. It concluded that a general reduction in resource consumption was not evident in the most developed countries. See generally Martin Jänicke et al., 'Dirty Industries': *Patterns of Change in Industrial Countries*, 9 ENVTL. & RESOURCE ECON. 467 (1997). The most exhaustive survey of literature on the subject similarly concluded that "[d]espite claims to the contrary, there is no compelling macroeconomic evidence that the U.S. economy is decoupled from material inputs." Cleveland & Ruth, *supra* note 80, at 45. The OECD studied the *global* material intensity for steel and wood from 1970 through 1992. Throughout this period, while the material intensities of wood and steel showed a negative slope, the "total world 'materials' consumption rose by 38%." OECD, *ECONOMIC GLOBALIZATION AND THE ENVIRONMENT* 64 (1997). The linkage of economic growth with resource consumption was also confirmed by a recent government study. See INTERAGENCY WORKING GROUP ON INDUS. ECOLOGY, MATERIAL AND ENERGY FLOWS, MATERIALS (1998) [hereinafter MATERIALS].

Analyses of energy consumption and waste generation show similar results. "Although the soaring numbers of products and objects, accelerated by economic growth, raised municipal waste in the United States annually by about 1.6 percent per person in the last couple of decades, trash per unit of GDP dematerialized slightly." Jesse H. Ausubel, *The Liberation of the Environment*, DAEDALUS, Summer 1996, at 1, 9.

may largely be due to other factors such as increased production efficiencies and input substitution. It is thus possible that the environmental bonus from the substitution of services and knowledge for material-intensive activities is not yet occurring to any significant degree—much as the information technology sector is yet to show increases in productivity—and will take decades to exhibit its potential. The examples cited at the beginning of Part I.D such as e-mail and telecommuting, for example, are still burgeoning. Viewed from this perspective, the results are not only promising but give reason to hope for much more. Indeed, a number of fledgling services would, if broadly adopted, create significant environmental benefits.⁸⁷

At the same time, however, the data are quite disturbing because rising absolute consumption is offsetting improvements in resource use. In fact, the data raise the possibility of a counterthesis—that the information revolution and the rise of services have a net *negative* environmental impact because they increase overall economic activity and thus overall resource consumption and its impacts.⁸⁸

Writings on the environmental consequences of the service economy have primarily focused on services' role as substitutes for products and polluting processes. In terms of environmental impact, however, far more important may be services' role as *complements* to traditional production factors, such as labor and resources, thus increasing their efficiency and leading to *increased* environmental impacts through greater resource flow and conversion.⁸⁹ Hence advances in telecommunications and data-processing technologies have not only made relevant information cheaper and transactions easier, but they have also increased the total number of transactions.⁹⁰ You may recall, with a chuckle, predictions by computer companies a decade ago of the paper-free office. Following the introduction of e-mail into an

87. See generally WEIZSÄCKER ET AL., *supra* note 59. These services include expanding leasing beyond traditional cars and office machines to unconventional products (e.g., leasing solvents, as Dow Chemical does), *see id.* at 101, replacement of material products such as newspapers and catalogues with bits and bytes, joint ownership of cars and appliances (as occurs in Berlin and the Netherlands), *see id.* at 128, and remanufacturing products designed for upgrades (e.g., Herman Miller furniture in the U.S.), *see id.* at 70.

88. See generally Ehrlich et al., *supra* note 25.

89. As a paradoxical example of how dematerialization may lead to an increase in material consumption, consider the developments in steam engine design in 19th century England. Over a short period of time, the steam engine became three times more efficient (i.e., the engine performed the same amount of work with one-third the coal). One might expect this would have led to a one-third reduction in coal use. Instead, coal consumption *increased ten-fold*. The more efficient steam engine was now put to many more uses. See Herbert Inhaber & Harry Saunders, *Road to Nowhere*, SCIENCES, Nov./Dec. 1994 at 20, 21.

90. As knowledge becomes a more important factor of production in some sectors, reductions in the cost of obtaining relevant information stimulate economic growth.

office, it turns out, paper consumption increases by 40 percent.⁹¹ While, on a life cycle basis, each e-mail consumes fewer resources and emits less pollutants than sending a letter, the vastly greater number of e-mails leads to a net increase in consumption and attendant pollution.⁹²

In recognition of this phenomenon, European Union and OECD nations have taken the unprecedented step of negotiating a common goal to dematerialize their economies. Specifically, they are working toward drastically reducing nonrenewable resource flows in the next few decades through four- to ten-fold reductions in material intensity.⁹³ While this soft international law is unenforceable, it reflects the common international concern over levels of resource consumption and their attendant environmental impacts.

The correlation between measures of material consumption and environmental degradation is a complicated issue in its own right and beyond the scope of this Article (the basic issues are described in the footnote below).⁹⁴

91. See Raju Narisetti, *Xerox Copiers Go Digital to Fight Off Printers*, WALL ST. J. EUROPE, May 13, 1998, at 5. As a well-known industrial ecologist has observed, "[n]ew technologies for information storage supplement the range and augment the amount of information stored, rather than reduce the use of paper." Wernick et al., *supra* note 75, at 179 (emphasis added).

92. The main pollution concern in this example would be the life cycle pollution from paper (i.e., production, distribution, disposal). The life cycle impacts of the personal computer would need to be considered as well. Equally, an alternative phenomenon may be at work. If e-mail is substituting for telephone calls rather than for postal mail, then a more resource-intensive activity is replacing a less resource-intensive one.

93. See *Meeting of OECD Environment Policy Committee at Ministerial Level* (visited Nov. 18, 1999) <http://www.oecd.org/news_and_events/reference/nw96-15a.htm>.

94. The concern expressed in the OECD recommendation presupposes a strong correlation between measures of material consumption and environmental degradation. In some cases there clearly is a direct correlation between consumption and harm. The collapse of two-thirds of the world's major fisheries is obviously linked to levels of consumption, for example. It is a simplification, however, to state flatly that increased consumption in and of itself is environmentally harmful. In each case, whether the resource is renewable, its rate of extraction, the impacts of extraction, its final form, and the externalities created throughout the resource's life cycle (such as pollution or loss of biodiversity) are all key factors in calculating environmental impact. The nascent field of industrial ecology is premised on this systems approach. See, e.g., Charles Powers & Marian Chertow, *Industrial Ecology: Overcoming Policy Fragmentation*, in THINKING ECOLOGICALLY: THE NEXT GENERATION OF ENVIRONMENTAL POLICY, *supra* note 7, at 19.

Why is it appropriate, then, to focus on macro indicators of resource consumption? The general concern voiced by scientists today stems less from the specifics of consumption than from its overall scale effects. The lead article in July, 1997, in the prestigious journal *Science*, for example, detailed the physical impacts of humans on ecosystems. See Peter M. Vitousek et al., *Human Domination of Earth's Ecosystems*, 277 SCIENCE 494 (1997). These range from the estimate that humans coopt or destroy between 39 and 50 percent of terrestrial net primary productivity (the basic food supply of virtually all animals and microorganisms) and have degraded over 40 percent of the earth's terrestrial vegetated land surface to climate change and ozone depletion. The article was not intended to present a litany of disasters but rather to demonstrate the facts underlying the scientific consensus that the combined impacts of these appropriations and pollution are degrading the welfare-enhancing services provided by nature. Known as "ecosystem services," these are the conditions and processes that make consumption possible and upon which the prosperity of all

For our purposes, Part I's analysis of the phenomenon of deindustrialization and its broad implications for environmental policy establishes two points. First, it debunks the myth of manufacturing's decline. Second, it demonstrates that the ascent of services and the related trends of the information revolution will not, in and of themselves, lead to improved environmental quality. We must therefore move from an investigation of services' potential for reducing overall environmental impacts to serious examination of their role as a source of environmental harm. Parts II and III now turn to the regulation of specific services.

II. LAW AND POLICY TO REDUCE THE ENVIRONMENTAL IMPACT OF SERVICES

Perhaps surprisingly, despite the economic importance of the service sector, scholars have barely addressed its implications for environmental pro-

societies depends. They include the purification of air and water, the mitigation of droughts and floods, the generation and preservation of soils and renewal of their fertility, the detoxification and decomposition of wastes, the pollination of crops and natural vegetation, the control of the vast majority of potential agricultural pests, the shielding of ultraviolet radiation, and the partial control of climate. See generally *NATURE'S SERVICES* (Gretchen C. Daily ed., 1998); James Salzman, *Valuing Ecosystem Services*, 24 *ECOLOGY L.Q.* 887 (1997). These services, taken for granted yet absolutely essential to human existence, have no viable substitutes on the scales on which they operate.

Scientists have spoken with one voice in warning that the human economy depends on the services provided by natural ecosystems but that our patterns and levels of consumption currently threaten their, and thus our, well-being. See, e.g., *POPULATION SUMMIT OF THE WORLD'S SCIENTIFIC ACADEMICS: A JOINT STATEMENT OF FIFTY-EIGHT OF THE WORLD'S SCIENTIFIC ACADEMICS* (1993). As the *Science* article concluded,

[a]ll of these seemingly disparate phenomena trace to a single cause—the growing scale of the human enterprise. The rates, scales, kinds and combinations of changes occurring now are fundamentally different from those at any other time in history; we are changing Earth more rapidly than we are understanding it.

Vitousek et al., *supra*, at 498.

If the hypothesis that services act as complements more often than as substitutes for manufacturing is correct, the net effect is increased resource consumption and life cycle impacts such as pollution. Given near consensus in the scientific community that our *current* levels and patterns of consumption are unsustainable, exacerbating these trends is worrying. Clearly, though, not all consumption will be equally significant to environmental impact. Unlike fisheries and ozone depletion, levels of resource consumption need not move in lockstep with degradation of ecosystem services and goods. One could argue, and many have, that increased provision of services rather than goods would satisfy today's level of consumption with considerably less resource consumption and environmental impact. The current situation of increasing resource consumption and degradation of ecosystem services, however, demonstrates we clearly are not moving in the right direction. Disentangling the components of, and specific threats to, provision of ecosystem services remains a daunting research challenge to ecologists with important implications for policy development. The author and Buzz Thompson are writing an article exploring these issues in greater detail.

tection or, more fundamentally, how we should even begin to think about these issues. As evidence, consider the flotilla of recent “reinvention” proposals adrift in the sea of public debate. Since 1992, there have been five major reviews of U.S. environmental policy, with participation from all the leading figures in the field.⁹⁵ These impressive initiatives have examined the protection of ecosystems and their services, threats to the global commons, concerns that we are approaching the asymptote of command-and-control regulations, opportunities to increase the application of market-based instruments, and a range of other issues. But only one of these policy reviews, the Next Generation Project sponsored by Yale University, has thoughtfully considered the service sector.⁹⁶

We know remarkably little about either the environmental impacts of services or appropriate policy tools. But overlooking the role of the service sector in environmental protection is myopic. As Brad Allenby has observed, “The simplicity of the underlying assumption—regulate manufacturing emissions and you will create an environmentally acceptable world—is touching but, unfortunately, wrong.”⁹⁷ The few writings seriously examining the environmental impacts of services have identified important themes using anecdotes, but they have not set out a coherent framework for thinking about services’ impacts and, depending on their severity, the appropriate governmental response. This is no easy task, for the service sector comprises a remarkably heterogeneous grouping of economic activities, as varied in their function as in their environmental impact. They include transportation and public utilities, wholesale and retail trade, finance, insurance, real estate, business services, health services, legal services, and government services. The rapidly growing information services, discussed in Part I, comprise only a small part of the sector.

The first step of analysis, then, is to divide services into categories meaningful for policy development. The simplest distinction is between services that cause high and low direct impact per facility—see Figure 4, below.⁹⁸

95. The exhaustive reviews have ranged from the high-profile President’s Council on Sustainable Development and the Enterprise for the Environment (chaired by former EPA Administrator Bill Ruckelshaus) to studies by the General Accounting Office, Resources for the Future, and Yale University. See Rejeski, *supra* note 7, at 26.

96. See Guile & Cohon, *supra* note 7, at 76.

97. Allenby, *supra* note 2, at 35.

98. Direct environmental impact is an approximate measure, of course, because the different types of impact (air and water pollution, solid waste, resource consumption, etc.) vary according to the service. The level of estimation is sufficient only to distinguish between the operation of those services that cause significant impact and the operation of those that do not.

The services in the upper box may be described as *smokestack services*, including electric utilities, trucking companies, airlines, telecommunication providers, and hospitals. Their operations involve large physical plants and emit significant quantities of air pollutants or solid waste. As a result, they are regulated but often inefficiently so, hindering opportunities for further environmental protection. The key policy issue for smokestack services is improving our understanding of their specific operations and impacts in order to develop more appropriate regulation.

Figure 4

While straightforward, a unidimensional analysis based on direct environmental impact is neither particularly nuanced nor revealing for significant policy development because most of the service sector falls in the chart's bottom box. Hence a second dimension of analysis is needed to further differentiate the service sector—cumulative direct impact—represented in Figure 5, below.

Figure 5

This measure delineates *cumulative services*—businesses that do not cause significant environmental harm at the level of individual operation but collectively have large impact. These include a large number of services such as dry cleaners, dentist offices, and fast-food chains such as McDonald's. While many cumulative services simply concentrate everyday activities, they pose a difficult policy challenge comparable to nonpoint pollution. That is, they present a universe of diffuse sources where specific command-and-control regulation may prove inadequate to address the overall environmental harm.

Part II examines the categories of smokestack and cumulative services, exploring their legal and policy implications for environmental protection. Part III takes a different approach, considering services as opportunities to reduce the environmental impacts of their commercial partners rather than as sources of impact themselves. These *leverage services* such as large retailers and utilities act as a funnel in product life cycles, influencing behavior both upstream and downstream.

When well crafted, categories impose order and clarifying depth in blurred surroundings. Yet they remain artificial constructs. It should be noted at the outset that the classifications of smokestack, cumulative, and leverage services overlap in some regards and are surely susceptible to refinement.

Despite these shortcomings, Parts II and III demonstrate that the law currently relies on two far cruder categories—manufacturing and services—that are no longer accurate descriptions of environmental impact, if they ever were.

In reshaping the law's vision of environmental protection, the categories created by smokestack, cumulative, and leverage services rest within the same analytical framework. As the chart on the following page demonstrates, the threshold question in each case asks why, given the existing legislative requirements, government should be concerned with the impact of specific services at all.

For each service activity, determine:

Categories → *What is the environmental problem?*

- * The direct impacts of the service itself?
(smokestack services)
- * The cumulative impact of small actions?
(cumulative services)
- * Significant impacts upstream or downstream?
(leverage services)

Regulatory Action → *Do the environmental impacts warrant governmental intervention?*

- * If so, do current regulations address the problem?
- * If so, do they address it inefficiently, hindering additional improvements?

Regulatory Targets → *Whom should the intervention target?*

- * Within the product's life cycle, which market actor is positioned to reduce the greatest environmental impact at least social cost?
- * What are the equitable and legal constraints to placing this responsibility on the least-cost provider?

Policy Instruments → *Which form of intervention is most appropriate?*

- * Should the instrument be voluntary or regulatory?
- * If the service is administered inefficiently, should the action be deregulatory?
- * Which instrument or combination of instruments is most efficient—
e.g., command-and-control standards, subsidies, education, liability, information collection and dissemination, etc.?

A. Smokestack Services

What is the environmental impact of a law firm or, for that matter, of a law school? Certainly paper consumption, energy consumption from lights, computers, and heating, water consumption, and solid waste from cafeteria operations. What about a barber shop? Lots of hair as solid waste, water and energy consumption, and perhaps some coiffure chemicals washed down the drain. But the fact is, as people intuitively know, the operation of most services does not cause sufficient direct environmental impact to warrant legal intervention.

A number of traditional services, though, are direct sources of significant environmental harm. These arise, for example, from the fuel consumption and air emissions of parcel delivery services, transport companies, and power plants, hazardous medical waste from hospitals, and solid waste from construction firms. These impacts are far greater than one might realize. Consider that electric utilities contribute one-third of the nation's nitrogen oxide emissions, carbon dioxide, and mercury, as well as two-thirds of the sulfur.⁹⁹ Construction waste is the single largest contributor to municipal solid waste.¹⁰⁰ Federal Express maintains a fleet of 451 airplanes and over thirty thousand vehicles to move its more than one million packages daily.¹⁰¹

For environmental policy analysts, smokestack services are the most obvious of the three categories because their activities are already regulated. Sulfur dioxide emissions from power plants are heavily regulated, the subject of the Title IV of the 1990 Clean Air Act amendments.¹⁰² Air pollution from the Federal Express fleet of delivery vans is subject to requirements under the mobile sources provision of the Clean Air Act.¹⁰³ Biomedical waste from hospitals is regulated by the Resource Conservation and Recovery Act of 1976 (RCRA).¹⁰⁴

Smokestack services clearly do not come to mind when describing the rise of the service economy. Indeed, many are core constituents of the smokestack economy. They are included in the analysis because, as a historical

99. See Interview with Ralph Cavanagh, Natural Resources Defense Council (Feb. 22, 1999); see also COMMISSION FOR ENVTL. COOPERATION, ASSESSING ENVIRONMENTAL EFFECTS OF THE NORTH AMERICAN FREE TRADE AGREEMENT 273-76 (1999) (detailing the contribution of electricity-generating utilities in the United States and Canada to levels of NO_x, SO₂, CO₂, particulate matter, and ground-level ozone).

100. See Telephone Interview with James McCarthy, Congressional Research Service (Mar. 26, 1999).

101. See Rejeski, *supra* note 7, at 27.

102. See 42 U.S.C. §§ 7651-7660 (1994).

103. See *id.* §§ 7521-7550.

104. See *id.* § 6922.

fact, environmental laws have *not* been drafted with services in mind. This has led either to exclusion of services from environmental regulation¹⁰⁵ or, as often happens in the case of smokestack services, their unthinking as a generic smokestack polluter. The net result is inefficient governance, requiring the regulated entity to devote quite significant resources to compliance. While this is, of course, a general problem of regulatory design, inefficient regulation of smokestack services can significantly impede innovative environmental protection measures.¹⁰⁶ A recent study in the *Harvard Business Review* of productivity in the service sector made a similar point, concluding that regulation of services is very inefficient. One of the most important ways "government can help the service sector improve productivity is not to overregulate it. . . . The point is that regulation should be carried out in both spirit and practice to minimize the demands made on [service] businesses' attention and resources."¹⁰⁷ As an example, consider the situation of BellAtlantic, the telecommunications provider in the Northeast.¹⁰⁸

While BellAtlantic does not produce large amounts of hazardous waste, its diffuse operations generate innumerable small sources that must be individually regulated. This includes wastes from maintaining a fleet of over eighteen thousand vehicles, treating sediment from 113,000 manholes, and managing the use and disposal of over 2.5 million utility poles treated with wood preservatives (of the 170 million poles in the country). The manhole sediment is typical of the mismatched regulatory burdens facing BellAtlantic. When repairing cables, BellAtlantic employees often work in manholes that contain water and sediment from the street. To get at the cables, it may be necessary to remove some of the water and sediment from the

105. As an example of how services have been overlooked in addressing smokestack emissions, the Toxic Release Inventory, one of the EPA's greatest pollution success stories, is limited by law to industrial facilities as identified by the Standard Industry Classification (SIC) code. See *id.* § 11023(b)(1)(A).

106. The recent best-selling diatribe railing against the follies of regulation, *The Death of Common Sense*, made this point painfully clear. See generally PHILIP K. HOWARD, *THE DEATH OF COMMON SENSE* (1996). Nor, obviously, is this a problem confined to services. The Clean Water Act's effluent standards, for example, are determined by industrial category based on the "typical" plant in that category. If a regulated entity believes its physical situation is fundamentally different from the setting on which the effluent standard was based, it may apply for a variance. See Clean Water Act, 33 U.S.C. § 1311(n); *Chemical Mfrs. Ass'n v. National Resources Defense Council*, 470 U.S. 116, 134 (1985) (holding that the EPA has the statutory authority to issue "fundamentally different" factor variances for toxic materials).

107. See van Biema & Greenwald, *supra* note 70, at 95.

108. The information about BellAtlantic is drawn from a consultant's report written for NYNEX (the corporate predecessor to BellAtlantic). See Kerry McDonald, *Rethinking Environmental Regulations Impacting a Telecommunications Company* (Aug. 14, 1995) (unpublished consultant's report, on file with author); Telephone Interview with Roy Deitchmann, former environmental manager at NYNEX (Mar. 5, 1999) [hereinafter Deitchmann]; see also Rejeski, *supra* note 7, at 27.

manhole. If they contain more than five parts per million (ppm) of lead, however, the water and sediment must be treated as RCRA hazardous waste. BellAtlantic tests have shown that the sediment is below 5 ppm about 55 percent of the time. Yet in practice BellAtlantic routinely treats the sediment as hazardous waste (with all the attendant RCRA Subtitle C requirements)¹⁰⁹ because of the need to repair cables quickly. This requires, for example, obtaining a separate EPA hazardous waste identification number for every manhole treated in this manner. The system of identification numbers, required for waste manifests, was designed with smokestack sites in mind; it was assumed there would be one site and therefore one source of hazardous waste generation. Perhaps not surprisingly, BellAtlantic has the largest number of waste identification numbers in the country.¹¹⁰

When BellAtlantic designed a mobile treatment unit that would eliminate the toxicity characteristics of the sediment, New Hampshire refused to permit the process, stating that mobile on-site treatment was only allowed for manufacturing companies. Because BellAtlantic's SIC code identified it as a service company, it could not apply for the permit.¹¹¹ Similarly mismatched regulatory burdens fall on BellAtlantic's use of emergency standby generators.¹¹²

Biotechnology provides another example of poor regulatory fit. Concerned over the burdensome and costly regulation of wastes generated by the state's biotech companies, California's Department of Toxic Substances Control created a fifty-member Laboratory Regulatory Reform Task Force. The task force's report concluded that RCRA had been designed for large industrial sites and was ill-suited to regulation of laboratory waste.¹¹³ Depending on the specific research project, labs generate infrequent, small amounts of many different types of hazardous waste. Industrial sites routinely generate large amounts of the same small number of wastes. Moreover,

109. See 42 U.S.C. §§ 6921–6931.

110. NYNEX removes sediment from four hundred to seven hundred manholes every year and needed to apply to the EPA for an identification number for each manhole. See Deitchmann, *supra* note 108.

111. NYNEX engineers designed a patented system of a sealed truck that vacuumed the sediment out of the manhole and mixed it in cement with binding agents that allowed the final block to pass the toxic characteristic test. See *id.*

112. NYNEX has over 1800 emergency diesel generators to provide power for the phone system in the event of a power failure. The generators run an average of 29 hours per year. The 1990 Clean Air Act amendment's "potential to emit" clause requires hundreds of permits or exceptions annually because it is assumed the generator runs constantly in a factory setting. In addition to the permits, there is considerable paperwork associated with reporting the presence of and risk management plans for lead acid batteries in every BellAtlantic building. See *id.*; see also Rejeski, *supra* note 7, at 32.

113. See LABORATORY REGULATORY REFORM TASK FORCE, STATE OF CAL. ENVTL. PROTECTION AGENCY, RECOMMENDATIONS OF THE REGULATORY REFORM TASK FORCE (1995).

while one person can oversee the paperwork for the routine generation of RCRA wastes at an industrial facility, RCRA regards laboratory waste as hazardous at the time of generation, thus requiring that virtually all lab workers understand and comply with RCRA's detailed requirements. The same story could be told for regulation of biomedical waste generated by hospitals, labs, physician's offices, and clinics.¹¹⁴

1. Implications for Law and Policy

The point in raising these brief examples is not to argue that regulation of smokestack services is unnecessary or inevitably inefficient but, rather, that such regulation warrants special attention because of the potentially poor fit. The problems faced by smokestack services in many instances will be no different from those faced by traditional smokestack industries; however, the former are more *likely* to be problematic. As an exception that proves the rule, the sulfur trading program for utilities (as well as the least-cost planning provisions discussed in Part III) serves as an example of a well-crafted regulatory program that *explicitly considered* the sector's situation. RCRA, in contrast, was not written with BellAtlantic, biotechnology, or other services in mind. Their operations simply do not fit the smokestack industries the law was drafted to address. Indeed, smokestack services provide an excellent opportunity for innovative regulatory strategies. Large transport services such as Federal Express, Hertz and Allied Van Lines, for example, might be willing to reduce their overall emissions if they could "bubble" their vehicle fleet or obtain other forms of regulatory relief.¹¹⁵ One would think such possibilities should be attractive to the Common Sense Initiative¹¹⁶ and Project XL,¹¹⁷ the EPA's flagship reinvention initiatives to develop smarter, more effective, and cheaper alternatives to traditional regulation. The

114. These sources generate over 158 million tons of waste every year, of which 10–15 percent contains biohazardous material and 5 percent is hazardous waste. Because of the complicated accounting requirements, a midsized hospital may spend \$350,000 or more annually for waste management. These costs are compounded by lack of regulatory uniformity. Medical waste, for instance, is defined differently in 42 states. While an intravenous solution bag is defined as solid waste in Vermont, it is treated as a biohazard in most other states (with an attendant 10-fold increase in disposal costs). See Guile & Cohon, *supra* note 7, at 86–87; Rejeski, *supra* note 7, at 27–28, 31.

115. California's Laboratory Regulatory Reform Task Force, for example, recommended that labs' hazardous waste be regulated as a bubble, treating "laboratory processing units" (i.e., a room or group of rooms) as a regulatory target rather than each lab worker's bench. The state rejected this proposal, arguing that it would provide more lax control than that required by the Resource Conservation and Recovery Act (RCRA) and therefore would violate the statute. See LABORATORY REGULATORY REFORM TASK FORCE, *supra* note 113.

116. See EPA, *Common Sense*, *supra* note 11.

117. See EPA, *Project XL*, *supra* note 11.

Department of Energy's well-funded Industries of the Future initiative would seem appropriate as well.¹¹⁸ These initiatives receive over \$100 million in support but have ignored services. None of the implemented Project XL initiatives has focused on services,¹¹⁹ none of the Industries of the Future includes a service,¹²⁰ and only one of the six Common Sense Initiative sectors even considered a service (printing).

These examples demonstrate the key message for the category of smoke-stack services—the need to understand far better these services' operations, impacts, and interactions before designing regulatory and nonregulatory strategies. As the decision framework¹²¹ makes clear, determining the appropriate governmental intervention first requires a clear understanding of the environmental problem. The examples at the beginning of this part, of a law firm or barbershop, were back-of-the-envelope assessments of their direct impacts and probably pretty accurate. However, the direct impacts of the health care sector are far less clear. In many respects the nation's six thousand hospitals provide the services of a small city, with myriad resource demands and complex waste streams.¹²² How well do the regulatory requirements match these impacts? Interestingly, the EPA's most explicit foray into the service sector seeks to find out. The EPA's Office of Policy Planning and Evaluation has commissioned the think-tank Resources for the Future to explore the environmental impacts of the health care sector.¹²³ Their

118. See U.S. Dep't of Energy, DOE's 3rd *Industrial Energy Efficiency Expo Highlights Government/Industry Partnerships That Save Energy and Cut Pollution* (visited Nov. 18, 1999) <<http://home.doe.gov/news/releases99/febpr/pr99011.htm>>.

119. See Office of Industrial Technologies, *Industries of the Future* (visited Nov. 18, 1999) <<http://www.oit.doe.gov/industries.shtml>>.

120. See *id.*

121. See *supra* p. 448.

122. Not to mention the 180,000 physician's offices, 15,500 medical clinics, and 12,700 extended care facilities. See Rejeski, *supra* note 7, at 27.

123. The EPA's Office of Policy, Planning, and Evaluation has launched a project with Resources for the Future to analyze the environmental impacts associated with three service sectors: health care, food services, and retail/wholesale sales. The project description states that "[t]his project is an attempt to systematically analyze the environmental impacts associated with service sector activities." Resources for the Future, *Environmental Impacts of the Service Sector* (visited Nov. 18, 1999) <http://www.rff.org/proj_summaries/files/davies_service.htm>. The primary goal of the project is to further understand the "nature and extent of environmental effects from various service sectors." *Id.* This initial project should determine whether the effects identified "[a]re of sufficient importance to warrant a more careful analysis by EPA." *Id.*

In another interesting recent development, EPA Region 5 entered into a memorandum of understanding with the American Hospital Association (AHA) to eliminate mercury-containing wastes and reduce total wastes by 33 percent by 2005. See U.S. Env'tl. Protection Agency, *Fact Sheet: Voluntary Partnership with the American Hospital Association to Reduce Hospital Waste* (visited Nov. 18, 1999) <<http://www.epa.gov/opptintr/pbt/ahafact.htm>>. The EPA and the AHA will host a series of waste management seminars as well as cooperative pollution prevention programs

findings may uncover significant impacts that are unregulated. More likely, they will find that application of a statute written for large industrial sites has imposed significant costs and obscured opportunities for environmental improvement that escaped notice because they were never considered.

B. Cumulative Services

This category contains the largest number of services and is in many respects the most difficult to address because it brings into play the problem of cumulative impacts. In a well-known account of the history of environmental protection efforts, Lynton Caldwell described two generations of environmental problems.¹²⁴ The first generation comprised traditional point source emissions of local or, at worst, regional pollutants. These were classic smokestack industry problems of air, water, and soil pollution. Their impacts were reduced by a series of 1970s statutes and what has become known as "command-and-control regulation." The second generation introduced transboundary and global threats such as ozone depletion, trade in hazardous wastes, and climate change, problems requiring coordination among nations and therefore poorly suited for first-generation policies and institutions focused on domestic concerns.

The rise of the service sector may well coincide with the advent of a third generation of environmental problems, the challenge of atomized sources. These sources create, from a policy perspective, "a nonpoint" world. Just as nonpoint sources of water pollution—from farms and urban run-off—defy control by the Clean Water Act, so too can the environmental impacts of small service providers begin to resemble unmanageable run-off, potentially overwhelming the capacity of traditional regulatory approaches.¹²⁵

for other wastes. This type of tailored approach provides exactly the flexible strategy needed to address the environmental impacts of such a complex service.

124. See generally LYNTON KEITH CALDWELL, *INTERNATIONAL ENVIRONMENTAL POLICY: EMERGENCE AND DIMENSIONS* 83–85 (2d ed. 1990).

125. The failure of the Clean Water Act to regulate effectively agricultural nonpoint source pollution is a requisite lecture in every survey environmental law course. See, e.g., PETER S. MENELL & RICHARD B. STEWART, *ENVIRONMENTAL LAW AND POLICY* 504–08 (1994); ROBERT V. PERCIVAL ET AL., *ENVIRONMENTAL REGULATION: LAW, SCIENCE, AND POLICY* 651–52 (1996). Part of the failure to control nonpoint pollution clearly stems from the political power of the farm lobby. Of more relevance to cumulative services is the technical challenge in regulating a large number of farms whose pollution cannot be easily monitored or controlled at a pipe.

Similarly, the early laws went after big smokestacks and pipes to control the major point sources, but now the relative importance is starting to shift. Small emitters are an increasingly important source of water toxics, but controlling these sources through command-and-control regulations imposes high enforcement and monitoring costs. See, e.g., Daniel C. Esty & Marian R. Chertow, *Thinking Ecologically: An Introduction*, in *THINKING ECOLOGICALLY: THE NEXT GENERATION OF ENVIRONMENTAL POLICY*, *supra* note 7, at 1, 2. As a historic parallel, it is inter-

Many cumulative services, such as a hotel or a restaurant, may be viewed as simply concentrating everyday activities. The environmental impacts do not differ in kind from those of a household; they are simply magnified. Consider the little placards discretely placed in hotel rooms asking whether you want your towel washed daily. The energy and waste water impacts of washing a towel at a hotel are little different from those at home.¹²⁶ The impact from washing a thousand rooms' towels, however, differs greatly. While the environmental impacts from a single McDonald's drive-through are minor, the cumulative impact of twenty-two million meals served daily are significant.¹²⁷ Hence these services raise the problems of scale and indirect pressures on ecosystems mentioned at the end of Part I.

A similar concern arises from cumulative services with more direct causal links to specific environmental harms. The services' pollutant emissions individually are negligible, but cumulatively are significant and identifiable. The contribution of dry cleaners' volatile organic compounds to smog formation provides one example. Perhaps surprisingly, dentist offices provide another.

In the early 1990s, the San Francisco Bay Regional Water Quality Control Board started detecting significant levels of a heavy metal, silver, in

esting to note that over 50 years ago Justice William O. Douglas stated that the regulation of six thousand brokers and traders would be "impractical, unwise, and unworkable," calling instead for self-regulation. See Harvey L. Pitt & Karl A. Groskaufmanis, *Minimizing Corporate Civil and Criminal Liability: A Second Look at Corporate Codes of Conduct*, 78 GEO. L.J. 1559, 1577 n.96 (1990) (quoting JOEL SELIGMAN, *THE TRANSFORMATION OF WALL STREET* 185 (1982)).

126. In fact, the environmental impact per towel washed is likely much lower in the hotel than at home if one compares the impacts from individually packaged detergents and running small loads to institutional economies of scale. Similarly, one could easily imagine that eating at a restaurant would cause less impact per mouthful than at home.

127. As an example of the enormous quantities of materials that pass through the McDonald's system, in 1994 its supplier of packaging for fruit pies lightweighted the package. This small change resulted in an annual savings of 55 tons of chlorofluorocarbon-free expanded polystyrene. *Environment: Reduce* (visited Nov. 18, 1999) <http://www.enviroweb.org/mcspotlight-na/company/publications/mcfact_section7.html>. In fact, there is little consideration in environmental law of cumulative resource consumption. Our laws optimize clean throughput, not total throughput. See generally James Salzman, *Sustainable Consumption and the Law*, 27 ENVTL. L. 1243 (1997) (arguing that environmental law and policy must focus explicitly on the issues related to resource consumption). The manufacture of cars, for example, produces less pollution than 20 years ago, but the far greater number of cars on the road has led to major increases in resource consumption. Since the 1950s, the number of cars on American roads has risen from 60 million to approximately 180 million. See Bill Hendrick, *Smart Cars: Radar Technology Will Warn Drivers of Road Hazards*, ATLANTA J.-CONST., Aug. 17, 1996, at F1. As a country, the U.S. consumes 40 percent of the world's gasoline. See Pamela Cohn, *Automobile Pollution: Japan and the US—Cooperation or Competition?*, 9 EMORY INT'L L. REV. 179, 181 (1995). In the United States, cars consume roughly 70 percent of the lead, 60 percent of the rubber, 15 percent of the aluminum, and 13 percent of the steel produced annually. See Amory B. Lovins & L. Hunter Lovins, *Reinventing the Wheels*, ATLANTIC MONTHLY, Jan. 1995, at 75, 83.

the water, sediment, and tissues of fish and marine mammals in the bay.¹²⁸ But where was the silver coming from? No silver mines were anywhere near the bay's watershed. A material flow analysis provided a surprising result, pointing a finger directly at dentist offices. Indeed, the ninety thousand dentist offices in the United States account for roughly half of the over thirty-eight hundred metric tons of silver consumed annually. The silver dissolves in fixer solutions used to develop x-rays and goes down tens of thousands of drains, eventually into bays and other watersheds. The small amount of fixer used at each office (less than five gallons per month at 80 percent of the sites) provides too little silver to offset the costs of recovery equipment, and RCRA presents serious regulatory burdens to on-site and off-site recovery efforts.

1. Implications for Law and Policy

The rise of services will exacerbate the problem of diffuse sources. While over 568,000 companies with twenty or more employees provide a daunting number of potential regulatory targets, consider that there are roughly 4.9 million enterprises with nineteen employees or less. Most of these are service providers and entirely unregulated by environmental law.¹²⁹ This is not to imply, however, that they should be specifically regulated. As with the category of smokestack services, we know very little about the impacts of cumulative services. The role of dentists in discharging silver effluent to San Francisco Bay was certainly a surprise to the researchers.¹³⁰ How common is this type of situation? We do not know. It is clear, however, that the large number of sources and low individual impacts of cumulative services match poorly a permit-based point source approach.¹³¹

Thus cumulative services pose significant administrative challenges to regulation. This plays out first as an informational challenge. Using the silver discharges by dentists as an example, it is no simple task to link such

128. The history of the silver contamination in San Francisco Bay is recounted in *MATERIALS*, *supra* note 86, and Rejeski, *supra* note 64, at 15.

129. See Small Business Administration, *Employer Firms, Establishments, Annual Payroll and Estimated Receipts by Firm Size, 1986-1996* (visited Nov. 18, 1999) <http://www.sba.gov/ADVO/stats/us88_96.pdf>.

130. Dentists are also the largest nonresidential source of mercury contamination in the San Francisco Bay. See PALO ALTO REGIONAL WATER QUALITY CONTROL PLANT, CLEAN BAY PLAN 56 (1998) [hereinafter PALO ALTO]. Pharmacies are the other major contributor, from their disposal of thermometers. See *id.*

131. It should be noted that, as with the category of smokestack services, small manufacturing operations can raise the same issues. The point is that the far greater number of services, and their relative invisibility in the eyes of the law, make cumulative services an important category to consider in their own right.

diffuse emissions with an identifiable harm. Assuming the link has been established, however, how much silver should each office be allowed to discharge? There is a significant difference between trying to allocate SO₂ emissions among three smokestacks in an airshed and trying to make a similar allocation among twelve hundred dentist offices in a watershed. Determining equitable and efficient levels can of course be done, but at a high cost.

Compliance and monitoring expenses may be even higher. For pollutants with clearly identifiable impacts of concern, such as dental offices, auto repair shops, and dry cleaners, the traditional regulatory response has been local command-and-control regulation. And while the idea of a meaningful point source permit for every dentist office seems horribly resource intensive, it can work.¹³² Palo Alto's water district, one of the best funded and most sophisticated in the country, routinely regulates small services and inspects their premises. Its ordinance on photoprocessors and medical offices reduced silver levels in the bay by over 90 percent in five years.¹³³ In the face of such informational, compliance, and enforcement costs, however, a more common response to cumulative services has been no response at all.¹³⁴ While the concentration of activities provides a more accessible target for permit-based regulations, the sheer number of sources overwhelms enforcement and compliance-monitoring capacity.

Beyond a command-and-control approach, two complementary policies therefore deserve close consideration. The first is greater use of economic instruments such as taxes, particularly for services that are not causally linked with specific harms. Economic instruments are particularly well suited to the harms posed by cumulative services because they direct diffuse behavior throughout a complex system with little need for permitting oversight.

132. Thus, these services need not be below the radar screen of regulators. As an example, dry cleaners' volatile organic compounds emissions have long been regulated in Clean Air Act nonattainment areas. See U.S. Env'tl. Protection Agency, *New Regulation Controlling Emissions From Dry Cleaners* (visited Nov. 18, 1999) <<http://www.epa.gov/region04/air/dryclean/newdry.htm>>. And services are often identified as potentially responsible parties in Superfund clean-ups of contaminated sites. See Telephone Interview with Professor Richard Revesz, N.Y.U. Law School (July 27, 1999).

133. See PALO ALTO, *supra* note 130, at 63. The water district implemented an ordinance providing photoprocessors and medical offices a choice of two compliance options: off-site management of silver-bearing wastes or permitted on-site treatment. Intensive visits in 1995 and 1996 resulted in 100 percent compliance rates. The water district has also provided practical information, distributing a newsletter called *Silver Lining* with pollution prevention and compliance assistance information. The resource requirements for these compliance and information activities are significant, but the results have been impressive as well. See *id.*

134. See Telephone Interview with Kelly Moran, Manager of Palo Alto's Pollution Prevention Program (Apr. 14, 1999). "The problem is partly resources, but partly cultural, as well. People [in wastewater treatment] look to industrial sources and aren't used to thinking about services or residential activities as the source of the problem." *Id.*

This capacity for self-regulation in a decentralized setting can reduce administrative oversight costs.¹³⁵ Rather than focusing on industry sectors, as in the best available technology (BAT) approach, fees and taxes may provide the least-cost strategy for regulation by focusing on the pollutant or resource of concern. Because most cumulative services concentrate individuals' environmental impacts, there is no need for service-specific economic instruments.

Thus one could impose a tax based on silver concentration in x-ray fixer solution, providing an incentive for dentists to use less fixer and producers to develop alternatives.¹³⁶ In a more publicized context, if our concern over climate change suggests a carbon tax to modify individuals' consumption of fossil fuels, the instrument will be equally applicable to cumulative services. Put simply, if you get the prices right, services will look after themselves in an environmentally responsible manner. The problems in getting the prices right, of internalizing externalities, are of course a core constituent of environmental policy and involve political (the unpopularity of taxes), technical (determining the right price), and administrative (effective compliance monitoring and enforcement) challenges. But they remain particularly appropriate for modifying the behavior of diffuse sources with individually small impacts.

A second approach relies on information dissemination. Despite their best intentions, cumulative services will rarely have institutional expertise on environmental matters. Unlike smokestack sources, cumulative services by definition do not face significant environmental regulation and therefore expend few management resources on the subject. That is not to say, however, that services have no interest in improving their environmental performance. To the contrary, there are a number of voluntary initiatives in the service sector. In 1995, for example, a number of golf courses joined together to develop environmental principles on siting, maintenance, and operation of golf courses. The American Hotel Foundation has created a video showcasing best environmental practices. Busch Entertainment has

135. See generally WILLIAM F. BAXTER, *PEOPLE OR PENGUINS: THE CASE FOR OPTIMAL POLLUTION* (1974) (providing the classic arguments why taxes should be the preferred policy instrument in attaining environmental goals); Barton H. Thompson Jr., *People or Prairie Chickens: The Uncertain Search for Optimal Biodiversity*, 51 STAN. L. REV. 1127 (1999). But see generally Daniel Cole & Peter Grossman, *When Is Command-and-Control Efficient?: Institutions, Technology, and the Comparative Efficiency of Alternative Regulatory Regimes for Environmental Protection* (unpublished manuscript, on file with author) (arguing that effluent taxes impose considerable monitoring costs on government because to assess the taxes accurately the government must know exactly how much each source is emitting).

136. There have also been calls for creating a market to reduce mercury use. Byron Swift has advocated a mercury use allowance system based on tradable permits. See Byron Swift, *A Better, Cheaper Way to Regulate Mercury*, 29 ENV'T REP. 1721, 1727 (1999).

created a spreadsheet of best management practices for application at its theme parks.¹³⁷

Government can play a key role in supplementing and fostering these information exchanges. This can take the form of informing cumulative services that their activities cause environmental impact and providing guidance on proven practices to reduce these impacts. The Palo Alto water district, for example, has published over twenty best management practice booklets, almost all of them directed at small-scale services such as food service facilities, swimming pool maintenance companies, apartment and condominium complexes, pottery studios, and car body shops.¹³⁸ The EPA has undertaken a similar promising initiative.¹³⁹

While it is unusual for cumulative services in the same sector to communicate with one another about environmental management, it is virtually unheard of across service sectors. Yet the issues are often the same. Evaluating sustainable timber practices, for example, is central to environmentally responsible purchasing decisions by retailers, construction companies, and the many other services that use wood and paper. The government is uniquely well situated to overcome this information barrier through crossfertilization, sharing best practices within and between service sectors.¹⁴⁰ As a careful observer of government education programs has observed, in seeking to reduce the impacts of manufacturing "[w]e give awards, build information clearing houses, fund research, support technology development, hold conferences, and continually try to understand how and why various incentives

137. See Rejeski, *supra* note 7, at 31–33.

138. See PALO ALTO, *supra* note 130, at 117. In addition to the booklets, the water district has published 41 technical reports focusing mostly on services (e.g., pollution prevention in the printing industry, hospitals, vehicle service facilities, and construction firms) and 107 fact sheets focusing mostly on small-scale services (e.g., auto parts stores, car washes, dry cleaners, pools and spas, and food handling facilities). See *id.* at 117–24.

139. To encourage compliance, the EPA's Office of Enforcement and Compliance Assurance has developed a series of notebooks with information on specific sectors. Over one-quarter of the 29 studies completed to date address services, including air, ground, and water transportation, dry cleaning, and local government operations. Each notebook provides an environmental profile, industrial process information, pollution prevention techniques, regulatory requirements, government and industry partnerships, and innovative programs and contact names. See Office of Enforcement and Compliance Assurance, U.S. Env'tl. Protection Agency, *EPA Sector Notebooks* (visited Nov. 18, 1999) <<http://es.epa.gov/oeca/sector/>>.

140. The EPA's Green Lights program is a wonderful example of this. See Joseph DiMento & Francesco Bertolini, *Green Management and the Regulatory Process: For Mother Earth, Market Share, and Modern Rule*, 9 TRANSNAT'L L. 121, 151 (describing the over one thousand corporate partnerships created by the program); Thomas O. McGarity, *The Expanded Debate over the Future of the Regulatory State*, 63 U. CHI. L. REV. 1463, 1512 n.246 (1996) (noting the effectiveness of voluntary programs). See generally U.S. Env'tl. Protection Agency, *Energy Star Buildings* (visited Nov. 18, 1999) <<http://www.epa.gov/greenlights.html/>>.

work or fail. Virtually anything we did for the service sector would be more than we are doing now"¹⁴¹

III. LAW AND POLICY OF LEVERAGE SERVICES

Part II analyzed the service sector through the perspective of environmental impact. Part III takes a different, unconventional approach, seeking to reduce the impacts not of the services themselves but of their economic partners. Proposing a separate, subtler metric, this approach considers services' economic leverage—the nature and strength of their links to suppliers and customers. Viewed through a systems analysis, services may be regarded as interstices of the economy, acting as market mediators to provide the commercial link between primary production (mining, agriculture, fishing), manufacturing, and end-users. A class of these services, known as *leverage services*, acts as a funnel through which products must flow (illustrated below).¹⁴² These include retailers, utilities, financial services, and fast-food chains.

Figure 6

As Part I explained, in recent years there has been a strong trend of consolidation and concentration of market share in an increasingly small number of companies. In the retail sector, this has resulted in a shift of commercial influence from producer to retailer.¹⁴³ A small number of retail-

141. Rejeski, *supra* note 7, at 31.

142. This diagram was suggested by Buzz Thompson.

143. Prior to becoming a law professor, the author served as the environmental manager for a major consumer products company. The company had a special sales office in a small town in Arkansas for the simple reason that Walmart's purchasing office was located there. If, for whatever reason, Walmart requested a change in product formulation or packaging, there was an immediate and compliant response. This represents a sharp break from the earlier balance of power in the consumer goods market. The retail trade has traditionally been highly fragmented. As a result,

ers such as Walmart, K-Mart, and Sears now account for roughly 10 percent of retail sales throughout the country.¹⁴⁴ Toys R Us is twice the size of its two largest suppliers put together.¹⁴⁵ Other leverage services have long dominated their product chain. In the restaurant sector, serving twenty-two million meals daily, McDonald's acts as the funnel for enormous consumption downstream, while its influence upstream strides over agriculture, ranching, and pulp and paper manufacture. Similarly, between the many coal mining and oil companies upstream and the millions of electricity customers downstream, there stands a small number of utilities.

Leverage services raise intriguing possibilities for environmental protection because, while not necessarily causing significant environmental impact in their immediate activities, they act as a uniquely effective fulcrum to leverage environmental improvements upstream and downstream in the life cycle.¹⁴⁶ This may result in changed product design and content as well as corporate and individual behavior.

Is there any way to energize this focal point within the life cycle to move toward reduced pollution and resource consumption? To do so requires a systemic vision of environmental protection, moving from a narrow focus on production and disposal to considering the web of commercial *relationships*—from a focus on discrete sources of pollution to management of a value chain.¹⁴⁷ As the decision framework sets out, the key to this approach lies, first, in identifying the actor with the most influence to reduce the net life cycle impact and, second, in creating a legal structure with appropriate incentives to extend and energize this influence. When and how to make use of this leverage remain largely unexplored questions for legal scholars that raise real concerns over both equity and efficiency.

Importantly, the three categories of services—smokestack, cumulative, and leverage—are not mutually exclusive. Electric utilities, for example, are both a strong smokestack and a strong leverage service, for they cause immense direct impact in their operations but also exercise important downstream influence through least-cost planning. To visualize how specific services share aspects of the different categories (and therefore the policy and legal considerations unique to each category), it is helpful to graph them along two axes. The y-axis represents “life cycle leverage,” a measure

companies such as Procter & Gamble and Coca Cola, because of the importance of their products to consumers, generally held the upper hand in negotiating with retailers.

144. See Guile & Cohon, *supra* note 7, at 77.

145. See Rejeski, *supra* note 7, at 27.

146. See PALO ALTO, *supra* note 130, at 117.

147. See *supra* note 12 and accompanying text.

of the service's potential to influence behavior upstream or downstream in the life cycle. The x-axis represents direct environmental impact.¹⁴⁸

Figure 7

A. Market Assignment of Responsibility

Before considering the merits of laws extending the leverage of services for environmental protection, it should be recognized that this occurs daily in the marketplace with no governmental intervention at all. As an alternative to vertical integration strategies, a growing number of major corporations (both service providers and manufacturers) have taken control over their supply chain, exercising leverage upstream in the life cycle. This is occurring voluntarily in response to consumer pressures.

1. Anticipation of Consumer Demands

Seeking competitive advantage by anticipating consumer demands, major corporations have established environmental purchasing requirements. Most of these are based on product content, requiring, for example, suppliers

148. Ideally one would want to graph the services along three axes (direct environmental impact, cumulative environmental impact, and life cycle leverage) but the representation on paper is too cluttered to be useful.

to provide recycled products such as paper or re-refined oil.¹⁴⁹ The U.S. government, the biggest service provider of all and the world's largest consumer, has followed suit in its green procurement standards.¹⁵⁰ A number of companies set requirements for suppliers' process and production methods.¹⁵¹ The major home improvement retailers in the United States and Britain have committed to sell only tropical timber products certified from sustainably managed forests.¹⁵² McDonald's refuses to buy beef from cattle raised in rain forests or recently deforested rain forest areas.¹⁵³ Small-scale services, such as restaurants, have signed charters committing them to create a greater demand for organic produce and seafood products from aquaculture.¹⁵⁴ Kinko's purchases thirty-six thousand tons of white paper annually. It has considerable influence over its supplier paper mills and requires that they exercise sustainable natural resource management policies,

149. See, e.g., Chaz Miller, *Recycling in the States, 1994 Update*, WASTE AGE, Mar. 1995, at 93 (describing voluntary agreements by newspapers to purchase only recycled newsprint); *Commitment to Action* (visited Nov. 18, 1999) <<http://www.kinkos.com/about/action.html>> (committing Kinko's not to knowingly purchase wood or paper derived from old-growth forests).

150. See Exec. Order No. 12,873, 3 C.F.R. 659 (1993). The order requires every executive agency to practice waste prevention and recycling as well as to promote the market for recovered materials through its procurement process. See *id.* This revoked the earlier Executive Order 12,780, signed by President Bush in October 1991, which required federal agencies to increase recycling and waste reduction efforts as well as to promote through their procurement the market for recycled materials. See 3 C.F.R. 369 (1992). Section 6902 of the RCRA was the impetus for this executive order through its requirement that the EPA develop procurement guidelines for products made from recovered materials. See 42 U.S.C. § 6902 (1994). The EPA has published guidelines for paper products, lubricating oils, retreaded tires, building insulation, cement containing fly ash, and others. See 40 C.F.R. 247.1-17 (1996). The EPA has already issued guidelines for concrete cement containing fly ash, retread tires, recycled paper products, re-refined lubricating oil, and insulation containing recycled material. See Exec. Order No. 12,873, 3 C.F.R. 659 (1993). Federal agencies are required to procure all goods in compliance with these guidelines unless written justification is provided. See *id.* Federal agencies are required to purchase paper with 30 percent recycled content by the end of 1998. See *id.* at 665.

151. See, e.g., *Boost for Green Procurement as Shell Expro Goes for ISO 14001*, ENDS REP., Apr. 1998, at 25, 25 (reporting that by the year 2000 Shell UK Exploration and Production will purchase 70 percent of its annual \$3.2 billion in purchasing from companies certified under the International Organization for Standardization (ISO) 14001 environmental management standard).

152. See *Interest Grows in Label for Products from Sustainable Forests*, ENDS REP., Jan. 1998, at 27, 27 (reporting that companies selling 14 percent of the wood products in Britain have committed to sell only products certified by the Forest Stewardship Council).

153. The McDonald's environmental policy statement declares: "This rain forest policy is strictly enforced and closely monitored. Any McDonald's supplier that is found to deviate from the policy or cannot prove compliance, will be immediately discontinued." *Rain Forest Preservation* (visited Nov. 18, 1999) <<http://www.McDonalds.com/community/enviroinfo/rainforest/rainforest.html>>.

154. In 1994, hundreds of chefs signed the "Chef's Collaborative 2000: Charter and Statement of Principles." See Rejeski, *supra* note 7, at 29. Organic farming has also been supported by the apparel company Patagonia's commitment to use organic cotton in its products, providing a market for 15 percent of the organic cotton grown in America. See *id.*

including a commitment not to purchase wood or paper from old growth forests.¹⁵⁵ Major manufacturers have launched similar initiatives.¹⁵⁶

2. Direct Consumer Pressure

In response to direct consumer pressure, major corporations have interceded directly upstream to minimize adverse publicity. The most publicized examples have concerned labor practices. Charges of unsafe working conditions, child labor, and pitifully low wages have energized sneaker companies such as Reebok and Nike to improve the labor practices of their suppliers in Asia.¹⁵⁷ Similar campaigns against Walmart's sale of the Kathy Lee Gifford line of apparel and against The Gap have led the major players in the apparel industry to adopt codes of conduct concerning the labor rights provided by their overseas suppliers.¹⁵⁸ Often these campaigns are directed at

155. Kinko's conducts "routine audits with our mills to evaluate their forest management practices, their compliance status with applicable federal and state environmental laws, and their overall environmental performance." *Commitment to Action*, *supra* note 149.

156. Major manufacturers play a similar role to leverage services, because their major raw material and component requirements give them considerable influence upstream over their suppliers. Working with Businesses for Social Responsibility, for example, Patagonia has established wastewater management guidelines for its suppliers that wash garments, produce dyes, and produce fabrics. See Patagonia, *Enviro Action* (visited Nov. 18, 1999) <<http://www.patagonia.com/main.ehtml?section=enviroaction>>.

157. Nike and Reebok have been accused of such practices by a number of human rights and labor groups. See Bob Herbert, Campaign for Labor Rights, *In America* (visited Nov. 18, 1999) <<http://www.summersault.com/~agj/clr/alerts/nike001.html>>.

In response, Nike has since commenced a high-profile campaign to improve its image. See, e.g., *Standards: Code of Conduct* (visited Nov. 18, 1999) <<http://www.nikebiz.com/labor/code.shtml>>; CNN Financial Network, *Nike Raising Overseas Wages* (visited Nov. 18, 1999) <<http://cnnfn.com/hotstories/companies/9903/23/nike/>>.

158. In a review of corporate codes of conduct, the U.S. Department of Labor reports that: Thirty-six of the 42 companies [surveyed] indicated that they have adopted a policy specifically prohibiting the use of child labor in the manufacture of goods they import from abroad. These policies take different forms:

- special documents (typically referred to as codes of conduct) outlining their values and guidelines in a variety of areas, including child labor. These documents are a means for companies to clearly and publicly state the way in which they intend to do business to their suppliers, customers, consumers and shareholders;
- letters stating their policies on child labor circulated to all suppliers, contractors and/or buying agents;
- compliance certificates, which typically require suppliers, buying agents, or contractors to certify in writing that they abide by the company's stated standards prohibiting the employment of children;
- clauses in formal documents such as purchase orders or letters of credit, which make compliance with the policy a contractual obligation for suppliers;
- a combination of the above.

See *Executive Summary: The Apparel Industry and Codes of Conduct: A Solution to the International Child Labor Problem?* (visited Nov. 18, 1999) <http://www.ilr.cornell.edu/library/e_archive/ChildLabor/>

leverage services. The Campaign for Labor Rights' most recent campaign against Nike, for example, calls for a boycott of the sport retailer Footlocker because: (1) Footlocker is Nike's largest retail outlet; (2) Nike is Footlocker's largest supplier; and (3) Footlocker is owned by Woolworth Corporation, which is concurrently embroiled in another sweatshop scandal involving the manufacturing facilities of its wholly owned clothing subsidiaries in Canada.¹⁵⁹ This focus on Footlocker rather than Nike is known as a "secondary boycott" and has become increasingly common.¹⁶⁰ The key strategic decision in organizing consumer boycotts lies in identifying the actor that is both most vulnerable to consumer pressure *and* exercises influence over the ultimate company of concern. One may choose a retailer, for instance, with a relatively small market share but a large share of the target company's goods. Similarly, in the context of socially responsible investing, campaigners seek to influence the company most susceptible to outside pressure *and* with influence over the ultimate target. This may, in fact, be a company not even in the product chain, such as a newspaper. This basic strategy—balancing both the cost and the effectiveness of choosing the leverage target—mirrors least-cost provider analysis in a regulatory context and will play out again in Part III.B.

apparelex.html>. See generally Ryan P. Toftoy, Comment, *Now Playing: Corporate Codes of Conduct in the Global Theater*, 15 ARIZ. J. INT'L & COMP. L. 905 (1998) (assessing corporate codes of conduct in the apparel industry).

159. See Campaign for Labor Rights, *Nike Campaign Strategy, Part 4: Foot Locker* (visited Nov. 18, 1999) <http://www.summersault.com/~agj/clr/alerts/nike_strategy_4.html>.

160. Secondary boycotts employ a similar focus on leverage services but exert pressure indirectly. For years, Greenpeace opposed clear-cut logging in British Columbia's Clayoquot Sound. Their long campaign turned the tide only when Greenpeace went to the end-users of the timber, particularly German magazine publishers, who demanded a change in logging practices. Four major German publishers issued a statement calling on their paper suppliers to purchase pulp from companies that do not practice clear-cutting as soon as quality and price allow. Germany's magazines consume one million tons of pulp annually, "the equivalent of clearing a football-field-sized patch of forest every six minutes." See Brian McAndrew, *German Printers Blast Canadian Clear-Cut Logging*, TORONTO STAR, Dec. 18, 1993, at A2; see also Bob Levin, *A Forest Fable*, MACLEAN'S, Aug. 16, 1993, at 20.

Rainforest Action Network has followed a similar strategy in opposing Mitsubishi Corporation's tropical logging practices. The nongovernmental organization (NGO) has organized a boycott of Unionbancal, formerly the Bank of California and Union Bank but now 80 percent owned by Mitsubishi, hoping to pressure the multinational to change the practices of its logging subsidiary. In a remarkable response to Rainforest Action Network's campaign, Mitsubishi's American subsidiaries signed a contract committing themselves to cease use of timber from old growth and primary forests, purchase only certified timber, create a Forest Community Support Program to support the protection, conservation, and restoration of forests and forest-dwelling communities, and institute an internal ecological accounting system to monitor their performance. See THE AGREEMENT BETWEEN RAINFOREST ACTION NETWORK, MITSUBISHI MOTOR SALES OF AMERICA, AND MITSUBISHI ELECTRIC AMERICA, Nov. 12, 1997 (on file with author); see also Barton Crockett, *Unionbancal Faces Boycott over Mitsubishi Ties*, AM. BANKER, May 10, 1996, at 4.

a. Virtual Campaigns

These preceding initiatives are representative of a larger phenomenon of the information revolution with special significance for the service sector. Public companies have always been shareholder-driven. They are increasingly becoming stakeholder-driven as well. In an age when mass accessibility to mass media is rapidly expanding, companies have become uniquely vulnerable to social expectations. And the bigger the company, the greater the social expectations it has to meet. Nongovernmental organizations (NGOs), in recognition of this, have been shifting tactics.¹⁶¹ Consider the story of the World Resources Institute's (WRI's) new initiative, the Global Forest Watch. WRI is creating a web-based monitoring system around the globe to verify the certification of sustainably harvested timber. Local NGOs will check on whether companies are living up to their commitments to sustainably manage their forests, and the results will go on the Global Forest Watch's web site in real time. Importantly, the money behind this initiative was given by furniture companies anxious to verify the commitments of their suppliers.¹⁶²

NGOs are also adapting to the digital revolution through the creation of virtual networks. The enhanced communication capacities of grassroots groups and national and international NGOs permit the formation of international alliances for a range of purposes, from monitoring raw material extraction and harvesting techniques to creating a campaign to ban landmines.¹⁶³ Indeed, the curious history of the landmine campaign is a case in point. The campaign was orchestrated by a virtual NGO brought into existence to create a landmine treaty. The NGO's identity was so linked to

161. One response that has grown rapidly in the 1990s is the development of NGO-sponsored certification programs for sustainably harvested timber, coffee, or seafood. One of these certification initiatives' goals is to provide consumers with an objective basis for selecting environmentally responsible products, similar to what traditional eco-labeling programs have sought to achieve. The more important and much less appreciated goal, however, is to change corporate purchasing practices. Thus, rather than battling with companies over whether their purchasing programs take into account environmental or labor considerations, NGOs have argued that companies should commit to purchase certified products, thus leaving no doubt as to their origin. See generally James Salzman, *The Use and Abuse of Environmental Labels*, 1 J. INDUS. ECOL. 11 (1997).

162. See Interview with Allen Hammond, Senior Scientist, World Resources Institute (Feb. 22, 1999).

163. The McSpotlight web site, for example, is a very sophisticated site allegedly presenting the dark side of McDonald's operations in regard to environmental harm, labor practices, and other social issues. See *McSpotlight* (visited Nov. 18, 1999) <<http://www.enviroweb.org/mcspotlight-na/home.html>>. The Environmental Defense Fund's web site provides local details of the toxic release inventory, allowing the user to submit her zip code and find details of nearby toxics emissions. See *Scorecard* (visited Nov. 18, 1999) <<http://www.scorecard.org/>>.

the web that, when it won the Nobel Peace Prize, it was unable to cash its prize check because it did not even *have* a bank account.¹⁶⁴

Such examples suggest that e-mail and the internet are creating an alternative form of governance, a sort of digital spotlight. Just as the advent of citizen suits in U.S. environmental law created legions of "citizen attorneys general," the advent of e-mail and the web is creating legions of non-governmental compliance personnel who report not to public enforcement authorities but to the public itself. Environmental law and policy are acutely dependent on information. In this context, web-based technologies are powerful not only because of increased access to information but, more fundamentally, because of increased access to *provision* of information. Any person or group can reach a potential audience of millions from a home personal computer. Such technological advances give new meaning to the definition of "insiders," and savvy providers of information have real power to influence governments, industry, and the public. In the context of leverage services the implication is obvious. Companies' practices are under scrutiny as never before, and the web provides instant and easy exposure (whether accurate or not).¹⁶⁵ No company wants to be exposed as environmentally irresponsible, especially large retailers who depend on customer goodwill for the bottom line.

3. Implications for Law and Policy

As the title of this part, "Market Assignment of Responsibility," suggests, the government does not have a large direct role to play, although it can foster these voluntary developments. In particular, the EPA's voluntary programs for smokestack industries, such as the 33/50 initiative¹⁶⁶ and Design for the Environment, merit consideration for the service sector. Under the 33/50 initiative, in 1990 EPA Administrator Bill Reilly sent letters to thirteen hundred companies operating six thousand facilities in the United States. Reilly listed seventeen priority chemicals and challenged the companies to reduce their emissions of these chemicals by 33 percent by 1993

164. See Interview with Kenneth Anderson, Professor (May 1, 1998).

165. While this new opportunity provides enormous potential to publicize accurate information, it equally provides the potential to disseminate inaccurate information. The web has no "papers of record," and new reports of deliberate misinformation that was spread over list-serves and through sites seem to appear every day. The potential to whip up market pressure and encourage groundless boycotts remains a pressing and timely challenge to NGOs seeking to capitalize on the web's opportunities.

166. See U.S. Env'tl. Protection Agency, *Toxics Release Inventory Related National and International Programs* (visited Nov. 18, 1999) <http://www.epa.gov/opptintr/tri/ttr_rela.htm>.

and by 50 percent by 1995. Participation was high, and the EPA's 50 percent goal was achieved a year early. By the end of 1995, the EPA reported emissions reductions of more than 750,000,000 pounds.¹⁶⁷ The EPA could easily extend the 33/50 program to leverage services, challenging them to bring about environmental improvements in the practices of their upstream suppliers and downstream end-users. Specifically, a select number of companies would be challenged to achieve a target number of projects within three and five years that created objective, measurable reductions in environmental improvement upstream or downstream in the life cycle.¹⁶⁸ The participating services' benefits would include positive recognition as environmental leaders as well as improved understanding within the service sector of what types of leverage are most effective and profitable. While a nonregulatory policy instrument, it could raise the issue of leveraging commercial partners and spur initiatives at the company level where none existed before.

The Design for the Environment program provides funding to promote companies' integration of environmental considerations into the design and redesign of products, processes, and technical and management systems.¹⁶⁹ The EPA could direct a similar initiative to integrate environmental considerations into the practices of leverage services in reducing life cycle impacts, whether this be retailers in their selection of goods, fast-food chains in their purchasing practices, or banks in their lending practices. As noted at the end of Part II, given the EPA's current baseline of virtually zero effort in disseminating information for services, the upside potential of doing anything at all would be an improvement.

B. Legal Assignment of Responsibility

While consumer pressure has an impressive record of forcing leverage services to exercise their influence upstream in the life cycle, its successes are limited and generally weak downstream from the leverage service. In this regard, legal mandates may be more effective through standard setting or providing economic incentives. In fact, one of the most traditional environmental policy tools, classic Pigouvian taxes, may be viewed as a type of

167. See U.S. Env'tl. Protection Agency, *33/50 Program* (visited Nov. 18, 1999) <<http://www.epa.gov/rqytgrnj/specinit/p2/volprog/3350.htm>>.

168. Any large service provider would be a good candidate because at the very least it exercises important purchasing power. But services not generally linked with environmental protection, such as banks and other financial institutions, would be particularly appropriate for a voluntary approach to heighten their sensibilities. One could follow the 33/50 model even more closely, challenging the company to achieve 33 quantifiable projects by 2003 and 50 projects by 2005.

169. See Office of Pollution Prevention and Toxics, U.S. Env'tl. Protection Agency, *Design for the Environment* (visited Nov. 18, 1999) <<http://www.epa.gov/dfe/>>.

leverage instrument. Taxation of one actor may leverage behavioral changes of another. Consider, for example, a policy goal to reduce the energy consumption of light bulbs. Light bulbs with efficiency ratings below a certain level are taxed. If the manufacturer is taxed, there may be leverage effects downstream. The manufacturer can choose to swallow the cost to remain price competitive while it develops more energy-efficient bulbs. This changes the behavior of the manufacturer alone. But the manufacturer can also choose to pass on the cost of the tax in the product price. If the consumer's demand is price elastic, this will shift the purchasing preference to more energy-efficient bulbs. Similarly, if applied at the level of the retailer, the tax will change behavior upstream or downstream as the consumer chooses whether or not to buy the product and the producer reacts accordingly.

1. Alignment of Economic Incentives

Rather than the stick of taxes described above, carrots can also influence leverage services such as utilities. The largest single contributors of many air pollutants, electric utilities are strong smokestack services. As one of the largest commercial sectors of the U.S. economy, they are also an important leverage service.¹⁷⁰ In a powerful example of extending the influence of a leverage service downstream, clever regulatory reform has altered utilities' incentive structure, forcing them to reconceive their relationship with end-users.

Prior to the 1970s energy crisis, the incentive structure for utilities was straightforward. In the face of growing energy demand, utilities would propose new power stations and public utility commissions would assent, establishing a reasonable rate of return on the capital investment. The energy "problem," if it even existed, was regarded as one of insufficient energy supply rather than inefficient demand. Costly forays by utilities into nuclear energy and the oil shocks forced utilities to raise the cost of energy, however, generating public interest in cheaper alternative strategies by the late 1970s. One of these alternatives was increased competition;¹⁷¹ another was least-cost planning.

The idea behind least-cost planning is simple.¹⁷² Consumers do not want electricity; they want the end services electricity provides, whether that be light, music, or heat. Faced with demands for more services, the

170. See WEIZSÄCKER ET AL., *supra* note 59, at 155.

171. In 1978, Congress required utilities to transport privately generated power on their grid and purchase it at a fair price. See *id.* at 156.

172. For a more detailed discussion, see generally Harold M. Hubbard, *The Real Cost of Energy*, 264 SCIENTIFIC AM. 36 (describing state utility reforms to promote end-user efficiency); Ellyn R. Weiss & James Salzman, *The Greening of American Energy Policy*, 63 ST. JOHN'S L. REV. 691 (1989).

standard utility response had been to increase power generation capacity. Least-cost planning advocates framed the problem differently. If the services were provided more efficiently, there should be no need for additional electricity. As Amory Lovins and coauthors have argued, consumers have found that saving "nega-watts" through efficiency can be cheaper than buying megawatts of electricity.¹⁷³ On its face, such a strategy would be poison to utilities because it places the traditional source of their income, selling energy, under threat. Least-cost planning avoids this potential conflict by aligning the interests of utilities and consumers. Since 1980, a number of public utility commissions have been decoupling utilities' profits from their projected sale of electricity and, instead, rewarding them for provision of services. In simple terms, utilities are encouraged to promote end-use efficiency by keeping as profit a share of their customers' savings. As a result, utilities have made significant investments in improving customers' energy efficiency with dramatic results.

Pacific Gas & Electric (PG&E), for example, projected in 1980 that it would need from ten to twenty new power stations to meet rising demands.¹⁷⁴ A decade later, the utility projected no need for further power stations and, in 1993, disbanded its engineering and construction department. The utility kept as profit 15 percent of the energy savings of its customers and in 1992 spent over \$170 million promoting energy efficiency. The net result was lower electricity bills and over \$40 million of profits for PG&E. Lovins estimates that "[w]ithin a few more years, energy efficiency will become America's largest source of energy services, surpassing all oil, domestic and imported."¹⁷⁵

a. Implications for Law and Policy

The lesson of least-cost planning is not simply the importance of avoiding perverse incentives—a worthy goal for any policy—but rather the power of *aligning* incentives. The economic interest of the utility now lies in actively extending its influence downstream to reduce its customers' energy consumption. Linking the customers' behavior with the service's profit incentives changes fundamentally how the problem is viewed—from least-

173. See WEIZSÄCKER ET AL., *supra* note 59, at 165.

174. Pacific Gas and Electric's efforts to promote end-user efficiency are described in WEIZSÄCKER ET AL., *supra* note 59, at 160.

175. *Id.* at 145. But see generally Paul L. Joskow & Donald B. Marron, *What Does Negawatt Really Cost? Evidence from Utility Conservation Programs*, 13 ENERGY J. 41 (1992) (arguing that utilities fail to report relevant costs, rely on projections of savings rather than actual savings, and employ other reporting bases that overall tend to underestimate the societal costs of negawatt strategies).

cost provision of electricity to least-cost provision of a service, from pricing a discrete point in the life cycle to consideration of life cycle costs. As another example, California's Marin Municipal Water District charges a hook-up fee to end-users of water but uses a sliding scale based on estimated use. Water-hungry lawns are levied a 300 percent surcharge over the basic fee but xeriscapes receive a 55 percent discount. The district's long-term interests lie in avoiding the capital costs to increase water supply. Encouraging end-user efficiency achieves this.¹⁷⁶

To be sure, utilities provide a special case because their rates are regulated. But the lesson of aligning incentives resonates in other service settings. The fans and pumps in most of America's buildings are terribly inefficient, resulting in much higher energy bills than should be necessary. Why? A large reason lies in the split incentive structure of bidding construction jobs. Subcontractors bid on the cost to do a job, not the overall life cycle cost to operate the integrated system.¹⁷⁷ The low bid to put in a ventilation system will use narrow pipes because they are cheaper up front. Because of their greater resistance to air flow, however, they are much more expensive in use than larger pipes.¹⁷⁸ Because large pipes may be more expensive up front, the mismatched incentives among service providers bury this opportunity.¹⁷⁹ Government can play a useful role in structuring incentives that encourage consideration of life cycle costs. A range of rebates and subsidies provided by states for energy efficiency in building construction performs this exact role.¹⁸⁰

176. See PAUL HAWKINS ET AL., *NATURAL CAPITALISM: CREATING THE NEXT INDUSTRIAL REVOLUTION* (forthcoming 1999).

177. The quote below describes the many separate transactions in constructing a building, making incentives for energy efficiency difficult to structure.

Unlike the automotive industry, the buildings sector in most countries is highly decentralized not only horizontally, but vertically as well. One study found that as many as 25 diverse actors—from developers and mechanical engineers to bankers and maintenance staff—can be involved in the design, construction, and operation of a single office building. Each makes decisions based on personal economic motivations, often ignoring the broader goal of keeping the building owner or occupant's "life cycle" costs to a minimum.

CHRISTOPHER FLAVIN & NICHOLAS LENSSEN, *POWER SURGE* 232 (1994); see also *id.* at 221–39.

178. The friction of air traveling through a pipe falls as a function of the fifth power of the diameter. A bigger pipe therefore means significantly less friction, therefore less pumping requirements throughout the system, hence a smaller engine, pump, inverter, etc. The diameter of the pipes determines the overall efficiency, and energy and design demands, of the entire system.

179. See WEIZSÄCKER ET AL., *supra* note 59, at 55, 178.

180. The state of Iowa's Facilities Improvement Corporation, for example, issues tax-exempt bonds to support energy efficiency measures with a pay-back period under six years. The program leases efficiency measures to building owners at less than the savings in energy costs. See Eric Hirst, *Boosting U.S. Energy Efficiency Through Federal Action*, 33 *ENVIRONMENT* 7, 33–34 (Mar. 1991). The federal government provides technical advice through its Energy Star Buildings voluntary partnership program. The program provides technical information, customized support services, and

2. Assignment of Liability

The most direct governmental influence on leverage services lies in the imposition of legal responsibility for upstream or downstream impacts, impacts that the services often did not cause. The best-known environmental example of this leveraging is the expansive net of liability cast by Superfund for the remediation of contaminated sites. In a sense, the Comprehensive Emergency Response, Compensation, and Liability Act (CERCLA, also known as Superfund) simply applies the common law principle of strict liability for abnormally dangerous activities.¹⁸¹ Parties that disposed of or generated hazardous waste that later contaminated a site bear potential strict, joint, and several liability for the clean-up response costs that followed, even if they had acted reasonably at the time. Such allocation of liability would be an example of the polluter-pays principle in action. Because these parties benefited economically from the sale of goods requiring the generation of the wastes or their disposal, imposition of retroactive liability is fair.

As anyone who has paid the slightest attention to the issue knows, however, the list of potentially responsible parties (PRPs) does not stop there. The cast of PRPs includes current owners and operators, past owners and operators at the time of disposal, persons who arranged for transportation or disposal (usually the generators of the waste), and persons who accepted the waste for disposal.¹⁸² Courts have expansively interpreted these categories, broadening the reach of liability to parties with arguably no culpability at all.

For our purposes, this is most interesting in the context of lender liability. CERCLA's secured creditor exemption states that the liability of owners and operators does not extend to a party that "without participating in the management of a vessel or facility, holds indicia of ownership primarily to protect his security interest in the vessel or facility."¹⁸³ This would appear to shield creditors that foreclose on property assets from CERCLA liability. In *U.S. v. Fleet Factors Corp.*,¹⁸⁴ however, the Eleventh Circuit

access to a range of resources and tools. See U.S. Env'tl. Protection Agency, *Background* (visited Nov. 18, 1999) <<http://inotes.icfkaiser.com/epa/estar/esbhome/about/background.html>>. See generally CHRISTOPHER FLAVIN & SETH DUNN, *RIISING SUN, GATHERING WINDS: POLICIES TO STABILIZE THE CLIMATE AND STRENGTHEN ECONOMIES* (Worldwatch Inst. Paper No. 138, 1997).

181. There is no reference to strict, joint, and several liability in the Comprehensive Emergency Response, Compensation, and Liability Act (CERCLA). The statute refers to § 311 of the Clean Water Act's oil spill response program, which, in turn, refers to common law principles. See PERCIVAL ET AL., *supra* note 125, at 336-37. This has been interpreted by the courts as strict, joint, and several liability, requiring no need for proof of negligence or intent. At the time, it was thought this expansive liability would actually prevent disputes over who pays.

182. See 42 U.S.C. § 9607(a) (1994).

183. *Id.* § 9601(20)(a).

184. 901 F.2d 1550 (11th Cir. 1990).

held that the secured creditor exemption is not available if the creditor “participates in management of the company to a degree indicating a capacity to influence the corporation’s treatment of hazardous wastes . . . [and] if its involvement with the management of the facility is sufficiently broad to support the inference that it could affect hazardous waste disposal decisions if it so chose.”¹⁸⁵ This “capacity to influence” rule has since been statutorily overturned,¹⁸⁶ but the influence of the decision has been enormous.

By potentially extending liability to lenders, CERCLA forced financial interests to require much greater oversight of both the waste management practices of their clients and, more directly, the level of contamination of property offered as collateral. Federal law does not govern real estate transactions, but the potential extension of CERCLA liability to lenders *effectively* does so. Real estate developers need banks to obtain financing. Banks now uniformly require testing of all sites proposed as collateral and smart banks require testing of sites involved in the transaction as well.¹⁸⁷ Thus the assignment of liability leverages the lenders’ role as a funnel through which real estate transactions must flow, effectively requiring remediation of sites prior to development. This cross-sectoral leveraging was clearly in the minds of CERCLA’s authors back in 1979. As Philip Cummings, chief counsel of the Senate committee that drafted CERCLA, commented,

CERCLA is not primarily an abandoned dump cleanup program, although that is included in its purposes. . . . [Rather, the] main purpose of CERCLA is to make spills or dumping of hazardous substances less likely through liability, enlisting businesses and commercial instincts for the bottom line in place of traditional regulation. It was a conscious intention of the law’s authors to draw lenders and insurers into this new army of quasi-regulators, along with corporate risk managers and boards of directors.¹⁸⁸

Such assignment of liability to seemingly nonculpable outsiders is not unique to environmental law. In exploring the role external institutions should play in policing responsible corporate activity, corporate law professor Reinier Kraakman has described this type of leverage as “gatekeeper

185. *Id.* at 1557–58.

186. In its subsequent regulations, the EPA rejected the capacity-to-influence test. The D.C. Circuit overturned the regulations in *Kelley v. EPA*, 15 F.3d 1100, 1103 (D.C. Cir. 1994), holding that the EPA lacked authority to determine liability under the statute. In 1996, the matter was put to rest when Congress passed the Asset Conservation, Lender Liability, and Deposit Insurance Protection Act of 1996, which stated that mere capacity to influence management or operational activities did not trigger liability. See 42 U.S.C. § 9601(20)(E), (F).

187. See, e.g., Brian Sen, Comment, *Avoiding Liability: A Real Property Purchaser’s Roadmap to the Dangers of Superfund Law*, 15 HAW. L. REV. 105 (1993).

188. ROBERT PERCIVAL ET AL., *supra* note 125, at 282 (quoting Philip Cummings).

liability.”¹⁸⁹ Kraakman argues that gatekeeper liability is appropriate when the legal system is unable to detect or prosecute a high proportion of offenses within a corporation.¹⁹⁰

[T]rue gatekeeper liability joins the risk of absolute liability with an active duty to monitor for offenses. It imposes liability on an entirely new class of innocent gatekeepers (in addition to controlling managers) to reduce enforcement costs, the frequency of offenses, or both.

... [T]rue gatekeeper liability is designed to enlist the support of outside participants in the firm when controlling managers commit offenses, that is, when the firm's internal monitors have failed.

The first requisite for gatekeeper liability is, of course, an outsider who *can* influence controlling managers to forgo offenses. For this reason, gatekeeper liability has received widest play in response to securities violations and similar “transactional” delicts rather than in response to wrongdoing that occurs wholly within the bowels of the firm. Gatekeepers can be drafted from among the many outsiders who supply specialized expertise to the managers of publicly-held corporations and facilitate their relations with constituencies outside the firm: outside directors, lawyers, accountants, and investment bankers. In fact, most of these influential outsiders have already been tapped for limited enforcement duty.¹⁹¹

Such gatekeepers are all service providers with the potential to act as leverage services. Consonant with the framework analysis set out at the beginning of Part II,¹⁹² these gatekeepers are the best-placed market actors both to ensure compliance and to increase deterrence of corporate wrongdoing. Their professional role necessitates private monitoring on behalf of capital markets.¹⁹³ As a result, they have low-cost and ready access to information relevant to corporate wrongdoing. This is not to say, however,

189. See Reinier H. Kraakman, *Corporate Liability Strategies and the Costs of Legal Controls*, 93 YALE L.J. 857, 889 (1984).

190. See *id.* at 868.

191. *Id.* at 889-90 (citation omitted). Kraakman goes on to describe examples in the Securities Act of 1933, ch. 38, § 11, 48 Stat. 74, 82 (codified as amended at 15 U.S.C. § 77(k) (1994)), and the Foreign Corrupt Practices Act of 1977, 15 U.S.C. § 78dd-1, 78ff. For example,

Section 11 of the Securities Act of 1933 . . . imposes a duty on directors, underwriters, and accountants to investigate securities registration statements. Similarly, enforcement actions brought under the federal securities laws during the 1970's have expanded the potential liability of lawyers and accountants who have facilitated—or even failed to halt—clients' delicts.

Id. at 890. “In our complex society the accountant's certificate and the lawyer's opinion can be instruments for inflicting pecuniary loss more potent than the chisel or the crowbar.” *United States v. Benjamin*, 328 F.2d 854, 863 (2d Cir. 1964) (Friendly, J.).

192. See *supra* p. 448.

193. See Kraakman, *supra* note 189, at 891.

that they are necessarily the least-cost providers, for such imposition of liability comes with costs. The imposition of legal duties can, at a certain point, frustrate the transactions that create the opportunity for gatekeeper liability in the first place.¹⁹⁴

This is certainly the case for leverage services. In the context of CERCLA's expansive liability, the very real benefit of increased scrutiny of waste management practices and real estate transactions has come at the cost of discouraging lenders from providing otherwise desirable loans, with the attendant social and economic losses.¹⁹⁵ This has been most evident in the much-publicized problem of brownfields—inner-city sites that remain undeveloped because potential investors and lenders have been wary of CERCLA liability.¹⁹⁶ Put simply, assigning liability to leverage services can be powerfully effective in driving environmental protection throughout the economic chain of actors, but it also creates a risk that the benefits of deterrence may be outweighed by the economic and social costs of frustrated transactions.

3. Assignment of Responsibility

Although less common than assignment of liability, government may directly impose legal responsibility on leverage services for downstream impacts they did not cause. While this may seem unfair or contrary to the polluter-pays principle, there is clear precedent, in fact a multibillion-dollar precedent, for extending responsibility in the retail sector. In 1991, the German Bundestag passed the Ordinance on Avoidance of Packaging Waste (the *Verpackungsverordnung*) in response to concerns over product packaging's contribution to municipal solid waste.¹⁹⁷ An example of a policy known as "extended producer responsibility," the law extends the responsibility of

194. See *id.* See generally Stephen Choi, *Market Lessons for Gatekeepers*, NW. U. L. REV. 916 (1998).

195. Exposing leverage services to liability risks may cause them to (1) charge high fees to cover their insurance costs, (2) charge extremely high fees if they cannot obtain insurance, or (3) refuse to engage in transactions that could expose them to liability, withdrawing their service entirely from certain classes of activity. The net result in each of these three cases is fewer transactions. See, e.g., Michael I. Greenberg & David M. Shaw, *To Lend or Not to Lend—That Should Not Be the Question: The Uncertainties of Lender Liability Under CERCLA*, 41 DUKE L.J. 1211 (1992).

196. See, e.g., Joel B. Eisen, "Brownfields of Dreams?": *Challenges and Limits of Voluntary Cleanup Programs and Incentives*, 1996 U. ILL. L. REV. 883; Joel B. Eisen, *Brownfields Policies for Sustainable Cities*, 9 DUKE ENVTL. L. & POL'Y F. 187 (1999).

197. In Germany, product packaging accounts for 50 percent of municipal solid waste by volume, 30 percent by weight, and 70 percent of the waste packaging goes to landfill. See BETTE K. FISHBEIN, GERMANY, GARBAGE, AND THE GREEN DOT: CHALLENGING THE THROWAWAY SOCIETY 20 (1994).

retailers and producers beyond their traditional spheres.¹⁹⁸ In simple terms, the ordinance gave consumers the right to return product packaging to the point of sale and required retailers to provide facilities for and accept the consumers' product packaging free of charge.¹⁹⁹ As might be expected, retailers were not overjoyed at the dismaying prospect of a growing mountain of trash in front of their stores.

In response to this concern, however, the ordinance was quite clever. Retailers are exempted from the take-back requirement if their product suppliers create an industry-wide system for collection and recovery of packaging. To qualify for the take-back exemption, the private system not only has to collect the packaging but also must meet material-specific quotas for collection and recycling.²⁰⁰ Not surprisingly, German retailers immediately embraced this exemption, informing suppliers that if their product packaging were not covered by an industry-wide collection system, the products would not be given shelf space in the store. In essence, this is all the law requires. There are no mandates on how the system must operate, who pays for its operation, or who operates it. There are no incentives or requirements for the end markets of the collected waste. The ordinance simply requires retailers to accept product packaging, provides an exemption for a collection system that meets specific goals, and everything else follows. In response to the retailers' threat, as the law had anticipated, German producers established a number of private joint ventures responsible for collecting packaging waste and arranging for its disposal, primarily through recycling.²⁰¹

198. There is a strong trend of imposing responsibility on producers of goods to reduce the environmental impacts of their goods throughout the product life cycle. A series of laws in Europe have imposed responsibility on producers for the take-back of their goods at the end of their lives. These include the German packaging law, discussed in the main text, as well as take-back laws for electronic goods, cars, construction waste, and large appliances. See Salzman, *supra* note 127, at 1276. On the upstream side, recycled-content laws have involved producers in the creation and maintenance of recycling infrastructures to ensure sufficient collection and provision of recycled materials. See *id.* at 1262.

199. See ORGANISATION FOR ECON. CO-OPERATION AND DEV., PHASE I REP., EXTENDED PRODUCER RESPONSIBILITY IN THE OECD AREA 54 (1996) [hereinafter EXTENDED PRODUCER RESPONSIBILITY].

200. See Salzman, *supra* note 127, at 1271-72. For each material, separate collection and recycling rates were set through 1995. The total recycling rates for individual packaging materials were as follows: 72 percent of glass, 72 percent of tinplate, 72 percent of aluminum, 64 percent of plastic, 64 percent of paper/carton, and 64 percent of composite. See *id.* at 1271 n.129. The actual recycling rate in 1993 for plastic was 29 percent. See *id.*

201. The largest private collection program is Duales System Deutschland (DSD). DSD is responsible for collecting packaging waste and arranging for its disposal, primarily through recycling. Any company selling consumer goods in Germany may pay a fee to DSD based on the total weight of packaging it sells, the material involved, and the volume of packaging. If the packaging meets DSD's requirements for recyclability, then the qualifying product is granted a license to

The key to the law, then, is its explicit reliance on retailers' power over their suppliers. The net effect is a downstream reduction in solid waste as well as upstream benefits of reduced resource consumption through design innovation.²⁰² For our purposes, the packaging ordinance poses a puzzling question. If the government intended from the outset to mandate the collection and recovery of packaging waste by producers, why did the law target retailers instead of producers? That presumably would have been more open, direct, and efficient.²⁰³ Indeed, determining the appropriate allocation of legal responsibility when choosing between a leverage service and the ultimate target party is *the* basic question in harnessing leverage services and, as described in the preceding discussion of corporate governance, requires consideration of least-cost provider analysis.²⁰⁴

a. Least-Cost Provider Analysis

If government seeks to reduce the solid waste caused by packaging, who is the least-cost provider to make responsible for collection, retailers or producers? In his classic treatment of allocating legal duties to reduce accident costs, Guido Calabresi dealt with an analogous dilemma, and his analysis provides useful insights.²⁰⁵ His guiding principle is to identify the "cheapest cost avoider," that party who will respond to legal duties by minimizing accident costs at the lowest societal cost.

place the company's green dot trademark on its package. This mark signifies to retailers and consumers that the package is recyclable and managed by DSD after disposal. *See id.* at 1272.

202. The German government reported that the total weight of its product packaging was reduced by 661,000 metric tons from 1991 to 1992, representing a 4 percent reduction at a time of economic growth. *See* FISHBEIN, *supra* note 197, at 71–73. DSD claims that from 1991 to 1995, total secondary packaging was reduced by 80 percent, while total consumption was projected to fall by approximately 970,000 metric tons. *See id.* at 43, 72–73. The changes in product design have been even more impressive. A visit by the author to German supermarkets in 1991 and 1992 revealed a much higher number of lightweighted and concentrated products, and much less outer packaging. Toothpaste, for example, is no longer sold in an outer cardboard carton. The program has not been without controversy, however. To stay in business, waste collection firms effectively need a contract with DSD, placing it in a monopoly position. In the first three years of DSD's operation, over four hundred German waste management companies were bought or went bankrupt. *See* Salzman, *supra* note 127, at 1286.

203. The European Union has adopted a directive mandating minimum packaging collection and recycling levels. Interestingly, a number of countries have imposed requirements directly on the producers rather than relying on the leverage of the retailers.

204. *See, e.g.,* Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089 (1972) (applying least-cost provider analysis in assessing property and liability rules). As the decision framework points out, once it is determined that an environmental problem warrants governmental intervention, the choice of the appropriate regulatory target should rest on considerations of efficiency (least-cost provider) and equity (whether allocation of responsibility is sufficiently unfair to rethink the strategy).

205. *See* GUIDO CALABRESI, *THE COSTS OF ACCIDENTS* 143–52 (1970).

Such an analysis may well have driven Germany's policy decisions. Indeed, it appears that retailers were selected as the least-cost regulatory target precisely *because* they are leverage services. As the funnel diagram in the introduction to Part III indicates, the packaging ordinance's requirements are channeled by the retailers both upstream and downstream. From the government's perspective, focusing regulations on a small number of leverage services may be more efficient than trying to regulate the universe of suppliers. Because retailers are relieved of their take-back requirements only if their suppliers comply with the collection requirements, it is in the retailers' interest to ensure that no cheating takes place.

In fact, the government's monitoring efforts will be even simpler than might be supposed, because it need only inspect a few major retail chains. Tengelmann is a major German supermarket chain. When it places a requirement on its suppliers, for instance to take back their packaging, this requirement becomes effective for all of the suppliers' packaging whether or not sold at Tengelmann, for the simple reason that the cost of collecting solely Tengelmann products' packaging separately is prohibitive. So long as the government effectively monitors a few retailers and the major producers involved in the collection program, requirements by key retailers will force changes throughout the retail system. This is the same phenomenon at work in the "California effect," in which the size of the California market effectively transforms California standards into national requirements.²⁰⁶

From the perspective of political costs, placing apparent responsibility on retailers may "hide the ball" and soften some of the potential opposition from producers. Moreover, because there are far fewer large retailers than producers (with less combined financial clout), they may have less political influence in opposing the legislation. As the discussion of NGOs and the internet explained, retailers may also be a preferred regulatory target because they are more vulnerable to adverse publicity. Retailers are, by the very nature of their business, close to consumers. Not surprisingly, then, their reputation contributes to the bottom line, and violations of environmental laws could prove doubly costly in fines and loss of sales.

The preceding analysis considers explicitly the government's interests and, given the nature of the political process, may have predictive and explanatory value. Focusing only on the government's administrative costs, however, risks overlooking the least-cost provider for *net* social costs. Con-

206. See generally Vivien A. Schmidt, *The European Nation-State Between Globalization and Integration: The Decline of National Sovereignty?* (Spring 1998) (visited Nov. 18, 1999) <<http://www.law.harvard.edu/programs/JeanMonnet/seminar/dpapers/draft5.html>> (describing a national race-to-the-top spurred by California's regulations); David Vogel, *Trading Up and Governing Across: Transnational Governance and Environmental Protection*, 4 J. EUR. PUB. POL'Y 556 (1995).

sider, for example, the costs of monitoring compliance. While it is easier for the government to regulate directly the few retailers rather than the many producers, the verification costs for the few retailers could be considerable. The retailers' combined costs to ensure compliance would exceed the marginal savings to the government if *each* of the retailers' agents needed to visit the producers and verify the collection and recovery of packaging (a task that can be accomplished by a single government official).²⁰⁷

Thus solely considering the government's administrative costs may provide inaccurate counsel in selecting the least-cost provider. When all the costs are summed, it may well be the case that regulating retailers is not preferable to direct regulation of producers. In fact, the European Union has adopted a directive mandating minimum packaging collection and recycling levels.²⁰⁸ Interestingly, every country besides Germany has imposed collection requirements directly on producers rather relying on the leverage of retailers.²⁰⁹

If the government knew *a priori* the least-cost provider (or at least thought it knew), it would direct the mandate to that actor. Absent certainty over the identity of the least-cost provider, a Coasean analysis suggests that if there were no transaction costs, it would not matter where the responsibility were allocated. Parties would arrive at the Pareto-efficient solution through contract. In the real world, though, absent cost-free transactions and knowledge of the least-cost provider, the optimal allocation of responsibility requires accounting for systematic differences in information and influence among the potential regulatory targets. Thus Calabresi argues that in the face of information asymmetries and market imperfections, when one does not know the least-cost provider, legal duties should be placed on the "Best Briber."²¹⁰ The Best Briber is that actor best placed to pass responsibility along the chain of actors until it reaches the least-cost provider.²¹¹

207. In fact, retailers need not expend significant resources on compliance verification because the producers supporting the private collection programs have a powerful incentive to identify cheating. Because the government verifies the compliance of the major producers, they have an incentive to exercise horizontal leverage and monitor the other producers. Otherwise their support of the collection efforts will be unfairly "shared" by free riders.

The major producers' technical knowledge and access to industry gossip likely places them in a better position than retailers to monitor compliance.

208. See Council Directive 94/62, 1994 O.J. (L 365).

209. See EXTENDED PRODUCER RESPONSIBILITY, *supra* note 199, at 1–6.

210. See CALABRESI, *supra* note 205, at 150.

211. One guideline for picking the cheapest cost avoider is "to allocate accident costs in such a way as to maximize the likelihood that errors in allocation will be corrected in the market. . . . It therefore urges us, to the extent we are unsure of who the cheapest cost avoider is, to charge accident costs to that loss bearer who can enter into transactions most cheaply." *Id.*; see also Calabresi & Melamed, *supra* note 204, at 1096–97 (expanding this analysis in the context of accidents and pollution).

This approach leaves the most flexibility for the parties to determine amongst themselves the least-cost provider. Through this prism, the leverage service will often be the Best Briber because it both is best equipped to pass information upstream and downstream and has sufficient influence to pass on the responsibility.

Expanding the San Francisco dentists example illustrates this point. Assume that San Mateo County, Alameda County, and fifteen other water districts across the country are sufficiently concerned over silver contamination in estuaries that they impose a Pigouvian tax on silver in fixer solution. On whom should the tax be levied—the producer, the retailer, or the dentist? At the extreme it could be levied at the level of the dentist, but she may have inadequate information or expertise to choose among the various fixer products on the market, much less to calculate the appropriate tax payment. More likely, it could be set at the level of the manufacturer. This might spur development of low-silver fixer solutions, but the tax's application would vary regionally, depending on whether the waste water emptied into a sensitive estuary. The manufacturer is not well placed to know the local tax burdens. In this example, the retailer is likely the Best Briber on whom to levy the tax, because it can provide information to the consumer on product options as well as to the manufacturer on local tax burdens and selection of products. It will also pass the tax responsibility downstream to the consumer or upstream to the manufacturer (if it chooses to swallow the costs). Thus asymmetries in information make the tax work differently depending on the party upon whom it is levied.²¹²

b. Implications for Law and Policy—Retail TRI

To bring the preceding discussions of leverage services together, this part examines a specific initiative that fuses extended producer responsibility with reflexive law. The point of the discussion is not to champion the proposal as a law that must be passed tomorrow (though there are arguments why that might be a good thing) but, rather, to illustrate the *type* of instruments that will enter the policy debate once analysts take seriously leverage services' potential to spur improvements throughout the product life cycle.

Interviews with leverage service providers reveal equal parts interest and frustration. They understand their pivotal role in the life cycle but bemoan their lack of information and expertise to make decisions. In the retail sector, for example, Home Depot spent a number of years trying to

212. See generally Howard Beales et al., *The Efficient Regulation of Consumer Information*, 24 J.L. & ECON. 491 (1981) (discussing barriers to efficient dissemination of information to consumers).

establish a corporate policy regarding the arsenate in pressure-treated wood and ultimately found it too difficult a problem.²¹³ As the discussion of cumulative services explained, because most services do not confront significant environmental issues in their daily operations, their institutional competency is weak. They have neither the in-house capacity to make decisions on sourcing nor, even if they had capacity, access to much of the information they would need.²¹⁴

Reflexive law provides a means to overcome this barrier. These laws rely on a disclosure rather than a sanctioning approach.²¹⁵ Laws such as the National Environmental Policy Act (NEPA),²¹⁶ the European Union's Eco-Management and Audit Scheme (EMAS),²¹⁷ and the Toxics Release Inventory (TRI)²¹⁸ are legal requirements intended to enhance the information content of decisions.²¹⁹ The goal of these statutes is not to constrain or to dictate behavior but, rather, to generate information and ensure its meaningful consideration.

Perhaps the most successful recent reflexive law has been the TRI. Contained in section 313 of the Emergency Planning and Community Right-to-Know Act of 1986, TRI requires industrial facilities to submit an annual report of listed toxic chemical releases to the environment.²²⁰ The reports must contain the quantities of releases as well as the maximum amount of the chemical on-site during the calendar year and the amount in wastes transferred off-site. The TRI list now exceeds 650 toxic chemicals.²²¹ While not much was thought of TRI at the time of its passage, the corporate and grassroots response has been extraordinary. Major corporations, confronted with publication of their annual releases and the reactions of local

213. See Telephone Interview with Lew Klessel, Director of Strategic Planning for Home Depot (Feb. 26, 1999).

214. Patagonia's efforts to "green" its supply chain, for example, would have been much more difficult without the free help of scientists at UCLA. See Telephone Interview with David Rejeski, Council on Environmental Quality (Feb. 22, 1999).

215. Such laws have been described as enhancing the "self-referential capacities of social systems and institutions outside the legal system, rather than direct intervention of the legal system itself through agencies, highly detailed statutes, or delegation of great power to courts." Eric W. Orts, *Reflexive Environmental Law*, 89 NW. U.L. REV. 1227, 1232 (1995).

216. 42 U.S.C. §§ 4321-4370 (1994).

217. Council Regulation 1836/93, 1993 O.J. (L 168).

218. 42 U.S.C. § 11001.

219. See Daniel C. Esty, *Toward Optimal Environmental Governance*, 74 N.Y.U. L. REV. (forthcoming Dec. 1999) (arguing that information gaps are the key obstacle to better environmental performance and thus should be a central focus in regulatory design).

220. See 42 U.S.C. §§ 11001, 11023.

221. See 40 C.F.R. § 372 (1998) (expanding the number of TRI chemicals).

communities, have pledged significant reductions in toxic emissions and commenced intensive waste reduction initiatives.²²²

TRI is limited, by law, to industrial facilities as identified by the SIC code. This initiative could be extended as a "retail TRI" to leverage services. The law would apply to retailers with annual sales above a predetermined high threshold. They would be required to provide annual data reports to the EPA (and therefore to the public) on listed products. Depending on the product, disclosure requirements would focus on toxic content, energy requirements, material throughput, solid waste, or other objective quantifiable measures.²²³ Sanctions for noncompliance could take one of two forms. Civil penalties for inaccurate or inadequate disclosure could be directed against retailers, with a due diligence defense to mitigate the final penalty.²²⁴ Alternatively, a civil penalty could be levied on the sales price of the offending product at the retailer's check-out.²²⁵

Just as TRI began with a small list of toxic chemicals, so, too, would the list of retail TRI products be limited. The EPA's selection would be based on three criteria. The first is impact. The product must pose environmental concerns at some point in its life cycle. This could range from water pollution from the copper emissions of vehicle brake pads to arsenic emissions from production of pressure-treated lumber. The second is leverage. As Part III has explained, the product must be amenable to upstream or downstream leverage by the retailer. This would likely exclude most intermediate prod-

222. Major environmental groups annually publish lists of the five hundred largest industrial polluters. Such pressure led companies such as Monsanto and AT&T to pledge pollution reduction of over 90 percent within short time periods. A National Wildlife Federation study found a 39 percent reduction in reported emissions in 1987 and 1988. See PERCIVAL ET AL., *supra* note 125, at 651-52. But see ALEXANDER VOLOKH ET AL., ENVIRONMENTAL INFORMATION: THE TOXICS RELEASE INVENTORY, STAKEHOLDER PARTICIPATION, AND THE RIGHT TO KNOW (Reason Pub. Policy Inst. Policy Study No. 247 1998) (arguing that TRI reporting does not distinguish between low- and high-risk chemicals, provides misleading information, and has the potential to harm companies by revealing sensitive information and exposing them to unwarranted lawsuits).

223. Perhaps surprisingly, producers often will not have this information. As Terry Davies, former Assistant Administrator of the EPA's Office of Policy explains, "When [the Toxic Substances Control Act] was first enacted, the strongest proponent of making product content information public was General Motors, which was unable to obtain this information from its suppliers." E-mail from Terry Davies, Resources for the Future, to James Salzman (Apr. 14, 1999) (on file with author).

224. Due diligence would be demonstrated, for example, by requiring producers to sign affirmations that their TRI reports to the retailers are fully accurate. Moreover, retailers could eliminate exposure by contract, agreeing with each producer to insure the retailer for costs in defending itself and any fines should the EPA determine the producer's report violates the law. This approach entails greater transaction costs than the levy on sales price and, as a result, will more likely focus the attention of retailers.

225. The fee might be 20 percent of the product's retail price. This would place the burden on the producer to ensure adequate reporting with small cost to the retailer (the overhead of carrying products with small sales volume).

ucts used for final production such as oil. The last criterion is opportunity. Are the impacts of concern difficult to reach through other policy instruments? This will be particularly relevant in the case of environmental impacts from offshore production. Pressure-treated lumber provides a case in point.²²⁶ The last arsenic production in the United States ceased in 1985, and our consumption needs (a staggering 90 percent of the world's supply) are supplied primarily by production in Chile and China.²²⁷ Listing

226. See *supra* note 64.

227. The use of a retail TRI law highlights the second step of the decision framework, determining whether an environmental problem warrants governmental intervention. This is particularly problematic if the pollution occurs offshore but the product is sold and distributed in the United States. In a sense, we have effectively exported the pollution and resource consumption (the negative externalities) while enjoying the use. This is a natural result of foreign commerce, ranging from fisheries and timber to textiles and chemicals, and is neither intrinsically good nor intrinsically bad. In many cases, current regulations will not address these problems, and this highlights a fundamental consequence of globalization. Our environmental laws were primarily designed to address pipes and smokestacks on the implicit assumptions of a closed economy and the absence of global environmental threats. The global marketplace, however, means we do not control the product's life cycle. Moreover, as a result of recent dispute panel decisions interpreting the General Agreement on Tariffs and Trade (GATT), only in exceptional cases can the United States use trade measures based on process and production methods in other countries.

Do the environmental impacts warrant retail TRI listing? This raises the difficult question of when we should be sufficiently concerned over extraterritorial environmental impacts to take governmental action. If the harm is transboundary and direct, traditional tort and international customary law principles make clear that governmental concern, if not legal action, is appropriate. Numerous bilateral and multilateral treaties, ranging from acid rain to equal access to court treaties, implement the *sic utere* principle—one should not harm one's neighbor.

Indirect harms to the commons are more complicated. We clearly have cause to be concerned over emissions of ozone-depleting substances or greenhouse gases, for their effects will ultimately be felt locally. This concern has been expressed in international treaties such as the Montreal Protocol on Substances That Deplete the Ozone Layer, Sept. 16, 1987, 26 I.L.M. 1550 (entered into force Jan. 1, 1989), and the Framework Convention on Climate Change, May 9, 1992, 31 I.L.M. 848 (entered into force Mar. 21, 1994). Even the loss of biodiversity in the tropics can credibly be considered an ultimately local harm in America, for we may suffer from the loss of insurance against loss of future pharmaceuticals or crop protection that genetic diversity provides.

Assume for the moment, however, that the environmental impacts from arsenic smelting and pressure-treated lumber production are entirely *local*. Their activities cause real harm to immediately adjacent ecosystems, but not beyond. Do such impacts in Chile or China warrant U.S. governmental action? For these types of emotive harms, arguments for legal action flow from the normative belief that we should be responsible for the harm our consumption causes. This is most clearly evident in the context of labor. We suffer no physical harm when five-year-olds labor in sweatshop garment factories to stitch our shirts, but we may feel an obligation to act against a practice we find ethically offensive, to use our laws to reflect moral disapprobation. Similarly, we suffer no physical harm when bottlenose dolphins, not an endangered species, suffer high levels of mortality from the tuna fishery in the Eastern Tropical Pacific. What domestic legal actions are appropriate when we export jobs without our labor or environmental protections, or when we import products that could not have been legally produced locally?

From the perspective of developing countries, such questions fly in the face of respect for national sovereignty. It is at best patronizing and at worst protectionist, they contend, to decide unilaterally what another country's environmental and labor standards should be. Each nation

pressure-treated lumber as a retail TRI product could provide an impetus to reduce the environmental impacts of its production. Moreover, such an approach would be GATT-consistent.²²⁸

Such a policy offers significant potential benefits. Looking upstream, it creates interactions between retailers and suppliers over the environmental profiles of products, providing new information to both. The management phrase, "what gets measured gets done," may sound trite, but it is powerfully true. Retail TRI information can provide a useful criterion for retailers to choose among products and create a competitive dynamic among suppliers to provide more environmentally responsible products. Such information can also provide producers (including farmers) the basis for creation of environmental management systems and a baseline measure against which to assess progress. As with NEPA and TRI, it may provide an opportunity for retailers and producers to reflect on their environmental performance in the light of objective data.

Looking downstream, the data will be valuable to interested NGOs and consumers, providing insight into differences among products they could only have guessed at before.²²⁹ It would also provide data to establish third-

should properly determine its own cost-benefit analysis, balancing for itself the appropriate weight given to concerns of development, poverty, labor rights, and environmental protection. These concerns are equally applicable to domestic trade restrictions based on extraterritorial harms to the commons. There is no simple answer to these ultimately political questions, but they relate directly to the choice of products in a retail TRI system.

228. GATT jurisprudence treats *de jure* and *de facto* discrimination differently. *De jure* discrimination occurs when the law openly treats foreign products differently (e.g., if the retail TRI law requires selection of foreign goods). To rebut the claim of *de jure* discrimination, the selection criteria for retail TRI need to be broad enough that they do not facially discriminate against foreign goods while still allowing their selection. On their face, the criteria of impact, leverage, and opportunity do not target foreign goods any more than domestic goods (and certainly not when compared to laws that have been challenged that explicitly target foreign goods). See generally ESTY, *supra* note 40, at 265-70. The second avenue for a GATT challenge would be *de facto* discrimination, facially neutral laws that discriminate against foreign goods. The leading GATT precedent holds that facially neutral measures can violate GATT Article III through *de facto* discrimination, but only upon a showing that the effect and the purpose of the law are inherently discriminatory. See *United States Taxes on Automobiles*, WTO Doc. DS31/R (Sept. 29, 1994), available in LEXIS, Itrade Library, Gttwto File, *376-78. Hence it is not enough to show that retail TRI actually discriminates against foreign companies. It must also be shown that the intent of the measure is to protect local companies. Judicious selection of domestic as well as foreign products for inclusion in the retail TRI products would effectively rebut the *de facto* claim. As the Auto Taxes Panel concluded, "the purpose of Article III is . . . not to prevent contracting parties from using their fiscal and regulatory powers for purposes other than to afford protection to domestic production." *Id.* (quoting *United States Measures Affecting Alcohol and Malt Beverages*, June 19, 1992, GATT B.I.S.D. (39th Supp.) at 276 (1993)).

229. Similarly, if retailers were required to provide composite scores on the mean environmental attributes of the TRI retail product (e.g., mean arsenic content of the pressure-treated lumber for sale), this would provide a basis for consumers to choose among retailers. If such infor-

party certification systems. Moreover, such data are particularly amenable to dissemination and analysis over the internet. And there may well not be fierce opposition from retailers, because the market dynamic at work in the German packaging ordinance is at work here. The resource implications for retailers to comply will be small because they can demand that their suppliers provide the information or simply not stock their products. In this respect, the retail TRI closely resembles Material Safety Data Sheets (MSDS) currently provided as a matter of course by manufacturers.²³⁰ Finally, retail TRI provides a relatively noninterventionist instrument for government to address longstanding environmental concerns.²³¹ For these reasons, it is not surprising that laws similar to the retail TRI have been proposed in Sweden, the Netherlands, Britain, and the European Union.²³²

mation were relevant to a number of consumers, it would introduce a new competitive dynamic on the margin among retailers as well as producers.

230. Material Safety Data Sheets provide information relevant to handling and accidental contact or ingestion of the material. Thus they contain information on the specific hazards associated with the material to ensure safe handling and proper emergency response. See 42 U.S.C. § 11021(a)(1) (1994).

231. One could imagine using alternative approaches such as product bans or material taxes and fees, but these are politically difficult. Using pressure-treated lumber as an example, the GATT's prohibition on the use of trade-restrictive measures based on process and production methods effectively prevents restrictions on the offshore producer or the importer. Traditional regulatory actions might be directed against the product itself. A tax on the sale of products containing a threshold level of arsenic, for example, would provide a financial incentive for the development of substitutes. More forcefully, a ban on the use of arsenic in pressure-treated wood would address overseas impacts by shutting down the U.S. market. Such actions, however, rarely occur. While the EPA has regulated DDT, PCBs, and three other compounds under the Toxic Substances Control Act (TSCA), the standard for such action is that the chemical "presents or will present an unreasonable risk of injury to health or the environment." 15 U.S.C. § 2605(a). In practice, this has meant the local environment. Moreover, such actions must be the "least burdensome" available. See *id.* Taxing substances for environmental reasons is rarer still. This weak statutory authority is not surprising for, just as environmental law has focused on smokestack industries to the exclusion of services, so too have we developed a sophisticated pollution policy and feeble product policy.

232. Sweden's governmental policy advisor on product issues, the Ecocycle Commission, has proposed legislation that would mandate manufacturers to create files of environmental impact data for certain categories of products. See *Sweden's Radical Vision of Producer Responsibility*, ENDS REP., June 1998, at 24, 24. The European Commission's report on integrated product policy recommended targeting retailers to provide information on the environmental impact of their activities. See *id.* at 26. The Dutch government requested that domestic industry voluntarily provide comprehensive information on the environmental profiles of its products, held on file by the government and open to the public. See *Dutch Scheme Calls for Producers to Supply Environmental Information on Products*, BUS. & ENV'T, Jan. 1994, at 12, 12. And the British Department of the Environment, Transport and the Regions has called for companies to create standardized formats of product information on environmental impact that are transparent and credible to the public. See *New Strategy Proposed for Consumer Product Information*, ENDS REP., Oct. 1998, at 39.

One might argue that because producers are best positioned to collect the product information, the retail TRI requirements should not be directed at retailers but, instead, at producers, and should mandate that they provide the information to retailers. In identifying the least-cost provider, the arguments described in the preceding part explaining Germany's focus on retailers in its packaging collection programs are equally relevant. From the government's perspective, it may be more efficient to focus regulations on a small number of retailers than on the universe of suppliers. So long as the government ensures compliance by a few key retailers, incentives to avoid free riders will encourage widespread monitoring within the industry. It is not clear, however, whether this approach reduces net social costs or simply the government's compliance-monitoring costs.

Considering the information costs is more dispositive. In terms of information passing between producers and their suppliers, there is no difference between placing the responsibility on retailers and placing it on producers. As with the earlier discussion of Pigouvian taxes for silver, though, where the responsibility is placed does matter in terms of other actors' behavior. Specifically, mandating retailers to collect and inform the government of the environmental impacts of the products they sell will, on the margin, ensure greater consideration and dissemination of the data. Retailers have a greater incentive, as well as better means, to provide this data to consumers than do producers whose products are more environmentally harmful than the norm. Retailers similarly are better placed to make comparisons between product suppliers and redirect the information upstream in making purchasing decisions. The key to retail TRI, as with industrial TRI, is to prompt consideration of information previously unavailable or ignored. Retailers already mediate the interaction between consumers and manufacturers by providing information on price. The additional marginal cost to mediate communication concerning environmental impacts, should they so choose, is small. Hence requiring the information to channel through the leverage service provides the greatest flexibility and least cost for redirecting the information upstream and downstream.

Despite the potential benefits of retail TRI, the downsides must be acknowledged as well. Producers will object to the expense of developing this information, which, it will be argued, increases costs to consumers for no corresponding benefit—another set of forms to be filled out and uselessly filed away. Given all of the activities taking place in the marketplace by environmentally responsible companies and wired-NGOs aimed at “greening” product life cycles, the status quo is the optimal policy. If this type of information were important to consumers or retailers, the market pressures driving leverage services to extend their influence would have already forced this type of

information disclosure. At the very least, there would be strong demands for certification of companies' environmental management systems.²³³ The poor success of eco-labels in the U.S. market is testament to the fact that consumers really are indifferent to the full environmental profiles of their products, seizing instead on a few easily identifiable traits such as recycled content to balm their conscience.²³⁴

Competition arguments may be raised, as well. By exempting small retailers, the proposal could place the larger retailers, working on thin margins, at a disadvantage with respect to niche retailers as well as the increasingly important direct mail and web retailers. Because the producers bear the bulk of the costs, though, this may be less of a concern than first appears. Indeed, the effect is likely to be subtler and manifested through product choice on the shelves.²³⁵ Implementation also poses obstacles. While the three criteria for selection provide some guidance in choosing TRI products, selection will surely be controversial.²³⁶ Moreover, absent credible compliance verification, retailers and producers will share similar incentives for poor or inaccurate reporting, particularly in the case of offshore producers.²³⁷

233. Since its issuance in 1997, there has been widespread adoption of the ISO's 14000 series of environmental management guidelines. There is little evidence, however, that these guidelines have been demanded by purchasers or provided competitive advantage in the marketplace. Those supporting the ISO 14000 series hope they will repeat the experience of the ISO 9000 series of total quality management guidelines. ISO 9000 certification has become a proxy for effective quality control practices and an informal requirement for doing business with many companies in Europe. The ISO 14000 series will likely never achieve this result because it does not set performance levels. ISO 14000 certification simply attests to the fact that the company has a system in place that tracks measures of environmental performance. See generally Naomi Roht-Arriaza, *Shifting the Point of Regulation: The International Organization for Standardization and Global Lawmaking on Trade and the Environment*, 22 *ECOLOGICAL L.Q.* 479 (1995).

234. See Salzman, *supra* note 161, at 13–14.

235. Producers may find it more cost-effective to avoid the costs of providing retail TRI information by selling only to smaller retailers exempted from the retail TRI program. This could bifurcate the market, potentially limiting the large retailers' sourcing. Whether this would occur in practice, though, is unclear.

It should also be noted that environmental law often targets large actors. Both RCRA and the Clean Air Act, 42 U.S.C. §§ 7401–7660, focus their provisions on large generators of waste and emissions. This focus is appropriate both because it provides more bang for the regulatory buck and because large companies are presumed to be more sophisticated and financially able to make longer-term investments.

236. The EPA's efforts to establish criteria for green procurement standards, for example, have remained mired within the agency for over three years. See Telephone Interview with Chad Dobson, Consumers Choice Council (Jan. 18, 1999).

237. It is worth noting that a similar law was proposed in the Netherlands in 1994. The Dutch government requested that producers provide comprehensive information on the environmental profile of their products. The information would be held on file by the government and open to the public. The government initially called for a voluntary program followed by a mandatory law four years

No effective policy, however, is without potential costs and objections. The key determinant in assessing a retail TRI law is whether the costs of information production, collection, dissemination, and competition effects outweigh the benefits throughout the life cycle of increased information and the potential for improvement. This will turn on product-specific facts.

For our purposes, the important point is not whether retail TRI is the most appropriate policy to reduce the environmental impacts caused by products. Rather, the example serves to demonstrate that leverage services' webs of commercial relations offer unexplored potential to spur environmental improvements by other market actors. As the discussion of lender liability under CERCLA and retail TRI showed, the policy requires a difficult balance. Assignment of legal liability or responsibility to leverage services cannot be so onerous as to frustrate the commercial relationships on which the policy depends. This cautions against simple assumptions of how legal intervention will play out. At the same time, however, these services' role as gatekeepers presents the exciting possibility of energizing linkages that all too often lie dormant.

CONCLUSION

For the past three decades, our vision of environmental pollution has been framed by smokestack industries. This perspective has been neither narrow nor meaningless, for it has achieved impressive results. With rare exceptions, our air is cleaner and our water purer than in 1970.²³⁸ It may have made sense to overlook services in the past. With the reductions in traditional industrial pollution and the rise of services, however, a bounded vision is entirely inappropriate today. In moving toward a sustainable society, serious consideration of services is inescapable.

This Article has sought to make three basic points. First, much of the debate over deindustrialization has propagated a myth. Yes, the service sector has grown incredibly in the last few decades. But contrary to popular views, the smokestack economy has not disappeared, nor have services replaced manufacturing to any significant extent. Indeed, data suggest that the rise of services and the knowledge revolution have increased environmental impacts. Second, the service sector must be considered explicitly by environmental scholars both because services are important sources of impact and because they pose challenges different from those of traditional sources. Analyzing companies as smokestack services and cumulative services pro-

later. Following concerted opposition from producers, the government withdrew its proposal. See *Dutch Scheme Calls for Producers to Supply Environmental Information on Products*, *supra* note 232, at 12.

238. See *supra* note 81.

vides a framework through which to craft sensible, effective environmental law and policy. Third, regardless of their own direct impacts, services play a powerful economic role as mediators in commercial transactions. The leverage some of the services exercise offers a meaningful opportunity to create new mechanisms and incentives for environmental protection.

This analysis provides the foundation for further research addressing the “new economy.” Scholars have a critical role to play in uncovering the hidden challenges and potential of the service sector for environmental protection. We need only widen our frame of vision to include the other 75 percent of the economy.