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The Individual as Polluter

by Michael P. Vandenbergh

Editors' Summary: Individuals are the largest source of dioxin emissions, contribute almost one-third of all ozone precursor emissions, and are a far larger source of several other air toxics than all large industrial sources combined. Thus, after more than 30 years of regulation largely directed at industry, individual behavior has emerged as a leading source of pollution. Prof. Michael P. Vandenbergh argues that treating individual behavior as a discrete source of pollution can lead to the development of viable, innovative regulatory instruments that have the prospect of achieving pollution reductions at a relatively low cost. The creation of an individual toxic release inventory, for example, is one such tool. Drawing on the work of norms scholars and leading social psychologists, Professor Vandenbergh argues that environmental norm activation theory can identify the information that is most likely to induce changes in environmental behavior and can help policymakers develop new tools for inducing such change.

I. Introduction

The federal environmental statutes enacted since 1970 have produced gains in environmental quality in the United States despite substantial population and economic growth. The regulatory instrument of choice for achieving these gains has been command-and-control regulation, and the regulatory target of choice has been industry.[1] Yet in recent years policy studies and academic scholarship have argued that environmental regulation has entered a new phase. One strand has focused on the need for innovative regulatory instruments to make the regulation of industrial sources more efficient and more effective.[2] A second strand has focused on the emergence of new sources of environmental harm. This work has suggested that although much remains to be done to improve industrial regulation, many of the remaining problems are caused not by large industrial point sources, but by numerous, diffuse, nonpoint sources.[3] Often described as next generation or second-generation sources, these sources include agriculture, small business, and the service industry.[4]

This Article engages both strands of regulatory reform by suggesting that perhaps the most important remaining source category has been largely overlooked: the behavior of private individuals. The first part of the Article develops a working definition of "individual behavior" as a discrete source category and profiles the share of several types of pollution attributable to individual behavior. Definitional issues are critical because at some level all economic activity, and all pollution, can be thought of as the product of consumer and other individual behavior. At the same time, if individual behavior is defined too narrowly, many opportunities to reduce pollution at low cost may be overlooked.

The Article then uses the working definition of individual behavior to assess the individual share of a wide range of toxic and conventional pollutants. The aggregate amounts and relative share are often stunning. For example, individ-

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1. *See* Michael P. Vandenbergh, *From Smokestack to SUV: The Individual as Regulated Entity in the New Era of Environmental Law*, 57 VAND. L. REV. 515 (2004) [hereinafter Vandenbergh, *From Smokestack to SUV*]; Michael P. Vandenbergh, *Order Without Social Norms: How Personal Norms Can Protect the Environment*, 99 NW. U. L. REV. 1101 (2005) [hereinafter Vandenbergh, *Order Without Social Norms*].
2. For a prominent example, see Bruce A. Ackerman & Richard B. Stewart, *Reforming Environmental Law*, 37 STAN. L. REV. 1333 (1985).
3. *See, e.g.*, PRESIDENT'S COUNCIL ON SUSTAINABLE DEVELOPMENT, TOWARDS A SUSTAINABLE AMERICA: ADVANCING PROSPERITY, OPPORTUNITY, AND A HEALTHY ENVIRONMENT FOR THE 21ST CENTURY i (1999) (identifying population growth as a challenge to sustainability); Daniel C. Esty & Marian R. Chertow, *Thinking Ecologically: An Introduction*, *in* THINKING ECOLOGICALLY: THE NEXT GENERATION OF ENVIRONMENTAL POLICY 1, 15 n.3 (Marian R. Chertow & Daniel C. Esty eds., 1997) (noting the importance of nonpoint emissions).
4. *See* J.B. Ruhl, *Farms, Their Environmental Harms, and Environmental Law*, 27 ECOLOGY L.Q. 263 (2000); J.B. Ruhl, *The Environmental Law of Farms: 30 Years of Making a Mole Hill Out of a Mountain, and Environmental Law*, 31 ELR 10203 (Feb. 2001); Richard J. Pierce, *Small Is Not Beautiful: The Case Against Special Regulatory Treatment of Small Firms*, 50 ADMIN. L. REV. 537, 559-60 (1998); James Salzman, *Beyond the Smokestack: Environmental Protection in the Service Economy*, 47 UCLA L. REV. 411 (1999).

uals are the largest source of dioxin emissions, and are a far larger source of several other air toxics than all large industrial sources combined. Individuals also contribute almost one-third of all ozone precursor emissions. In short, after three decades of regulation focused largely on industrial sources, individual behavior has emerged as a leading source of pollution. The analysis presented here draws from data in U.S. Environmental Protection Agency (EPA) and other government and private reports, but government agencies, academicians, and interest groups typically do not analyze individual behavior as a discrete source category. As a result, the analysis reported here is the product of extracting and re-combining data from a wide range of reports and source categories.[5]

Even if individual behavior constitutes a large share of the remaining sources of pollution, a rational risk regulator might not take steps to reduce the individual share if behavior change cannot be achieved at an acceptable economic or social cost, or is not politically viable. The second part of the Article suggests that conceiving of individual behavior as a discrete source of pollution can lead to the development of viable, innovative regulatory instruments that have the prospect of achieving pollution reductions at low cost. A healthy dose of skepticism certainly is warranted. For policymakers, the experience with individual environmental behavior change has confirmed the intuition that many behaviors are very difficult to change without unpopular, intrusive, and expensive methods. Early efforts to impose regulatory requirements on driving, for example, were extremely unpopular and would have been very expensive to enforce had they not typically crashed and burned before implementation. In some cases, regulating the industrial makers of consumer products will be more efficient and less intrusive than attempting to change consumer behavior.[6] At the same time, most current laws and policies reflect not a healthy skepticism but a wholesale abandonment of the field. For instance, remarkably sophisticated and expensive measures have been taken to require automobile manufacturers to reduce tailpipe emissions per vehicle mile traveled. Far less effort has been directed at the use of those vehicles. The same can be said for dioxin emissions and the emissions generated by residential electricity use.

Shifting individual behavior will require policymakers and academicians to develop a more sophisticated understanding of the social influences on behavior and the ways in which law can induce changes in social and personal norms, in particular. Drawing on work by norms scholars in the legal literature (including symposium participants Profs. Ann Carlson and Steven Hetcher) and the work of leading social psychologists (including symposium participant Paul Stern), the Article suggests that many individual behaviors may be subject to change at lower costs than the costs of emissions reductions from other source categories. The Article argues that environmental norm activation theory can identify the information that is most likely to induce changes in environmental behaviors and can help policymakers develop new tools for inducing behavior change. For example, a minor amendment to the statutory provisions that created the toxic release inventory (TRI)[7] could require EPA to survey individual behavior and publish the survey data in an individual TRI (ITRI). If published in the same format and at the same time as the other TRI data, which are only gathered from large industrial sources, the ITRI data could better inform policymakers about the contributions of individuals and could activate the norms that influence individual behavior.

The Article concludes by examining three implications. First, accounting for individual behavior will require changes in agency management, including not only the types of regulatory tools used, but also data gathering and analysis, staffing, and organizational structure. Second, although the analysis here focuses on the contribution of individual behavior to pollution, understanding individual behavior may be a predicate to understanding and ultimately addressing unsustainable levels of consumption.[8] Finally, the regulatory tools developed to shift individual behavior also may be valuable for shifting the behavior of industrial, agricultural, small business, and other sources of pollution, all of which ultimately act through individual decisionmaking.[9] Treating individual behavior as a discrete source category thus may lead to regulatory innovations for traditional industrial sources and new generation sources as well.

II. Is Individual Environmental Behavior an Important Source of Pollution?

A. Individual Environmental Behavior

Unlike many other pollution source categories, individual behavior is not identified as a discrete source category or defined in any environmental statute or regulation. A rigorous analysis of the contribution of individuals to pollution requires a clear definition that can be applied in a consis-

5. A panel of the National Research Council (NRC) recently identified research on individual environmentally significant behavior as a top research priority. *See* Committee on Human Dimensions of Global Change, NRC, Decisionmaking for the Environment: Social and Behavioral Research Priorities 1-5, 69 (Garry D. Brewer & Paul C. Stern eds., 2005).

6. For example, according to the California Air Resources Board, the average cost of reducing volatile organic compounds (VOCs) from certain consumer products is between 25 and 85 cents per pound (lb.) of VOC emissions, California Air Resources Board, *Consumer Products and Smog*, *at* http://www.arb.ca.gov/consprod/geninfo/cpsmog.htm (last visited Aug. 19, 2005), a figure that compares favorably to the $5 per lb. average cost of industrial VOC emissions reductions. *See* California Air Resources Board, *New Regulations for Portable Gas Cans and Gas Can Spouts*, *at* http://www.arb.ca.gov/msprog/spillcon/gascanfs/gascanfs.htm (last visited Aug. 19, 2005).

7. *See* Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986, §313, Pub. L. No. 99-499, 100 Stat. 1613 (1986) (codified at 42 U.S.C. §11023(a)-(c)). EPCRA was enacted as §§301-313 of the Superfund Amendments and Reauthorization Act of 1986, Pub. L. No. 99-499, 100 Stat. 1613 (1988).

8. Interest in the effects of consumption by individuals on environmental quality appears to be growing across a wide range of disciplines. *See, e.g.*, Edgar G. Hertwich, *Consumption and Industrial Ecology*, 9 J. Indus. Ecology 1 (2005) (introducing symposium issue on research on consumption and the environment); Douglas A. Kysar, *Law, Environment, and Vision*, 97 Nw. U. L. Rev. 675, 711-13 (2003) (discussing implications of consumption); Anne H. Ehrlich & James Salzman, *The Importance of Population Growth to Sustainability*, 32 ELR 10559, 10600 (May 2002) (noting the importance of population size to consumption and sustainability).

9. I share this view with symposium participants Profs. Mark Cohen and Daniel Farber. *See* Mark A. Cohen, *Individual and Household Environmental Behavior: What Does Economics Contribute to the Discussion?*, 35 ELR 10754 (Nov. 2005); Daniel A. Farber, *Controlling Pollution by Individuals and Other Dispersed Sources*, 35 ELR 10745 (Nov. 2005).

tent manner. For the purposes of this analysis, the "individual behavior" source category is defined to include emissions that arise from activities that are under the substantial control of a private individual. For purposes of this definition, "private individual" means a person acting in a personal capacity, not in the course of employment. Emissions in some cases are more amenable to measurement by household, e.g., for electricity consumption, and "household" refers to all of the individuals living in the same housing unit.[10] "Substantial control" means that the individual has a meaningful ability to affect the emissions or environmental harms arising from the behavior, either by altering the type or amount of activity undertaken or of product used, or by altering the manner of activity or product use.

The most difficult issue is to determine how much control is sufficient to comprise substantial control. The amount of control exercised by individuals falls along a continuum with sole individual control on one end, sole industrial or governmental control on the other, and partial or mixed control in the middle. The emissions from sources that are exclusively or predominantly under the control of the individual, such as burning garbage in backyard barrels and household chemical use, are assigned to the individual behavior category. Emissions from the industrial sources that manufacture consumer goods, which lie at the other end of the continuum, are not included. For example, although emissions from household solvent use are apportioned to individuals, the emissions released during household solvent manufacturing are not. Although the emissions from the facilities that produce household solvents ultimately are attributable to individuals and could be reduced through changes in consumption, individuals only have limited control over the types of manufacturing methods and pollution control efforts of manufacturing facilities.

The most challenging attribution issues arise from emissions that are under the partial control of the industrial firm that produces the product, the governmental entities that affect how it is used, and the individual who uses it. So long as the individual has a substantial degree of control over the emissions, these emissions are attributed to individual behavior. For example, the emissions from on-road and nonroad motor vehicle use by private individuals, e.g., not from company cars, delivery vans, etc., could be assigned to the motor vehicle manufacturers; to the governmental entities that are responsible for highways, mass transport, and other transportation infrastructure; or to the individuals who operate the motor vehicles. These emissions are assigned to individuals. Similarly, the emissions attributable to residential electricity use could be assigned to electric utilities or residential electric users. Again, these emissions are assigned to individuals. In each of these situations, the individual has sufficient control over the product's emissions to include the emissions in the individual behavior source category.

Using this definition, it is possible to examine existing data on a wide range of pollutants and assign a share to individual behavior. A comprehensive analysis is beyond the scope of this Article, but the data presented here provide a snapshot of the importance of individuals across several toxic and conventional pollutants. In some cases, the available data enable a comparison between individual behavior and all other major sources of a particular pollutant. In other cases, comparable data are readily available only for particular source categories, e.g., the large industrial facilities that are subject to TRI reporting requirements, and the only comparison that can be made at this point is between individual behavior and these categories.

B. Dioxin

Changes in dioxin releases over the last 20 years demonstrate both the success of command-and-control regulation of large point sources and the emergence of individual behavior as an important source category. Dioxin is a persistent, bioaccumulative toxic (PBT) chemical.[11] Table 1 identifies the top-five leading sources based on EPA data included in a 2003 report by the National Institute of Medicine (NIM) of the National Academy of Sciences (the NIM Dioxin Report).[12]

Table 1: Leading Sources of Dioxin in the United States

1987 (gTEQ/year)			**1995**		**2002/2004**	
1.	Municipal solid waste incineration, air	8,877	Municipal solid waste incineration, air	1,250	Backyard barrel burning, air	628
2.	Medical waste incineration, air	2,590	Backyard barrel burning, air	628	Sewage sludge, land	77
3.	Secondary copper smelting, air	983	Medical waste incineration, air	488	Residential wood burning, air	63
4.	Backyard barrel burning, air	604	Secondary copper smelting, air	271	Coal-fired utilities, air	60
5.	Bleached pulp and paper mills, water	356	Cement kilns (hazardous waste), air	156	Diesel trucks, air	36
	All others	585	All others	459	All others	243
	Total	13,995	**Total**	3,252	**Total**	1,106

10. U.S. Census Bureau, American Community Survey Subject Definitions, *Household Type and Relationship*, *at* http://www.census.gov/acs/www/UseData/Def/Hhld_rel.htm (last visited Aug. 19, 2005) (defining household).

11. *See* Persistent Bioaccumulative Toxic (PBT) Chemicals; Lowering of Reporting Thresholds for Certain PBT Chemicals; Addition of Certain PBT Chemicals; Community Right-To-Know Reporting, 64 Fed. Reg. 58666 (Oct. 29, 1999) (codified at 40 C.F.R. §372.65) [hereinafter U.S. EPA, PBT List].

12. *See* NIM Commission, Dioxins and Dioxin-Like Compounds in the Food Supply: Strategies to Decrease Exposure 279, tbl. A-28 (2003) [hereinafter NIM Dioxin Report]. Totals in the table are expressed in gram toxicity equivalents (gTEQ) to a common form of dioxin and are rounded to the nearest whole number. *Id.*

The data presented in the NIM Dioxin Report indicate that dioxin emissions from large industrial and other point sources have declined by over 90% since 1987, and reductions in industrial emissions account for the bulk of the overall declines.[13] At the same time, individual behaviors such as garbage burning in backyard barrels remain largely unregulated, and the relative share of total dioxin emissions created by backyard burning increased in each time increment depicted in Table 1. As a result, the estimates presented in the NIM Dioxin Report suggest that the largest remaining source of dioxin emissions is a startling one: backyard burning of garbage, accounting for almost 60% of all dioxin emissions in the United States.[14] The estimates suggest that a second individual behavior, residential wood burning, is now the third leading source. An EPA source inventory published in the summer of 2005 suggests that backyard barrel burning may be closer to 32% of the total but confirms that backyard barrel burning is by far the largest source.[15] Urban or suburban readers accustomed to municipal garbage collection will find the backyard burning totals curious, but in many rural areas garbage burning is common, and if certain plastics are included in the garbage, releases of dioxin will often occur.[16] The amounts released through individual behavior do not demonstrate that individual emissions of dioxin are generating substantial risks, but they make it clear that rational regulation of the remaining dioxin emissions will need to account for two quintessential individual behaviors: backyard barrel burning and residential wood burning.

C. Additional Hazardous Air Pollutants (HAPs)

In addition to dioxin, individual behavior also constitutes a large share of a number of other high priority toxics. To provide a snapshot of the individual share of these other toxics, this analysis compares the emissions attributable to individual behavior of five HAPs, acetaldehyde, acrolein, benzene, 1,2-butadiene, and formaldehyde, with the emissions from industrial sources as reported in the TRI.[17] These HAPs are among the 33 chemicals that EPA has concluded present "the greatest threat to public health in the largest number of urban areas."[18] Household chemical use and other individual behaviors also may release substantial quantities of these chemicals,[19] but as a starting point this analysis focuses just on releases from private individuals' use of on-road vehicles, e.g., cars, trucks, and motorcycles, and nonroad vehicles, e.g., recreational vehicles.[20]

Through the use of on-road and nonroad motor vehicles, individuals account for a remarkably large proportion of the releases of these HAPs.[21] The relative contributions of individuals and large industrial sources are identified in Table 2.

Table 2: Sources of Air Toxics (in tons)[22]

Emissions Type	*Individual Amount*	*Large Industries Amount*	*Combined Total*	*Individual Percentage of Total*
Acetaldehyde	20,598	6,410	27,008	76.3%
Acrolein	3,295	41	3,336	98.7%
Benzene	203,751	4,092	207,843	98.0%
1,2-Butadiene	23,279	1,347	24,626	94.5%
Formaldehyde	54,489	5,765	60,254	90.4%
Total	305,412	17,655	323,067	94.5%

As compared to the TRI emissions reported by industrial sources, individuals comprise a very large portion of the emissions of each of these HAPs. For example, simply

13. *See id.*

14. Dioxin is also the subject of limited state and local regulations. *See id.* at 38, 228-29, tbl. A-8.

15. *See* U.S. EPA, The Inventory of Sources and Environmental Releases of Dioxin-Like Compounds in the United States: The Year 2000 Update tbl. 1-6 (2005).

16. *See* Paul M. Lernieux, U.S. EPA, Evaluation of Emissions From the Open Burning of Household Waste in Barrels, Technical Report ii (1997).

17. Office of Air Quality Planning & Standards, U.S. EPA, National Air Emissions Trends 1900-1998, at 7-2, tbl. 7-1 (2000) (EPA-454/R-00-002) (available from the ELR Guidance & Policy Collection, ELR Order No. AD04976 [hereinafter U.S. EPA, 2000 Air Trends Report]. *See* Office of Environmental Information, U.S. EPA, *2001 TRI Explorer Database*, *at* http://www.epa.gov/triexplorer/chemical01.htm?year=2001 (last visited Sept. 12, 2005).

18. *See* U.S. EPA, 2000 Air Trends Report, *supra* note 17, at 7-5, tbl. 7-2 (discussing the Integrated Urban Air Toxics Strategy under Clean Air Act (CAA) §§112(c)(3), 112(k)); National Air Toxics Program: The Integrated Urban Strategy, 64 Fed. Reg. 38706 (July 19, 1999).

19. *See, e.g.*, Lernieux, *supra* note 16 (identifying the air pollutants emitted from household waste burning and other activities).

20. *See generally* Office of Transportation & Air Quality, U.S. EPA, Technical Support Document: Control of Emissions of Hazardous Air Pollutants From Motor Vehicles and Motor Vehicles Fuels (2000), *available at* http://www.epa.gov/otaq/regs/toxics/r00023.pdf (last visited Aug. 19, 2005) (identifying vehicle types included in the on-road and nonroad categories). The individual component of these emissions was calculated by adding the total amount of emissions from light-duty gas vehicles (cars) to light-duty gas trucks, on-road motorcycles, and nonroad 2- and 4-stroke gasoline engines. Office of Transportation & Air Quality, U.S. EPA, The Projection of Mobile Source Air Toxics From 1996 to 2007: Emissions and Concentrations tbls. 5 & 8 (2001) (available from the ELR Guidance & Policy Collection, ELR Order No. AD04672) [hereinafter U.S. EPA, Mobile Source Projection]. EPA's on-road motor vehicle category includes heavy-, medium-, and light-duty trucks, as well as cars. U.S. EPA, 2000 Air Trends Report, *supra* note 17, tbl. 3-3. The estimate of individuals' air toxics from on-road motor vehicle use omits all heavy- and medium-duty trucks, as they are unlikely to be owned or operated by private individuals. The estimate includes only the emissions from the light-duty gasoline cars and trucks not owned or operated by an employer. Private individuals comprise 76.3% of all light-duty car drivers and 82.5% of all light-duty trucks. Energy Information Administration, Assumptions for the Annual Energy Outlook 2003 (2003), *available at* http://www.eia.doe.gov/oiaf/archive/aeo03/assumption/index.html (last visited Aug. 19, 2005). All emissions from highway motorcycles and nonroad gasoline engines were attributed to individuals. For nonroad vehicles, all vehicles likely to be used exclusively or predominantly by private individuals were included, e.g., lawn and garden equipment and recreational marine engines, but not locomotives and airplanes. *See* U.S. EPA, Mobile Source Projection, *supra*.

21. *See* U.S. EPA, *Air Trends: Toxic Air Pollutants*, *at* http://www.epa.gov/airtrends/toxic.html (last visited Aug. 19, 2005) (stating that transportation generates more than 50% of all HAPs).

22. With the exception of acrolein and butadiene data, all data are reproduced from Vandenbergh, *From Smokestack to SUV*, *supra* note 1, tbl. 3 (citing the original sources and methodology for preparing the chart). The acrolein and butadiene data are presented in Vandenbergh, *Order Without Social Norms, supra* note 1, tbl. 2. See also *infra* notes 181-82, for a discussion of the butadiene data.

through motor vehicle use individuals released almost 50 times more benzene to air than all large industrial facilities combined. Several caveats are in order. First, this comparison only examines individual releases from mobile sources and industrial TRI releases. In some cases, small businesses or other area sources not attributable to individual behavior comprise a large share of the total released.[23] Second, the EPA Tier II motor vehicle emissions standards that are being phased in over the 2005 to 2007 time period will reduce the individual share of these HAPs somewhat.[24] Although the new Tier II standards can be expected to reduce the totals attributable to individuals by roughly one-third after they are fully in place after 2007, increases in the number of vehicles and the vehicle miles traveled per vehicle can be expected to undercut much of the gains from the Tier II tailpipe reductions.[25] As a result, even after these reductions individuals will remain a far larger source of each of these chemicals than all large industrial facilities combined. The point is not that individual behavior should be regulated to the exclusion of additional tailpipe, large industrial source, or small business standards, but that rational risk regulation requires consideration of individual behavior as a discrete source and evaluation of measures to change individual behavior when analyzing regulatory options.

D. Mercury

Mercury is a PBT chemical, and sufficient data exist to allow a comparison of individual and household releases with releases from the large industrial facilities that are subject to TRI reporting.[26] Table 3 provides a comparison of the releases.

Table 3: Sources of Mercury (in pounds)[27]

Emissions Type	*Individual Amount*	*Large Industries Amount*	*Combined Total*	*Individual Percentage of Total*
Air	33,538	117,743	151,281	22%
Wastewater	1,749	1,805	3,554	49%
Land	67,000	228,283	295,283	23%
Total	102,287	347,831	450,118	23%

The relative contributions of individuals and large industrial sources to mercury releases are difficult to establish because mercury is released in many ways to air, water, and land, and estimates of mercury releases vary widely.[28] One individual contribution that can be quantified is the release of mercury from the residential use of electricity generated by fossil fuel-fired electric utilities. Coal-fired utilities are the primary source of air emissions of mercury in the United States,[29] and approximately 35.7% of all electricity generated from electric utilities is for residential use.[30] As a result, if the residential share of all electricity consumption is the same as the residential share of all electricity generated by fossil fuel-fired units, in 2001 individuals accounted for 32,538 pounds (lbs.) of the total mercury released by utilities into the air.[31]

Individuals also release mercury from the use of mobile sources.[32] Cars and light-duty trucks do not contribute meaningful amounts of mercury, but mercury emissions do occur from the two-stroke and four-stroke gasoline engines of nonroad motor vehicles.[33] Individuals contribute approximately 1,000 lbs. annually through the use of these mobile

23. For example, motor vehicles only accounted for 21% of the emissions of all HAPs in 1997. U.S. EPA, 2000 Air Trends Report, *supra* note 17, at 20, fig. 3-6. The 21% figure does not exclude motor vehicles operated for industrial or other businesses, thus, the 21% figure cannot be attributed entirely to individuals. *See id.*

24. *See* 40 C.F.R. pt. 80.1 (2004).

25. *See* U.S. EPA, Mobile Source Projection, *supra* note 20, tbls. 4, 5. Older vehicles will not be subject to the new standards but will comprise a declining proportion of the vehicle inventory over time. *Id.* For example, after the Tier II standards have been phased in in 2007, the volume of acetaldehyde emitted from mobile sources is expected to decrease to 41,539 tons, a decrease of 40% from 1996. *See id.* tbl. 4. Nevertheless, individuals will still contribute a large share of all emissions. For example, in 2007, individuals are expected to emit 10,090 tons of acetaldehyde from mobile sources, or 24% of acetaldehyde emissions from all mobile sources in the United States. *Id.* tbls. 5, 8. This 10,090 figure is almost twice the 1996 releases to air from all TRI facilities. Office of Information, U.S. EPA, *1996 TRI Explorer Database*, *at* http://www.epa.gov/tri/tridata/tri96/pdr/index.htm (last visited Sept. 12, 1996) [hereinafter U.S. EPA, *1996 TRI Explorer Database*]. In 2007, the volume of benzene emitted from mobile sources is expected to decline to 147,060 tons, a decrease of 43% from 1996. U.S. EPA, Mobile Source Projection, *supra* note 20, tbl. 4. In 2007, individuals are expected to emit 116,279 tons of benzene from mobile sources alone, or 79% of benzene emissions from all mobile sources in the United States. *Id.* tbls. 5, 8. In 2007, the volume of formaldehyde emitted from mobile sources is expected to decline to 96,201 tons, a decrease of 44% from 1996. *Id.* tbl. 4. In 2007, individuals are expected to emit 58,883 tons of formaldehyde from mobile sources alone, or 61% of formaldehyde emissions from all mobile sources in the United States. *Id.* tbls. 5, 8. In addition, in a recent consent decree EPA agreed to propose a rule limiting emissions of these five HAPs by February 28, 2006. These new emissions standards can be expected to result in further emissions reductions. *See* Sierra Club v. Johnson, No. 04-CV-00094 (D.D.C. July 22, 2005).

26. Mercury is 1 of 16 PBT chemicals on the TRI list, and mercury compounds are 1 of 4 PBT chemical categories. *See* U.S. EPA, PBT List, *supra* note 11. The analysis in this Article does not distinguish among the various types of mercury and mercury compounds.

27. *See* Vandenbergh, *From Smokestack to SUV*, *supra* note 1, tbl. 2.

28. *See, e.g.*, U.S. EPA, Mercury Study Report to Congress Vol. II: An Inventory of Anthropogenic Mercury Emissions in the United States ES-6 (1997) [hereinafter U.S. EPA, 1997 Mercury Report] (estimating that during the 1994 to 1995 period, annual mercury emissions were 141 tons or 282,000 lbs. from "point sources"); Office of Environmental Information, U.S. EPA, 2001 Toxics Release Inventory Public Data Release Report tbl. 3-34 (2002), *available at* http://www.epa.gov/tri/tridata/tri01/pdr/index.htm (last visited Aug. 21, 2005) [hereinafter U.S. EPA, 2001 TRI Public Data Release] (indicating that in 2001, all large industrial facilities reported releasing 150,463 lbs. of mercury). The mercury-emitting facilities that are subject to TRI reporting changed significantly for the 1998 reporting year with the addition of electric utilities and mining. *See* U.S. EPA, Addition of Facilities in Certain Industry Sectors; Revised Interpretation of Otherwise Use; Toxic Release Inventory Reporting; Community Right-To-Know, 62 Fed. Reg. 23834 (May 1, 1997).

29. *See* U.S. EPA, 1997 Mercury Report, *supra* note 28, at ES-10 (noting that coal-fired utilities released roughly 33% of all anthropogenic mercury air emissions in 1994-1995).

30. *See* U.S. Department of Energy, Percent of U.S. Electricity Sales by Class of Consumer (2000) (noting that residential electricity use constituted 35.7% of all electricity use in 2000).

31. U.S. EPA, 2001 TRI Public Data Release, *supra* note 28, tbl. 3-41 (indicating that in 2001, the mercury air emissions from large industrial sources were 150,463 lbs., and that electric utilities contributed 91,144 lbs. of that amount).

32. Mobile sources released 6.8 tons of mercury air emissions in 1996, or 4.2% of all mercury air emissions. U.S. EPA, Mobile Source Projection, *supra* note 20, at 2.

33. U.S. EPA, Mobile Source Projection, *supra* note 20, tbl. 6.

sources.[34] When added to the 32,720 lbs. generated from electric utility use, the resulting 33,538 lb. total[35] is 22% of the combined total releases to air by individuals and all large industrial facilities.[36]

In addition, a rough estimate of the releases of mercury to wastewater can be derived from the data in several reports. According to a study conducted by the Association of Metropolitan Sewerage Agencies (AMSA), the concentration of mercury in domestic wastewater is 138 nanograms (ng) of mercury per liter (*l*) of water.[37] Common household products and toiletries make up approximately 15% of the total mercury found in domestic wastewater.[38] Household products that may include trace amounts of mercury include detergents, shaving cream, deodorants, soap, shampoo, toothpaste, soft drinks, and some other foods.[39] Based on an average water flow, data in the AMSA study suggest that an average household contributes 20.6 ng/*l* of mercury in wastewater, or 0.075 grams of mercury annually.[40] Although this is a minute amount, when the total is multiplied by the number of households in the country, the total annual national releases to wastewater from all households is 1,749 lbs.[41] In comparison, the total TRI-reported releases to surface water of mercury from all large industrial facilities in 2001 were 1,805 lbs.[42] The quantity of mercury released to water by households thus is roughly equivalent to the quantity released to surface water from all large industrial facilities.

Individuals also release substantial quantities of mercury to land. Household product use contributes to mercury in landfills and other disposal areas. Individuals release mercury through the disposal of batteries, fluorescent lighting, thermometers, discarded electrical equipment, thermostats, and other household products.[43] In 1989, household batteries were the largest single source of mercury in the waste discarded in municipal landfills. The amount of mercury in household batteries has declined significantly. Data on current amounts of mercury in household batteries is not readily available, but one projection in the mid-1990s estimated that at least 198,000 lbs. of mercury would still be released as of 2000.[44] Similarly, fluorescent bulbs in use in 2000 contained an estimated 82,000 lbs. of mercury.[45] The percentage of batteries and fluorescent bulbs used by individuals is unclear. Even if only one-third of the projected nationwide battery disposal for 2000 is attributed to individuals (66,000 lbs.), however, as well as a small amount from fluorescent bulbs, thermometers, and other consumer products (1,000 lbs.), then the individual total released to land is 67,000 lbs., as compared to a total of 228,283 lbs. released to off-site disposal by all TRI facilities combined in 2001.[46] Again, these data do not dictate any specific regulatory response, but they suggest that individual behavior is an important source of mercury releases to various media.

E. Pesticides

As with other toxics, the amount of pesticides released into the environment by individuals and households is difficult

34. *Id.* As discussed below, individuals also contribute to mercury air emissions when mercury vapors are released from fluorescent and certain other bulbs, e.g., if they are broken. Although the total released to the air from all fluorescent bulbs has been estimated to be 8,800 lbs. per year, the share attributable to individuals is unclear and this source was not added to the total. *See* U.S. EPA, 1997 Mercury Report, *supra* note 28, fig. 3-1 (estimating 4.0 megagrams or metric tons per year released to air from mercury in discarded lamps). A metric ton can be converted to a U.S. short ton by multiplying it by 1.1023. *See* U.S. EPA, 2000 Air Trends Report, *supra* note 17, at 1-4. Thus, 4.4 U.S. short tons or 8,800 lbs. were released to the air through lamp breakage.

35. The 0.5 ton figure is 0.3% of the total national mercury air emissions and 6% of the total releases reported in 1996 by all TRI facilities. U.S. EPA, Mobile Source Projection, *supra* note 20, tbls. 6, 9. The individual contribution to mercury air emissions from mobile sources is comprised of all emissions from nonroad motor vehicles with gasoline-powered engines.

36. The 22% figure was arrived at by dividing the 33,538 lb. total attributable to individuals by 151,281 lbs. The 151,281 lb. figure is the sum of the 117,743 lb. total air release figure from industry that is not attributable to individuals and the 33,538 lbs. that are attributable to individuals.

37. AMSA, Evaluation of Domestic Sources of Mercury 3 (2000), *available at* http://www.amsa-cleanwater.org/pubs/mercury/mercury.pdf (last visited Aug. 19, 2005) [hereinafter AMSA, Domestic Sources of Mercury]. A nanogram (ng) is a billionth of a gram.

38. *Id.* at 7. The source of the remaining 85% is unclear according to the AMSA report, although mercury present in human waste may constitute as much as 83% of the total quantity of mercury in domestic wastewater. *Id.* at 10-11. The sources of the mercury in human waste in large part may arise from mercury in dental fillings. *Id.* at 11. Silver dental amalgams include up to 50% mercury. *See* Byron Swift, *A Better, Cheaper Way to Regulate Mercury*, 29 Env't Rep. (BNA) 1721, 1725 (1999).

39. For example, the AMSA study evaluated various products and found that mercury concentrations in soap and shampoo ranged from 835 ng/*l* to 25,000 ng/*l*, shaving cream from 90 ng/*l* to 670 ng/*l*, and fruits and vegetables from 116 ng/*l* to 874 ng/*l*. AMSA, Domestic Sources of Mercury, *supra* note 37, at 7. The study concluded that "[b]ackground mercury concentrations averaging more than 100 [ng/*l*] can be expected in POTW wastewater influents, even if complete elimination of industrial point source discharges is accomplished." *Id.* at 14.

40. *Id.* at 10. According to the AMSA study, households on average use 545,040 liters (144,000 gallons) of water per year. *Id.* at 3. When the concentration of mercury in domestic wastewater (138 ng/*l*) is multiplied by the wastewater generated per year (545,040 liters), a total quantity of mercury released per year per household can be determined (0.075 grams).

41. To calculate the total quantity of mercury releases to domestic wastewater, this profile utilized the AMSA study figures for domestic wastewater mercury concentration (138 ng/*l*), and household wastewater quantity (45,420 *l*/month or 545,040 *l*/year). *Id.* at 3, 8. The 138 ng/*l* was multiplied by 545,000 *l*/year of domestic wastewater to get 75,215,520 ng. The 75,215,520 ng figure was divided by 1 billion to arrive at 0.0752155 grams per year. The 0.0752155 grams per year figure was multiplied by 105,480,101 households to arrive at 793,373.84 grams per year released from all households. One pound includes approximately 453.6 grams. *See* William L. Masterton & Emil J. Slowinski, Chemical Principles 9 (4th ed. 1977) (providing conversion tables). The 793,373.84 grams per year figure divided by 453.6 grams per lb. yields a total of 1749.1 lbs.

42. To compare the total releases of mercury to surface water from industry and the total in wastewater from households, *compare* U.S. EPA, 2001 TRI Public Data Release, *supra* note 28, at 3-57, *with* AMSA, Domestic Sources of Mercury, *supra* note 37, at 3, 7-10.

43. *See* U.S. EPA, 1997 Mercury Report, *supra* note 28, at 4-18.

44. *See* Marquita K. Hill, Understanding Environmental Pollution 215-17 (1997). The Mercury-Containing and Rechargeable Battery Management Act, Pub. L. No. 104-142 (1996), became effective in 1996 and sharply restricts the amount of mercury in batteries. *See* Swift, *supra* note 38, at 1724. According to EPA, only lead-acid batteries have mercury levels of significant concern. U.S. EPA, 1997 Mercury Report, *supra* note 28, at 4-18 (noting that "[i]n 1989, alkaline batteries accounted for about 419 tons or close to 60% of the mercury in the [municipal solid waste] stream").

45. Hill, *supra* note 44, at 219.

46. U.S. EPA, 2001 TRI Public Data Release, *supra* note 28, at 3-57, tbl. 3-41.

to assess. One EPA estimate suggests that home and garden pesticide use was 140 million lbs. in 1997.[47] In comparison, approximately 985 million lbs. were used for agriculture, a substantial increase over the 1992 level of 892 million lbs. Finally, 148 million lbs. were used for industrial, commercial, and governmental applications (such as on rights-of-way and for landscaping around businesses).[48] If these estimates are correct, pesticide use by individuals accounted for 11% of total pesticide use in the United States in 1997.

Other EPA estimates differ to some extent. For example, EPA also has estimated that approximately 67 million lbs. of "active ingredient pesticides" are applied to private lawns every year, or an average of roughly 1 lb. per private lawn.[49] In addition, as discussed in the analysis of low-level ozone below, an EPA assessment of the volatile organic compound (VOC) air emissions from pesticides estimated that between 7% and 8% of all pesticides used in the United States are used for exterminating home and garden pests.[50] The available estimates thus vary to some extent, but home pesticide use constitutes a notable percentage of the total volume of pesticides released to the environment on a nationwide basis.

F. Low-Level Ozone

Ozone is formed by chemical reactions in the atmosphere involving two ozone precursors: oxides of nitrogen (NO_x) and hydrocarbons (principally VOCs).[51] Ozone precursor releases attributable to individual behavior occur from a wide range of activities, including: (1) operation of on-road motor vehicles (including cars and light-duty trucks, e.g., pick-up trucks and sport utility vehicles); (2) operation of nonroad motor vehicles (including lawn and garden equipment, recreational marine equipment, and certain other recreational vehicles); (3) residential electricity consumption (including the emissions from electric utilities attributable to residential use); and (4) consumer product use, including use of solvents, pesticides, and architectural coatings, e.g., household paints.

Individuals and households released at least 26 billion lbs. (12,979,700 tons) of ozone precursors in 1998,[52] or roughly 246 lbs. of ozone precursors per household.[53] Individuals and households thus contributed more than 30.6% of all low-level ozone precursors nationwide. Industrial, commercial, government, and other types of sources contributed the remainder. Table 4 identifies the volumetric and percentage contributions of NO_x and VOCs from each of the individual sources that were included in the estimate.

Table 4: Individual Sources of Ozone Precursor Emissions (in tons)[54]

Source Category	*Individual Amount*	*Share of Individual*	*Individual Share of Total*
On-Road Motor Vehicles			
Cars	4,295,700	33.1%	10.1%
Light-Duty Trucks	3,243,900	25.0%	7.6%
Subtotal	7,539,600	58.1%	17.7%
Nonroad Motor Vehicles			
Recreational Marine Vehicles	668,000	5.1%	1.6%
Lawn & Garden Equipment	1,037,200	8.0%	2.4%
Recreational Gas Engines	240,200	1.9%	0.6%
Subtotal	1,945,400	15.0%	4.6%
Fuel Comb. Elec. Util.			
Residential	2,155,000	16.6%	5.1%
Subtotal	2,155,000	16.6%	5.1%
Consumer Product Use			
Consumer Solvents	1,099,000	8.5%	2.6%
Pesticide Application	30,400	0.2%	0.1%
Architectural Coatings	210,300	1.6%	0.5%
Subtotal	1,339,700	10.3%	3.2%
Total	12,979,700	100%	30.6%

47. U.S. EPA, Draft Report on the Environment 3-10 (2003), *available at* http://www.epa.gov/Envindicators/roe/pdf/EPA_Draft_ROE.pdf (last visited Aug. 21, 2005) [hereinafter U.S. EPA, Draft Environment Report]. The 1999 EPA estimate is drawn from a report by the National Center for Food and Agricultural Policy. *See* Leonard P. Gianesi & Monica B. Marcelli, National Center for Food and Agricultural Policy, Pesticide Use in U.S. Crop Production: 1997 National Summary Report (2000).

48. U.S. EPA, Draft Environment Report, *supra* note 47 (citing Gianesi & Marcelli, *supra* note 47).

49. *See* Vandenbergh, *From Smokestack to SUV*, *supra* note 1, at 577 n.238 (citing Barry Lewis, Nonpoint Sources, Part Two: Lifestyle Decisions Can Have Serious Effects, Know Your Environment 2 (1996)). The disparity between the 67 million-lb. and the 140 million-lb. estimates may be that the former does not include non-active ingredients.

50. U.S. EPA, Emission Inventory Improvement Program, Document Series Vol. III: Area Sources ch. 9, at 9.2-2, tbl. 9.6.6 (2001), *available at* http://www.epa.gov/ttn/chief/eiip/techreport/volume03/ (last visited Aug. 19, 2005) [hereinafter U.S. EPA, Air Inventory Pesticides Report] (noting that home pesticide use constitutes 7% to 8% of the total ozone precursor emissions by all pesticides).

51. NO_x and VOCs are commonly referred to as ozone precursors. Office of Transportation & Air Quality, U.S. EPA, Fact Sheet OMS 4: Automobiles and Ozone 2-3 (1993) (EPA 400-F-2-006). Ozone concentrations tend to be elevated during the summer months (sometimes referred to as the "ozone season"). *Id.* at 1.

52. The 12,979,700 ton figure is 30.6% of the 42.370 million tons that EPA estimates to be the total 1998 for ozone precursors in the United States. U.S. EPA, 2000 Air Trends Report, *supra* note 17, at ES-1. The 42.370 million tons of ozone precursors includes 17.920 million tons of VOCs and 24.450 million tons of NOx. *Id.*

53. U.S. Census Bureau, American Fact Finder, QT-P10, Households and Families: 2000 (2000), *available at* http://factfinder.census.gov/ (last visited Sept. 12, 2005). The average household share of 246 lbs. was calculated by dividing the total amount of ozone precursors produced by individuals (12,972,700 tons) by the total number of households in America (105.5 million households). U.S. EPA, 2000 Air Trends Report, *supra* note 17, tbls. 3-2 & 3-3.

54. The table was compiled from data in the reports identified *infra* at notes 55-71. All figures are for 1998 unless otherwise indicated.

Automobiles and light-duty trucks are the largest single source of ozone precursors from individuals, accounting for approximately 17.7% of the total amount of ozone precursors emitted nationwide in 1998.[55] In some areas, the percentage contribution from cars and light trucks is much higher.[56] By comparison, no other single industrial source category comes close to 17.7% of the total.[57]

In addition, many seemingly innocuous activities other than automobile driving also have substantial impacts on ozone formation. In 1998, individual use of nonroad vehicles, including lawn and garden equipment, recreational marine equipment, e.g., personal watercraft and motorboats using inboard and outboard engines, all-terrain vehicles, and off-road motorcycles comprised 4.6% of all ozone precursors emitted nationwide.[58] The subcategories of nonroad vehicle use attributable to individuals also include several large sources of ozone precursors. For example, lawn and garden equipment was responsible for approximately 2.4% of the total amount of ozone precursors emitted nationwide.[59] Although new mowers are 70% less polluting than old mowers, using an older model lawn mower (many of which are still used today) for two hours produces the same quantity of ozone precursors as driving between 100 and 300 miles with a late-model automobile.[60] Similarly, recreational marine equipment contributed roughly 1.6% of the total ozone precursors emitted nationwide.[61]

Another major category of individual contributions to ozone precursor emissions arises from residential electricity consumption. As discussed above, on average individuals in the United States consume approximately 35.7% of the electricity generated from electric utilities, much of which is generated from burning fossil fuels such as coal, oil, and natural gas.[62] As a result, in 1998 individuals' electricity use constituted roughly 5.1% of the total amount of ozone precursors emitted nationwide by all sources.[63]

Household consumer product use is another surprisingly large source of ozone precursors. Three types of household consumer product use are particularly important: consumer solvent use; private home and garden pesticide use; and individual architectural coating use. Consumer solvent use, such as the use of household cleaners and hairsprays, produced more than one million tons of ozone precursors nationwide in 1998.[64] Consumer solvent use thus constituted approximately 2.6% of the total ozone precursors emitted from all sources. To put the consumer solvent use figure into perspective, the million ton total exceeds the combined total of all ozone precursor emissions from EPA's Metal Processing and Chemical and Allied Product Manufacturing categories.[65]

The use of architectural coatings and pesticides around the home also produces a large quantity of ozone precursors. Nationwide, private individuals use 41% of all paints and other architectural coatings.[66] As a result, the individual

55. According to EPA data, in 1998 individuals emitted 4,295,700 tons of ozone precursors from light-duty cars and 3,243,900 tons from light-duty trucks. U.S. EPA, 2000 Air Trends Report, *supra* note 17, tbls. 3-2 & 3-3. The totals were calculated by reducing the totals from all light-duty cars and light-duty trucks by the percentages of private individual operation of each. In total, light-duty gasoline cars and trucks emitted 9.613 million tons of ozone precursors in 1998, which constituted approximately 23% of the total amount of ozone precursors emitted in that year. *Id.*

56. *See, e.g.*, Craig N. Oren, *Getting Commuters Out of Their Cars: What Went Wrong?*, 17 Stan. Envtl. L.J. 141, 152 (1998).

57. *See* U.S. EPA, 2000 Air Trends Report, *supra* note 17, tbls. 3-2 & 3-3 (identifying VOC and NO_x emissions by source category).

58. EPA identifies this category as "off-road" or "nonroad" motor vehicles. Office of Air & Radiation, U.S. EPA, Reducing Air Pollution From Nonroad Engines 1 (2000) (EPA 420-F-00-048), *available at* http://www.epa.gov/otaq/regs/nonroad/f00048.pdf (last visited Aug. 19, 2005) (also available from the ELR Guidance & Policy Collection, ELR Order No. AD04974) [hereinafter U.S. EPA, Nonroad Engines Report]. The term "nonroad" is used in this Article. The estimate in this Article excludes emissions from nonroad motor vehicles that EPA includes in the category but that are not likely to be driven by individuals during the summer or are likely to be operated by firms, such as aircraft, locomotives, and construction equipment. Emissions levels from nonroad vehicles will be declining as a result of new EPA regulations and state voluntary agreements, but these reductions will be offset somewhat as the number of these vehicles increases. According to EPA, all nonroad engines in 2000 contributed 3.677 million tons of hydrocarbons (as compared to 3.772 million tons of highway hydrocarbon emissions) and 5.461 million tons of NO_x emissions (as compared to 7.988 million tons of highway NO_x emissions). *Id.* at 2.

59. EPA includes lawn and garden equipment in the nonroad category. *See* U.S. EPA, Nonroad Engines Report, *supra* note 58, at 2-4. Lawn and garden equipment produced approximately 1,037,200 tons of ozone precursors in 1998. *Id.* Lawn and garden equipment produced less than 3% of the total NO_x emissions categorized as nonroad emissions by EPA, but it produced 40% of the nonroad VOC emissions. *Id.* at 2. All lawn and garden equipment ozone precursor emissions were assumed to be generated by individuals. The 2.4% total is derived from data in the 2000 EPA *Air Trends Report*, which identifies a total from all sources of 42.4 million tons of ozone precursors produced per year. U.S. EPA, Air Trends Report, *supra* note 17, tbls. 3-2 & 3-3. The nonroad report provided percentages for lawn and garden equipment emissions in 2000 (40% of the total VOC nonroad emissions and approximately 1% of the total NO_x emissions from nonroad vehicles). U.S. EPA, Nonroad Engines Report, *supra* note 58, at 2. These percentages were multiplied by the total NO_x (5.280 million tons) and VOC (2.461 million tons) emissions from nonroad vehicles provided in the *Air Trends Report*. U.S. EPA, Air Trends Report, *supra* note 17, tbls. 3-2 & 3-3. The 2.4% figure is approximate because the nonroad report does not give an exact number of tons of NO_x produced by lawn equipment. U.S. EPA, Nonroad Engines Report, *supra* note 58, at 2. The lawn and garden equipment total was assumed to be 52,800 tons, which would be 1% of the nonroad NO_x emissions. The 52,800 estimate was based on the assumption that the category entitled "other" in the nonroad report constituted 3% of the total NO_x emissions from nonroad sources. *Id.* This "other" category included only individual activities, namely lawn and garden equipment use, recreational marine equipment use, and recreational gas engine use. *Id.* The 3% was proportioned equally between these 3 categories (1% each).

60. *See* Office of Mobile Sources, U.S. EPA, Your Yard and Clean Air 1-2 (1996), *available at* http://www.epa.gov/otaq/consumer/19-yard.pdf (last visited Aug. 19, 2005).

61. U.S. EPA, 2000 Air Trends Report, *supra* note 17, tbls. 3-2 & 3-3. More than 12 million marine engines are operated in the United States. *See* Office of Air & Radiation, U.S. EPA, Boating Pollution Prevention Tips 1-2 (1996).

62. *See supra* note 30 and accompanying text.

63. U.S. EPA, 2000 Air Trends Report, *supra* note 17, tbls. 3-2 & 3-3. Assuming residential consumption generated 35.7% of these emissions, the individual share of fuel combustion emissions was 2.155 million tons.

64. U.S. EPA, 2000 Air Trends Report, *supra* note 17, tbl. 3-3. U.S. EPA, Emission Inventory Improvement Program, Document Series Vol. III: Area Sources ch. 5 (Consumer and Commercial Solvent Use) (1996), *available at* http://www.epa.gov/ttn/chief/eiip/techreport/volume03/ (last visited Aug. 19, 2005).

65. *See also* U.S. EPA, 2000 Air Trends Report, *supra* note 17, tbls. 3-2 & 3-3.

66. *See* U.S. EPA, Economic Impact and Regulatory Flexibility Analyses of the Final Architectural Coating VOC Rule 1-12 (1998) (stating that "do-it-yourselfers" consumed 41% of the architectural coatings used in the United States in 1991). It was assumed that individuals also were responsible for 41% of the emissions from the coatings (as applied to 1998 data from the 2000 *Air Trends Report*). *Id.*

share of architectural coating emissions nationwide in 1998 was 0.5% of the total ozone precursors emitted from all sources.[67] This 0.5% share may have significant impacts on a regional basis. The South Coast Air Quality Management Board, the principal air regulatory body for the Los Angeles, California, area, has estimated that on an average day drying paint releases more smog-forming compounds than all the oil refineries and gas stations combined in the Los Angeles area.[68] Similarly, home pesticide use contributes a notable percentage of the total volume of ozone precursors nationally.[69] Pesticides often include VOCs, and, as discussed above, EPA's air office estimates that between 7% and 8% of all pesticides in the United States are used in private homes and gardens.[70] As a result, the individual share of pesticide emissions in 1998 accounted for 30,400 tons or 0.1% of the total ozone precursors emitted from all sources nationwide.[71]

G. Petroleum

Although no government or private report has calculated the share of petroleum releases attributable to individual behavior, over the last 30 years the National Research Council (NRC) has conducted three landmark studies of the quantity, fate, and effects of petroleum released to oceans in North America. As with the earlier studies, the most recent study, issued in 2003, does not specifically address individuals as a source category, but it does include data that suggest that individual behavior accounts for a substantial share of total petroleum releases.[72]

The 2003 NRC report provides several important insights about the contributions of individuals.[73] The report identifies three anthropogenic sources of petroleum releases to the oceans: petroleum extraction; petroleum transportation; and petroleum consumption.[74] The report estimates that the total amount of petroleum that enters North American waters annually from these three sources is 29 million gallons, of which 25 million gallons are released by consumption, 2.7 million gallons from transportation, and 880,000 gallons from extraction.[75] On average, petroleum consumption during 1990 through 1999 thus was responsible for almost 85% of the petroleum released from anthropogenic sources.[76]

Petroleum consumption emissions occur from several different sources, including land-based petroleum use that enters the ocean through rivers and runoff, recreational marine vessel use, oil spills, operational discharges, atmospheric deposition, and jettisoned aircraft fuel. The report states that "these typically small but frequent and widespread releases contribute the overwhelming majority of the petroleum that enters the sea due to human activity."[77] Individuals may play a role in land-based runoff, recreational marine vessel use, and atmospheric deposition. These three categories contribute 23.7 million gallons of petroleum each year, or 96% of the emissions caused by petroleum consumption.[78]

According to the report, land-based runoff to rivers, wastewater systems, and stormwater systems from on-land petroleum consumption is the most significant single source of petroleum consumption emissions. Approximately 15.9 million gallons of petroleum are released annually through land-based inputs,[79] or 56.2% of the total releases from human-related activities. The report describes land-based sources as "the most poorly documented" of the releases from petroleum consumption and does not identify the extent to which individuals contribute to land-based sources.[80] Nevertheless, individuals are likely to contribute in several ways, including urban runoff (both through direct dumping and runoff of chemicals that are present on the ground as a result of atmospheric deposition arising from petroleum combustion), municipal wastewater (through

67. U.S. EPA, 2000 Air Trends Report, *supra* note 17, tbls. 3-2 & 3-3; U.S. EPA, Emission Inventory Improvement Program, Document Series Vol. III: Area Sources ch. 3 (Architectural Surface Coating) (1995), *available at* http://www.epa.gov/ttn/chief/techreport/volume03/ (last visited Aug. 19, 2005).

68. *See* South Coast Air Quality Management District, 25 Ways You Can Clean the Air (2003). In the Los Angeles area, car and light-duty truck use and consumer product use are the top-two sources of VOC emissions. The top industrial source, commercial paints and coatings, is a distant third. In addition, the total VOCs from commercial paints and coatings exceeds the total for petroleum marketing (22 tons per day). *See* Gary Polakovic, *Chemicals in Home a Big Smog Source*, L.A. Times, Mar. 9, 2003, at A1.

69. U.S. EPA, Air Inventory Pesticides Report, *supra* note 50, at 9.2-2; *see also* U.S. EPA, 2000 Air Trends Report, *supra* note 17, tbls. 3-2 & 3-3 (noting that all pesticide application accounted for 405,000 tons or approximately 1% of the national emissions of ozone precursors in 1998). The consumer pesticide category includes the use of pesticides approved for home and garden use. U.S. EPA, Air Inventory Pesticides Report, *supra* note 50, at 9.2-1, tbl. 9.6.6 (noting that pesticides contain VOCs).

70. U.S. EPA, Air Inventory Pesticides Report, *supra* note 50, at 9.2-2.

71. U.S. EPA, 2000 Air Trends Report, *supra* note 17, tbls. 3-2 & 3-3 (the figures indicate that the individual share of pesticide ozone precursor emissions were 0.2% of the total VOCs emitted in 1998). For this study, it was assumed that 7.5% of all pesticide emissions could be attributed to individuals based on home and garden use. *See id.*

72. NRC, Oil in the Sea III: Inputs, Fates, and Effects 2, 3 (2003) [hereinafter 2003 NRC Report].

73. *Id*. The study reviewed releases of petroleum to the oceans from North America, not just the United States. *Id.* According to the study, petroleum extraction (oil and gas exploration or production) releases 880,000 gallons, petroleum transportation (refining and distribution) releases 2.7 million gallons, and petroleum consumption releases 25 million gallons. Petroleum consumption includes "[r]eleases that occur during the consumption of petroleum, whether by individual car and boat owners, non-tank vessels, or runoff from increasingly paved urban areas . . . ." *Id.* at 3. According to the study, a ton of oil may be converted to 294 U.S. gallons. *Id.* at 189, app. B.

74. A fourth category, natural seeps, accounts for 47 million gallons. *See id.* at 2-3.

75. *Id*. at 2-3, 86.

76. *Id*. at 3, tbl. 2-2. The "best estimate" of the total quantity of releases from petroleum consumption is 84,000 tons. The contributions to the 84,000 total from the subcategories of petroleum consumption are as follows: (1) land-based petroleum use that enters the ocean through rivers and runoff, 54,000 tons (64%); (2) recreational marine vessel use, 5,600 tons (6.7%); (3) oil spills from non-tank vessels, 1,200 tons (1.4%); (4) operational discharges from vessels 100 gross tons or larger, 100 tons (0.1%); (5) operational discharges from vessels under 100 gross tons, 120 tons (0.1%); (6) atmospheric deposition, 21,000 tons (25%); and (7) jettisoned aircraft fuel, 1,500 tons (1.8%). *Id*.

77. *Id.* at 2.

78. *Id*. tbl. 2-2 (noting that land-based river and runoff contributes 54,000 tons of hydrocarbons per year, recreational marine vessels contribute 5,600 tons of hydrocarbons per year, and atmospheric deposition is responsible for an average of 21,000 tons of hydrocarbon emissions from petroleum use each year). The total thus was 80,600 tons of hydrocarbons.

79. *Id*. at 80-81.

80. *Id.*

discharges to stormwater and wastewater systems), and river discharges.[81]

Two-stroke engines in recreational marine vehicles are also a significant source.[82] The report identifies recreational marine vehicles, such as boats with two-stroke outboard motors and personal watercraft (most of which are operated by private individuals), as a growing source that was not included in an earlier 1985 study.[83] According to the report, recreational marine vehicles release 1.47 million gallons of petroleum annually, a total that comprises approximately 5% of the total releases of petroleum from all human-related activities.[84]

The 2003 NRC report concludes that atmospheric deposition accounts for 6.2 million gallons or 22% of all petroleum released annually to oceans in North America.[85] The individual share of atmospheric deposition is unclear, but given the large contribution of on-road and nonroad motor vehicle use to petroleum releases, the individual share is likely to be large. In short, it is clear that individuals contribute a large share of petroleum emissions from a variety of activities, but this is an area in which individual releases have not been studied sufficiently to allow quantitative comparisons to be made.

H. Emissions Versus Risks

Identifying the amounts of pollutants released through individual behavior and the relative share as compared to other source categories is only one step in the risk regulation process. Ultimately, the environmental risk presented by pollutant releases from individual behavior will have to be assessed and compared against the risks presented by releases from other source categories. Although far more work remains to be done, even at this early stage there are reasons to believe that the releases from individual behavior pose substantial risks to human health and the environment.[86]

At the outset, the large volumes released from individual behavior provide the potential for substantial risk creation. The concept that large volumes form the basis for further inquiry is embedded in a variety of federal statutes and programs, including the Toxic Substances Control Act[87] and EPA's High Production Volume Challenge Program.[88] In addition, in some cases EPA has assessed the aggregate risk posed by the pollutants discussed above. For example, EPA has estimated that mobile sources (including on-road and nonroad vehicles operated by private individuals and by employees of corporate or other organizations) are responsible for roughly one-half of the cancer deaths caused each year by HAPs.[89]

Second, the releases from individual behavior may generate greater human exposures than releases of the same quantity of substances from other source categories. The releases will generally occur in close proximity to other individuals, such as in the home. Personal exposure levels may be higher than either indoor or outdoor air levels as a result of driving and the use of consumer and hobby chemicals, and individuals' releases have been characterized as a "personal cloud" of toxics.[90] Much of this personal cloud effect occurs indoors. EPA estimates that on average 75% of homes use some form of pesticide indoors each year and that 80% of an individual's exposure to pesticides occurs within the home.[91] Measured levels of pollutants in the air inside homes have exceeded by several times the levels in the ambient air, and indoor air pollution is a leading human exposure route for many toxics.[92] Emissions from vehicles on the highway may have a similar effect. As cars drive down the road, the emissions from other cars enter the ventilation systems, and one study concluded that the levels of some air pollutants inside motor vehicles exceed the levels in the ambient air.[93]

Third, individuals' toxic chemical releases may be more likely to occur in locations that create exposure to sensitive subpopulations or ecosystems. For example, children and

81. *Id*. One state has estimated that private individuals in the state generate more than one million gallons of used oil per year. Tennessee Department of Environment & Conservation, *Used Oil Collection Act of 1993: Fact Sheet*, *at* http://tennessee.gov/environment/swm/oil/oilfactsheet.php (last visited Aug. 19, 2005).

82. 2003 NRC Report, *supra* note 72, tbl. 2-2. These two sources combined comprise two-thirds of all releases from petroleum consumption. *Id*. at 3. Reductions in emissions from new recreational marine engine emissions should occur with the implementation of new regulations effective in 2006. *Id.* at 81.

83. *Id*.

84. *Id*. tbl. 2-2. The total figure reported was 5,000 tons, which was converted to gallons using 294 gallons per ton. *See id*. at 219-20, app. F. Reductions in the releases to surface water will occur with new EPA regulations on recreational marine vehicles. *See id*. at 81 (noting that new EPA regulations will reduce air emissions by 75%).

85. *Id*. tbl. 2-2. The percentage was calculated by dividing 21 tons by 96.1 tons, the total from all anthropogenic sources.

86. *See* U.S. EPA, Region/ORD/OAR Workshop on Air Toxics Exposure Assessment; Summary Report 6 (2002) [hereinafter U.S. EPA, Air Toxics Workshop] (noting that "personal exposure" is a growing focus of EPA research). Quantities of toxic releases are only a proxy for risk creation, but data on the quantities of a chemical released are valuable as a starting point in the analysis. *See* 2003 NRC Report, *supra* note 72, at ix (noting that quantitative data provide a baseline and guide for further studies).

87. *See* Toxic Substances Control Act §4(a)(B)(i), 15 U.S.C. §2603(a)(B)(i) (requiring testing if "a chemical substance will be produced in substantial quantities").

88. *See, e.g.*, David W. Case, *The EPA's HPV Challenge Program: A Tort Liability Trap?*, 62 Wash. & Lee L. Rev. 147, 160-63 (2005) (discussing EPA's High Production Volume Challenge Program).

89. *See* Oren, *supra* note 56, at 152 (citing *Implementation and Enforcement of CAA Amendments of 1990: Hearings Before the Subcomm. on Oversight and Investigations of the House Comm. on Commerce*, 104th Cong. 209 (1995) (statement of Mary Nichols, Assistant Administrator, U.S. EPA, Office of Air and Radiation); H.R. Rep. No. 101-490, pt. 1, at 152, 316 (1990)). In addition, one study concluded that in the Los Angeles area air toxics released from mobile sources (including benzene and formaldehyde) account for about 20% of the total carcinogenic risk. Jack Broadbent et al., South Coast Air Quality Management District Final Report on MATES-II Program ES-3 (2000) (on file with author).

90. *See* U.S. EPA, Air Toxics Workshop, *supra* note 86, at 13 (response of Prof. John Adgate to question about the results of a Minneapolis-St. Paul toxic chemical exposure study).

91. U.S. EPA, The Inside Story: A Guide to Indoor Air Quality 14 (1995), *available at* http://www.epa.gov/iaq/pubs/insidest.html#Look7 (last visited Aug. 21, 2005) (also available from the ELR Guidance & Policy Collection, ELR Order No. AD04975).

92. One EPA study concluded that levels of roughly a dozen organic pollutants are between two and five times higher in household indoor air than outside, and the conclusion held without regard to whether the homes were located in highly industrial areas or rural areas. *See id.* at 12.

93. *See* Charles Rodes et al., Measuring Concentrations of Selected Air Pollutants Inside California Vehicles, Final Report (ARB Contract No. 95-339, 1998) (unpublished manuscript), *available at* http://www.arb.ca.gov/research/indoor/in-vehsm.htm (last visited Aug. 19, 2005) (concluding that some toxics inside vehicles exceed ambient levels).

other sensitive subpopulations may be more likely to breathe indoor air or the air inside a motor vehicle than to breathe air contaminated by air toxics released from a distant factory.[94] Toxic releases by individuals also often occur in areas of particular ecological sensitivity. The 2003 NRC report concluded that although not all petroleum releases are likely to have adverse effects, the petroleum released from two sources that include large individual contributions—land runoff and two-stroke engines—"is particularly significant because, by their very nature, these activities are almost exclusively restricted to coastal waters. In fact, the estuaries and bays that receive the bulk of the load are often some of the most sensitive ecological areas along the coast."[95] Household pesticides and fertilizers in runoff also may present particular risks to sensitive ecosystems.[96] Thus, many releases from individuals may have a greater effect on human health and environmental quality than releases of similar quantities from other sources.

For each of the pollutants identified in this analysis, the extent to which the releases of any particular pollutant contribute to any particular human health or ecological risk is difficult to assess because government agencies do not collect or report data on individuals and households as a source category. The data presented in this Article suggest, however, that a comprehensive analysis of the environmental and human health risks posed by individual behavior is overdue. The 2003 NRC report on petroleum releases may serve as a valuable model for such an approach. Rational policymaking in the absence of this information will be difficult at best.

III. Can Individual Behavior Be Changed at Acceptable Economic and Social Cost?

Even if individual behavior contributes a large share of many types of pollution, a rational regulator might choose to focus on other source categories if the economic or social costs of emissions reductions exceed the costs of reductions from other sources. The limited attention given to individual behavior in environmental law may be the product of an intuitive judgment that regulating industry is more cost effective than regulating individual behavior, or it may result from the political unpopularity of regulating individuals.[97] In addition, the limited attention may be the product of the framing of "polluter" in environmental debates to include industry, not individuals.[98] That conceptual framework may have affected how we collect data, the resources we devote to developing and implementing new regulatory measures, and the targets of those measures. Regardless of the origins of the current approach, the data presented above suggest that individual behavior deserves a second look.

At the outset, the prospects for the two leading tools of environmental law, formal legal regulation and economic incentives, are limited. When applied to individual environmental behavior, prescriptive rules enforced by legal sanctions may change behavior but will often be intrusive, expensive, and very unpopular, particularly when used as the sole means of steering behavior. The occasional attempts to impose federal environmental requirements on individuals demonstrate the unpopularity of formal legal regulation, at least at the federal level. Perhaps as a result, when the U.S. Congress, EPA, and the courts have addressed individuals at all, they often have done so by excluding individual behavior from regulation.[99]

Economic incentive measures also face limitations when applied to individual behavior. One school of thought suggests using taxes or subsidies to provide incentives for socially desired behaviors, and, as Prof. Mark Cohen points out in his article in this issue, these measures have been used successfully in some cases.[100] Yet taxes are wildly unpopular, and subsidies are vulnerable to being hijacked for special interest purposes rather than societal environmental goals.[101] A second school of thought suggests that government should encourage the development of markets to provide incentives for achieving environmental goals. Although the sulfur dioxide emissions trading scheme included in the 1990 Clean Air Act Amendments is widely viewed as a success,[102] extending market trading to individual behavior will be difficult because of the large number of

94. *See* U.S. EPA, America's Children and the Environment: Measures of Contaminants, Body Burdens, and Illnesses (2003) (available from the ELR Guidance & Policy Collection, ELR Order No. AD04972) (analyzing risks posed to children).

95. 2003 NRC Report, *supra* note 72, at 4. EPA has concluded that the pollutants discharged through runoff and storm sewers "contribute high levels of pollutants, including heavy metals, toxics, oil and grease, solvents, nutrients, viruses and bacteria into receiving waterbodies." *See* National Pollutant Discharge Elimination System—Regulations for Revision of the Water Pollution Control Program Addressing Stormwater Discharges, 64 Fed. Reg. 68722, 68727-28 (Dec. 8, 1999) [hereinafter U.S. EPA, Phase II Stormwater Regulations]. Urban runoff constitutes one of the leading sources of water quality impairment in the United States. *See, e.g.*, U.S. EPA, National Water Quality Inventory 2000 Report 31 (2001), *available at* http://www.epa.gov/305b/2000report/chp4.pdf (last visited Aug. 19, 2005) [hereinafter U.S. EPA, 2000 Water Quality Inventory]. In addition, although assessments of the contribution of residential areas to nonpoint water pollution are rare, the 1983 EPA Nationwide Urban Runoff Program did not detect significant differences in pollutant concentrations between the urban runoff from residential, commercial, and mixed urban areas. *See* U.S. EPA, Results of the Nationwide Urban Runoff Program, Vol. 1: Final Report 6-28, -31 (1983).

96. Household pesticide use has been shown to lead to the presence of toxics in urban and suburban runoff. *See* U.S. EPA, 2000 Water Quality Inventory, *supra* note 95, at 52. Pesticides are one of the principal components of contaminated urban runoff. *See* U.S. EPA, Phase II Stormwater Regulations, *supra* note 95, at 68725.

97. For example, efforts in 1990 by the Los Angeles area air quality authority to reduce the smog caused by backyard grilling led to a backlash, with critics using the slogan "use a barbecue, go to jail." Gary Polakovic, *Chemicals in Home a Big Smog Source*, L.A. Times, Mar. 9, 2003, at B1.

98. *See* Michael P. Vandenbergh, *The Social Meaning of Environmental Command and Control*, 20 Va. Envtl. L.J. 191, 201-04 (2001); Bradley Bobertz, *Legitimizing Pollution Through Pollution Control Laws: Reflections on Scapegoating Theory*, 73 Tex. L. Rev. 711, 718 (1997).

99. For example, although tailpipe emissions are the product of the emissions per vehicle mile traveled, specific CAA provisions prevent EPA from imposing restrictions on private motor vehicle use. *See* Vandenbergh, *From Smokestack to SUV, supra* note 1, at 55. Similarly, although in theory an individual could be regulated as a point source under the Clean Water Act (CWA), courts and regulators have declined to interpret the Act in this way. *See, e.g.*, United States v. Plaza Health Lab., Inc., 3 F.3d 643, 650, 23 ELR 21526 (2d Cir. 1993) (concluding that Congress "had bigger fish to fry" than releases from individuals).

100. *See* Cohen, *supra* note 9.

101. Perhaps the best example is the tax break that is only available for purchases of vehicles that are *over* 6,000 lbs. gross vehicle weight. *See* Pamela Najor, *Tax-Cut Bill Would Give Small Businesses Reason to Buy Largest Sport Utility Vehicles*, Daily Env't Rep. (BNA), May 28, 2003, at A-6.

102. 42 U.S.C. §7651b.

potential market participants and the miniscule emissions from any one individual.[103] In short, formal legal regulation and economic incentives will have a role in steering individual environmental behavior, but neither is likely to be a viable tool on its own.

A. Norms

Until recently, legal scholarship had little to offer other than formal legal regulation and economic incentive measures. That began to change with the 1991 publication of *Order Without Law*, Prof. Robert Ellickson's study of the influence of law and informal social norms on ranchers in Shasta County, California.[104] Professor Ellickson's work has spawned a large body of literature on how the law can influence the creation, modification, and enforcement of norms. The focus on norms has opened the eyes of legal scholars to the importance of social influences on behavior and the effects of law on these social influences.

Norms include both social norms—informal obligations that are enforced through social sanctions or rewards[105]—and personal norms—obligations that are enforced through an internalized sense of duty to act and guilt or related emotions for failure to act.[106] The norms scholarship in the legal literature has attempted to account for norms within the rational actor model favored by law and economics scholars: individuals are presumed to pursue their self-interest.[107] Norms scholars suggest that social norms influence the payoff an individual receives from a behavior by affecting the material outcomes from the behavior, e.g., because others will refuse to trade with someone who violates a social norm, or by imposing psychic costs and benefits on the individual. Several theories have been advanced to explain the origins and influence of social norms. For example, one theory asserts that social norms arise and are enforced because of esteem competition.[108] Another maintains that social norms enable individuals to signal that they are cooperators.[109]

The norms scholars in the legal literature have argued that social norm enforcement is most effective when the targeted activity occurs in a group with characteristics that facilitate social sanctions and rewards. Professor Ellickson, in particular, has stressed the importance of iterative relationships and access to adequate information among group members. He has described groups with conditions that facilitate social sanctioning as "close-knit" groups, in contrast to "loose-knit" groups, which lack the iterative relationships and information necessary for strong norm enforcement.[110] Professor Ellickson and others have demonstrated the remarkable effects of social norms when the material benefits of cooperation to the individual are large and the behavior occurs in close-knit groups.[111] Norms scholars argue that even in loose-knit groups, if the benefits to the individual are sufficiently large, e.g., where safety benefits arise from seat belt and child safety seat requirements, norms may provide the additional incentive necessary to change behavior.[112] The growing focus on social norms has induced some to suggest "norm management" as a regulatory tool.[113]

1. Environmental Norms Literature

The norms work in the legal literature has only begun to address environmental behavior.[114] Professor Carlson has conducted the first sustained treatment in the legal literature of the influence of norms on environmental behavior.[115] She notes that many environmental problems arise because individuals confront collective action problems. The classic collective action analysis assumes that individuals are narrowly rational and suggests that in certain situations individuals face a disincentive to change behavior.[116] For example, an individual whose lawn mowing will release ozone precursors will benefit if everyone in the community refrains from lawn mowing on high ozone days, but the contribution of the individual to the problem will be negligible. The indi-

103. *Cf.* Bradley C. Karkkainen, *Information as Environmental Regulation: TRI and Performance Benchmarking, Precursor to a New Paradigm?*, 89 Geo. L.J. 257, 270 (2001) (noting the large amount of information necessary to establish market trading schemes).

104. *See* Robert C. Ellickson, Order Without Law: How Neighbors Settle Disputes (1991). As Professor Hetcher notes in his contribution to this symposium, Professor Ellickson's work followed that of Stuart McCauley and others, but it was Professor Ellickson's work that precipitated an explosion in legal scholarship on norms in the 1990s.

105. *See* Richard McAdams, *The Origin, Development, and Regulation of Norms*, 96 Mich. L. Rev. 338, 340 (1997) [hereinafter McAdams, *Norms*].

106. *See* Steven Hetcher, *Creating Safe Social Norms in a Dangerous World*, 73 S. Cal. L. Rev. 1 (1999) (discussing social norms and customs); Richard H. McAdams, *Accounting for Norms*, 1997 Wis. L. Rev. 625, 626-30 (noting the terms used for internalized norms); *see also* Shalom H. Schwartz, *Normative Influences on Altruism*, *in* Advances in Experimental Social Psychology 221, 231 (L. Berkowitz ed., 1977) (noting that "the sanctions attached to personal norms are tied to the self-concept").

107. *See* McAdams, *Norms*, *supra* note 105, at 377. The principal focus of the norms scholarship to date has been on social norms rather than personal norms. As Robert Scott has argued, if personal norms influence behavior but are unstable, "then the rational choice analyst must treat [them] as endogenous or abandon any pretense of having a fully predictive model." Robert E. Scott, *The Limits of Behavioral Theories of Law and Social Norms*, 86 Va. L. Rev. 1603, 1622 n.39 (2000) (referring to values and preferences). *See also* Eric Posner, Law and Social Norms 43 (2000) (concluding that "no well-developed theory of guilt allows us to make predictions about when" it will be influential).

108. *See generally* McAdams, *Norms*, *supra* note 105 (proposing esteem competition theory).

109. Posner, *supra* note 107, at 43. In addition, Profs. Cass Sunstein and Larry Lessig have noted the important relationships among social norms, social roles, and social meaning. *See* Cass R. Sunstein, *Social Norms and Social Roles*, 96 Colum. L. Rev. 903 (1996); Lawrence Lessig, *The Regulation of Social Meaning*, 62 U. Chi. L. Rev. 943 (1995).

110. *See* Ellickson, *supra* note 104, at 181.

111. *See* Ellickson, *supra* note 104, McAdams, *Norms*, *supra* note 105, Posner, *supra* note 107.

112. *See* discussion *infra* note 126.

113. *See* Sunstein, *supra* note 109, at 907.

114. Prof. Elinor Ostrom has written extensively on environmental norms in the political science literature, and her work has influenced a number of legal scholars. *See, e.g.*, Elinor Ostrom, *Toward a Behavioral Theory Linking Trust, Reciprocity, and Reputation*, *in* Trust and Reciprocity 21 (Elinor Ostrom & James Walker eds., 2003) (noting that at least 30 variables influence solutions to collective action problems involving natural resources).

115. Ann E. Carlson, *Recycling Norms*, 89 Cal. L. Rev. 1231 (2001). For a brief, early exploration of the role of norms in environmental behavior, see Carol M. Rose, *Rethinking Environmental Controls: Management Strategies for Common Resources*, 1991 Duke L.J. 1, 29-36.

116. *See* Mancur Olson, The Logic of Collective Action: Public Goods and the Theory of Groups 64 (2d. ed. 1971).

vidual will gain essentially all of the same benefits, plus the benefits of a freshly cut lawn, if she does not refrain from lawn mowing while others do. The payoff for the individual of not refraining thus will be positive, whereas the payoff from refraining will be negative. If we assume that individuals are narrowly rational, we can see why individuals often fail to refrain from engaging in many of these types of behaviors. In addition to the negative payoff, the larger the number of individuals involved, the less any one individual's failure to refrain will affect air quality and the less incentive the individual will have to refrain. As Professor Hetcher notes in his article in this issue, game theorists often use the "prisoner's dilemma" to model environmental and other collective action problems.[117]

Based on an analysis of recycling studies, Professor Carlson concludes that many environmentally significant behaviors such as recycling and driving occur in situations in which the individual will receive a small or negative payoff from behavior change and in which the group characteristics do not facilitate social sanctioning.[118] In these situations, the material payoff for the individual does not create an incentive for behavior change and social norms do not create a substantial additional incentive. Despite the absence of a material payoff or effective social norm enforcement, Professor Carlson finds that individuals with strongly held norms often engage in recycling. For other individuals, she concludes that unless norm campaigns are of the expensive face-to-face variety, they have limited effects, particularly if the behavior change requires sustained or substantial effort.[119] As a result, she concludes that norms scholars have been too sanguine about the prospects for norm management as a regulatory measure. Instead, she recommends that policymakers invest in financial incentives and infrastructure improvements to make the behavior more convenient.[120]

2. Easy Cases and Hard Cases

Professor Carlson's analysis leads to what might be called a "policymaker's dilemma": government investments in infrastructure and financial incentives appear to be preferable to norm campaigns for recycling and similar environmental behaviors, but in the absence of strong public support, policymakers have limited ability to invest in infrastructure or financial incentives. As a result, neither norm campaigns nor other measures appear to be viable tools. The current scholarship thus appears to offer a pessimistic prognosis for individual environmental behavior change.

This Article suggests that a greater focus on personal norms may lead to a more optimistic conclusion. It examines whether the payoff to the individual is positive or negative before considering the effects of social sanctions and rewards. It also examines whether the group setting provides opportunities for iterative relationships and the exchange of information. Following Professor Ellickson, this Article refers to those that do as close-knit groups and those that do not as loose-knit groups.[121] Situations in which there is a positive payoff and the behavior occurs in a close-knit group are referred to as the "easy cases" for normative influence. The "hard cases" arise when the payoff is negative and the group is loose-knit.

At the outset, it is important to note that many behaviors occur in easy case situations. Individuals often will benefit personally from behavior change but simply lack information about the implications of their behavior.[122] An easy case situation arises if an individual generates dioxin by burning garbage in her backyard barrel in plain sight of family members or neighbors in a small town, and the fumes settle on her yard and the yards of neighbors. She not only may obtain a large payoff if she reduces consumption of dioxin-contaminated garden vegetables and dermal contact with dioxin on the lawn, she also may avoid social sanctions by family members or neighbors who are aware of the dioxin contamination.[123] In this positive-payoff, close-knit group situation, information about the dioxin releases and their potential effects may be sufficient to change behavior.[124] Similarly, an individual may use a household chemical around the home and the individual or others in the home may be exposed to the chemical. If so, the costs arising from the increased health risk to the individual or others important to the individual may exceed the benefits of the activity. Members of the household may reinforce the individual's material payoff with social sanctions.[125]

In thinking about individual behavior, it is important not to overlook the gains that may be achieved simply by identifying the easy cases and providing individuals with the information necessary to enable them to make choices that are both in their interest and in the societal interest. For some pollutants, this may be the low-hanging fruit of the next generation of environmental laws.[126] In addition, the individual

117. Although as Professor Hetcher notes, prisoner's dilemma problems assume that all players are participating and thus do not account for intergenerational problems. *See* Steven Hetcher, *Norms as Limited Resources*, 35 ELR 10770 (Nov. 2005).

118. Professor Carlson analyzes individual behavior along two dimensions: the payoff to the individual and the group size. *See* Carlson, *supra* note 115.

119. *See id.* at 1300 (noting "undue optimism" about the role of norms).

120. *Id.*

121. Small group size is highly correlated with close-knittedness but is not essential. *See, e.g.*, ELLICKSON, *supra* note 104, at 182. Situations in which the individual's actions are not observable by others and situations in which the actions are observable but occur in non-close-knit groups are referred to as loose-knit group situations.

122. External constraints such as a lack of funds or access to mass transportation are addressed later in the Article.

123. In addition, the payoff to the individual from behavior change may be positive not because the individual will bear the risks of her behavior, but because the current behavior causes costs to the individual that exceed the benefits. Inefficient electricity, water, and motor vehicle use may fall into this category. In the absence of constraints, if the individual is acting rationally, information should induce the individual to change behavior in these situations. Even if the individual does not simply based on the information, so long as these activities take place in close-knit groups, norm enforcement should occur.

124. This assumes that behavior change such as removing dioxin-releasing items from garbage or using a garbage collection service is less costly to the individual than the dioxin exposure.

125. Some types of lawn and garden equipment use may fall into this category. Individuals often expose themselves to toxics through dermal contact with household chemicals and inhalation of the exhaust from lawn and garden equipment. *See* U.S. EPA, AIR TOXICS WORKSHOP, *supra* note 86, at 54.

126. Some behaviors will not occur in situations with both positive payoffs and close-knit groups, but will occur in situations that involve only one of these characteristics. For example, a behavior may generate a positive payoff and occur in a close-knit group, but the behavior may be particularly difficult to change. *See, e.g.*, Paul C. Stern, *Information, Incentives, and Proenvironmental Consumer Behavior*, 22 J. CONSUMER POL'Y 461, 465 (1999) (noting the difficulty of changing habitual behavior).

contribution of some pollutants may be so great that a norm campaign will be well worth the cost even if only a small percentage of the target audience changes behavior.

Many of the individual behaviors that release pollutants occur in hard case situations, where the payoff of the behavior is negative and the group is loose-knit. These situations often arise when an individual externalizes the harm caused by her behavior, resulting in costs of behavior change to the individual that exceed the benefits. Some dioxin-releasing behaviors occur in hard case situations. Barrel-burning emissions may not settle in the vicinity of the barrel but may drift onto the gardens and farms of others miles away, e.g., if the emissions are carried away by the prevailing winds. The harms thus may be externalized and the costs to the individual of behavior change may exceed the benefits. Individuals also may engage in barrel burning in loose-knit group situations, such as in an isolated rural setting or a vacant urban lot in a neighborhood with a transient population. Other behaviors that often arise in hard case situations include household waste disposal, driving, and consumer purchasing. In these situations the individual will not be motivated to change behavior based on self-interest, and social sanctions will not change the individual payoff.

3. Environmental Norm Activation

In hard case situations, social norms are likely to have only limited effects on behavior. Personal norms, however, may influence behavior even in the absence of social sanctioning. A better understanding of which personal norms are widely held and how they are activated in specific types of situations will improve behavioral predictions and enable the development of viable regulatory measures.[127] Recent legal and social psychological scholarship provide the basis for a theory of environmental norm activation.

Although the norms scholarship in the legal literature has only focused to a limited extent on personal norms, important insights have emerged.[128] In particular, legal scholars have asserted that individuals hold specific, first-order or concrete norms as well as generalized, second-order or abstract norms.[129] These two types of personal norms are enforced by guilt and related emotions.[130] For example, individuals may hold a specific, first-order preference for milk, behind which is a more abstract, second-order preference for health.[131] Legal norms theorists also have proposed that the linkage between the second- and first-order norms often is the set of beliefs about what actions tie second-order to first-order norms. New information about child safety or the enactment of a law regarding child safety, for example, may tie the abstract norm of "be a good parent" to the concrete norm in favor of child safety seat use.[132] Legal scholars have identified how particular personal norms influence particular behaviors and how norms are internalized, but they have given little attention to a more systematic identification of the norms that influence categories of behavior and to the mechanisms by which changes in beliefs trigger existing personal norms.[133] They also have focused much of their attention on the expressive effects of law while giving limited attention to the ability of laws to influence beliefs and norms directly by requiring information disclosure.[134]

The social psychology literature has proceeded on a parallel track, but it offers a generalized theory of the types of beliefs that are likely to affect personal norms. As Stern demonstrates in this issue, he and some of his colleagues have proposed a values-beliefs-norms (VBN) theory.[135] The VBN theory posits that a new belief that a value is threatened and that the individual can act to reduce the threat tends to activate norms and induce action.[136] The VBN theory provides a mechanism for norm activation through belief change, but it does not address the legal influences on belief change.

Environmental norm activation theory integrates the insights of the VBN theory with legal norms theory. It begins with the assumption that individuals often function as rational actors who seek self-interest and that they account for both material and psychic costs and benefits in their decisionmaking. In contrast to many legal norms theories, the environmental norm activation theory also accounts for altruism in some circumstances.[137] In short, the theory seeks

127. *See, e.g.*, Huib Pellikaan & Robert J. van der Veen, Environmental Dilemmas and Policy Design 147 (2002) (reporting results of empirical study suggesting that individuals' preferences differ based on the type of collective action problem presented); Richard H. McAdams, *Signaling Discount Rates: Law, Norms, and Economic Methodology*, 110 Yale L.J. 625, 627 (2001) (reviewing Posner, *supra* note 107) (concluding that "the value often comes directly from Eric Posner's thinking about the specific issue rather than from applying his conceptual apparatus"). *Cf.* Gregory Mitchell, *Why Law and Economics' Perfect Rationality Should Not Be Traded for Behavioral Law and Economics' Equal Incompetence*, 91 Geo. L.J. 67, 75 (2002) (suggesting that the "evidence of individual and situational differences in rationality . . . directs attention instead to comparisons of the relative predictive power of the two models in specific domains for specific groups of people").

128. *See* Robert D. Cooter, *Structural Adjudication and the New Law Merchant: A Model of Decentralized Law*, 14 Int'l Rev. L. & Econ. 215, 218 (1994) [hereinafter Cooter, *Decentralized Law*]; McAdams, *supra* note 127, at 627; McAdams, *Norms*, *supra* note 105, at 377-84.

129. *See* Robert Cooter, *Do Good Laws Make Good Citizens? An Economic Analysis of Internalized Norms*, 86 Va. L. Rev. 1577, 1595-96 (2000) (referring to first-order and second-order preferences); McAdams, *Norms*, *supra* note 105, at 382-84 (referring to concrete and abstract norms).

130. *See* McAdams, *Norms*, *supra* note 105, at 382-84.

131. Cooter, *supra* note 129, at 1595-96. *See also* Cooter, *Decentralized Law*, *supra* note 128, at 220-21.

132. *See* McAdams, *Norms*, *supra* note 105, at 407-08.

133. *See* Cooter, *supra* note 129, at 1580. For an exception to the general lack of focus among norms scholars on the effects of belief change on norms, see Alex Geisinger, *A Belief Change Theory of Expressive Law*, 88 Iowa L. Rev. 35, 55 (2002) [hereinafter Geisinger, *Expressive Law*].

134. *See, e.g.*, McAdams, *Norms*, *supra* note 105, at 400 (suggesting that "[i]f the esteem theory is correct, it suggests two specific ways that statutes create and strengthen norms: (1) lawmaking publicizes a societal consensus, and (2) law provides the concrete norms that define compliance with internalized abstract norms").

135. *See, e.g.*, Stern, *supra* note 126, at 463 (citing Shalom Schwartz, *Universals in the Content and Structure of Values: Theoretical Advances and Empirical Tests in 20 Countries*, 25 Advances Experimental Soc. Psychol. 1, 65 (1992)). *See also* Paul C. Stern, *Understanding Individuals' Environmentally Significant Behavior*, 35 ELR 10785 (Nov. 2005).

136. *See, e.g.*, Paul C. Stern et al., *A Value-Belief-Norm Theory of Support for Social Movements: The Case of Environmentalism*, 6 Hum. Ecology Rev. 81, 83-85 (1999). Other leading theories of behavior in social psychology are the theory of reasoned action and the theory of planned behavior. *See* Geisinger, *Expressive Law*, *supra* note 133, at 55-62.

137. *Cf.* Ostrom, *supra* note 114, at 39-40 (assuming individuals are "rational in a broad sense . . . that they seek to improve values of importance to them (including what happens to other individuals who are

to understand not only the behavior that can be anticipated by a self-interested rational actor, but also the extent to which personal norm activation is likely to induce social-regarding changes in that behavior.

The principal benefit of this approach is that it begins to identify the types of legal measures that are most likely to motivate an individual to act in situations that are not amenable to appeals to self-interest, or where even self-interest is insufficient to overcome barriers to change. That step is essential for policymakers. In many cases, the costs of a particular action will outweigh the benefits or will be sufficiently closely matched that an additional stimulus will be needed to induce an individual to act. A policymaker may not need a precise prediction of the amount of behavior change that will occur in a given situation, and in fact as Professors Carlson and Hetcher demonstrate regarding recycling, the thick rational actor model often cannot provide this in any event.[138]

Many individuals share a common set of abstract, second-order personal norms.[139] These abstract norms are stable for extended periods of time.[140] Two abstract norms are particularly widely held, stable, and likely to influence individuals' environmental behavior: environmental protection and reciprocity.[141] These are not the only abstract norms that influence environmental behaviors, but these norms each address a critical aspect of the problem created by situations with negative payoffs and loose-knit groups. In particular, the environmental protection norm addresses the negative payoff by generating a sense of obligation to act even absent other legal, economic, or social incentives.[142] The reciprocity norm addresses the disincentives for action that arise in loose-knit group situations by ensuring that individuals who feel an initial sense of obligation to act do not fail to do so because they fear that they will be a "sucker."[143]

Environmental norm activation theory follows the legal and social psychological literatures in suggesting that individuals hold a wide range of more specific concrete personal norms that relate to the abstract norms. These concrete norms include a number that are important for environmental behavior.[144] For example, the notions that individuals have an obligation to refrain from pouring toxic chemicals into a stream or killing endangered species are widely (although not universally) held.[145]

Linking abstract norms and concrete norms is the set of beliefs about what actions implicate the abstract norms and either activate existing concrete norms by tying them to abstract norms or create new concrete norms.[146] Norm activation thus provides a mechanism by which norms influence behavioral intentions and behavior.[147] Social psychological studies of several environmental behaviors have supported the norm activation concept.[148] To activate a concrete norm, an individual must hold two types of beliefs. First, she must be aware of the consequences (AC) of her act regarding the objects of an abstract norm. For example, a study of backyard burning asked whether the respondents believed that the smoke from backyard burning made it difficult for people to breathe.[149] Second, she must take personal responsi-

of concern to them)"). Others such as Professor Hetcher assume that individuals are predominantly rational actors who generally are self-interested and motivated only by material costs and benefits, yet have a limited budget for altruism where the altruistic effects of a given behavior sufficiently outweigh the costs of engaging in the behavior. Hetcher describes this as "predominant altruism." *See* Hetcher, *supra* note 117.

138. *See* Hetcher, *supra* note 117.

139. *See* Stern, *supra* note 126, at 463 (drawing on empirical studies by Shalom Schwartz).

140. *See* McAdams, *Norms*, *supra* note 105, at 383.

141. In contrast to the two norms included in the norm activation theory, the VBN theory refers to abstract norms as values and includes four "value clusters." *See* Stern et al., *supra* note 136, at 83-87 (identifying altruistic, egoistic, traditional, and openness to change value clusters). The specific values operationalized in empirical tests of the VBN theory correspond roughly to the abstract, second-order norms identified in the legal literature. *See, e.g.*, *id.* app. at 95 (including "protecting the environment" and "conserving natural resources" in the altruistic value cluster).

142. Studies suggest that an abstract norm favoring protection of human health and the environment is widely held, stable, and influential. *See, e.g.*, Riley E. Dunlap et al., Health of the Planet 83, tbl.15 (1993) (providing data from opinion polls); Hazel Erskine, *The Polls: Pollution and Its Costs*, 36 Pub. Opinion Q. 120, 120 (1972) (noting that respondents expressing support for greater environmental spending increased from roughly 30% in 1965 to 59% in 1971). Support for protection of human health from environmental threats may differ from support for environmental protection, but the differences often are insignificant, and they are treated as a single "environmental protection norm" throughout the remainder of the Article. *See* Riley E. Dunlap & Kent D. Van Liere, *Land Ethic or Golden Rule: Comment on "Land Ethic Realized" by Thomas A. Heberlien*, 33 J. Soc. Issues 200, 204-05 (1977); Thomas A. Heberlein, *A Rejoinder to R.E. Dunlap and K.D. Van Liere*, 33 J. Soc. Issues 207, 208 (1977).

143. *See* Ostrom, *supra* note 114, at 40-42 (noting the influence of an individual believing that she is a "sucker" and that "[r]eciprocity is viewed by sociologists, social psychologists, and philosophers as one of the basic norms taught in all societies"). *See* Carlson, *supra* note 115, at 1247-50 (reviewing results of studies of collective goods problems).

144. The personal norms of the VBN theory correspond to concrete norms. *See* Stern et al., *supra* note 136, at 85 (describing personal norms as "a sense of moral obligation that creates a predisposition to act").

145. *See, e.g.*, Sherman J. Clark, *The Courage of Our Convictions*, 97 Mich. L. Rev. 2381, 2394 (1999) (discussing wildlife protection values or norms); J. Stanley Black et al., *Personal and Contextual Influences on Household Energy Adaptations*, 70 J. Applied Psychol. 3, 17-18 (1985) (postulating different concrete norms for energy efficiency and curtailment, and distinguishing personal norms from social norms).

146. *Cf.* Geisinger, *Expressive Law*, *supra* note 133, at 55 (noting that "[c]urrent theories of expressive law have been criticized as . . . failing to provide a mechanism by which law can be predicted to have an expressive effect").

147. *See* Shalom H. Schwartz, *Moral Decisionmaking and Behavior*, *in* Altruism and Helping Behavior (J. MacCauley & L. Berkowitz eds., 1970).

148. *See, e.g.*, J. Stanley Black, Attitudinal, Normative, and Economic Factors in Early Response to an Energy-Use Field Experiment 274 (1978) (unpublished dissertation, University of Wisconsin) (available at Dissertation Abstracts International, 39, 436B) (on file with author) (concluding that "the norm-activation model is strongly supported, with personal norm, awareness of consequences, and the belief in the energy crisis having major impacts on intentions to conserve peak-period electricity"); Stern, *supra* note 126, at 469 (concluding that a pro-environmental norm accounted for 11% of the variation in energy conservation activities, whereas price accounted for 2%). *See also* Stern et al., *supra* note 136, at 85; Paul C. Stern et al., *Support for Environmental Protection: The Role of Moral Norms*, 8 Population & Envt. 204, 220 (1995) [hereinafter Stern et al., *Role of Moral Norms*]; Paul C. Stern et al., *Value Orientations, Gender, and Environmental Concern*, 25 Envtl. Behav. 322, 348 (1993); Kent D. Van Liere & Riley E. Dunlap, *Moral Norms and Environmental Behavior: An Application of Schwartz's Norm-Activation Model to Yard Burning*, 8 J. Applied Soc. Psychol. 174, 187 (1978).

149. *See* Van Liere & Dunlap, *supra* note 148, at 180, 187 (examining AC by asking for response to the statement that "[s]ome people say that the smoke from backyard burning makes it difficult for people with

bility for causing or preventing those consequences (commonly referred to as ascription of responsibility (AR)). The backyard burning study evaluated AR by asking whether the respondents believed that it was difficult or costly to avoid backyard burning.[150]

For an individual who holds an abstract personal norm, changes in beliefs concerning AC and AR relevant to the abstract norm will activate a concrete personal norm, producing a sense of duty to act consistently with the concrete norm and guilt if the norm is violated.[151] The sense of duty to act may arise even in the absence of a perceived likelihood of external social sanctions.[152] Of course, by changing the perceived likelihood of norm enforcement by others or by changing beliefs about the certainty of information, the norm-activating information also may increase or decrease the influence of social norms.[153]

Once activated, the sense of obligation arising from the concrete personal norm will then lead to the formation of a behavioral intention, which will induce the individual to behave in a particular way if other constraints do not impede action.[154] These constraints, ranging from the financial costs of behavior change, e.g., purchasing a less polluting car, to the physical effort required for the behavior, e.g., walking to a bus stop, to the social costs, e.g., the inability to signal social status with a large vehicle, in many cases will be substantial. Behaviors that have a direct effect on the environment, such as backyard burning or driving, however, should be distinguished from behaviors that have an indirect effect on the environment through their influence on government action, such as voting or working for a ballot initiative to fund mass transit. The former are direct environmental behaviors and the latter are civic behaviors. In many cases, civic behaviors will be more likely to change than direct environmental behaviors.[155]

Legal interventions must accomplish several types of belief change to activate norms. In particular, beliefs must be changed concerning the awareness of consequences and acceptance of responsibility relevant to a particular abstract personal norm. Legal theorists have argued that the law can change beliefs in at least two ways. First, the enactment of a law can change beliefs about the nature of the underlying social problem addressed, e.g., a smoking ban may change beliefs about the human health effects of smoking. Second, the enactment of a law can change beliefs about the existence of a social consensus regarding the problem (and thus increase the perceived likelihood of social and legal sanctions for certain behaviors). These expressive functions of law have been the subject of extensive treatment in the legal literature.[156]

The law also can have a third, more direct effect on belief change that has received less attention in the literature: the required disclosure of information that is targeted at the types of beliefs that activate norms. Careful targeting of the information generated by this direct informational regulatory approach may be necessary. In particular, when applied to environmental behaviors, legal interventions may be most effective if they change individuals' awareness of consequences and acceptance of responsibility related to the environmental protection and reciprocity norms.

The belief changes necessary for norm activation differ between the two norms. To activate concrete norms related to the abstract environmental protection norm, the legal measure should induce individuals to believe that the environmental problems caused by their behavior are significant (AC), and that if they change behavior these problems can be ameliorated (AR). Although gathering information on the contribution of any one individual often is prohibitively expensive and intrusive, information on the *mean* individual also may lead to norm activation.[157] In many cases the contribution of a single individual to an environmental problem over the course of a short period of time is miniscule, but the individual's contribution to the problem is more apparent if expressed over a year or a lifetime.[158] A recent work in the mass media accomplished this in dramatic fashion by dumping in the front yard of a suburban house the load of coal necessary to provide electricity to the average American household for a particular time period.[159] Another focused on household energy conservation by placing in the front yard of a house all of the goods in the house made from petroleum.[160] Despite the visual appeal of these examples, the environmental problems caused by any one individual's behavior often will be minimal even over the course of a lifetime, and will only be significant if the *aggregate* effects of all individuals are considered.

In sum, for an individual who holds the abstract norm of environmental protection, environmental norm activation theory suggests that the law can induce norm activation if new information induces the individual to believe that the *mean* individual's behavior or that individuals' behavior in the *aggregate* causes an environmental problem (AC) and that reductions in the behavior, e.g., backyard burning or driving, by the mean individual or by individuals in the aggregate will ameliorate the problem (AR). These belief changes will activate a concrete norm against engaging in the behavior. The individual will feel an obligation to en-

respiratory problems to breathe."); *see also* Stern et al., *supra* note 136, at 96 (asking if "toxic substances in air, water and soil" pose a "serious problem" for "you and your family," "the country as a whole," or "other species of plants and animals").

150. Van Liere & Dunlap, *supra* note 148, at 179-80 (examining AR by asking for response to the statement that "[s]ome people say that backyard burning should be allowed because many people are not able to take wastes to the dump and cannot afford to have them hauled to the dump"); *see also* Stern et al., *supra* note 136, at 83 (noting that AR refers to "the belief or denial that one's own actions have contributed to or could alleviate those consequences").

151. Although the norm activated is a particular concrete norm related to a more general abstract norm, to simplify the description of the process, this Article often refers to activation of the abstract norm, e.g., it refers to activation of the environmental protection norm.

152. *See* Paul C. Stern, *Toward a Coherent Theory of Environmentally Significant Behavior*, 56 J. Soc. Issues 407, 412 (2000).

153. *See* Richard McAdams, *A Focal Point Theory of Expressive Law*, 86 Va. L. Rev. 1649, 1720 (2000) (discussion of the relationship between personal norms and perceived norm enforcement).

154. This Article follows the approach of the VBN theory in accounting for other constraints on behavior. *See* Stern et al., *supra* note 136, at 86.

155. *See* Stern et al., *supra* note 136, at 82-91 (focusing on environmental citizenship, policy support, and private sphere behaviors).

156. *See* McAdams, *Norms*, *supra* note 105, at 343-47.

157. For some behaviors, the median individual may be more meaningful.

158. *See, e.g.*, Paul Slovic, The Perception of Risk 70-71 (2000) (noting that a risk expressed as a lifetime cumulative risk may be more likely to provoke a behavior change than one expressed on a per-occurrence basis).

159. *See* Kilowatt Ours (Jeff Barrie ed., 2004).

160. *See* Tim Appenzeller, *The End of Cheap Oil*, Nat'l Geographic, June 2004, at 80.

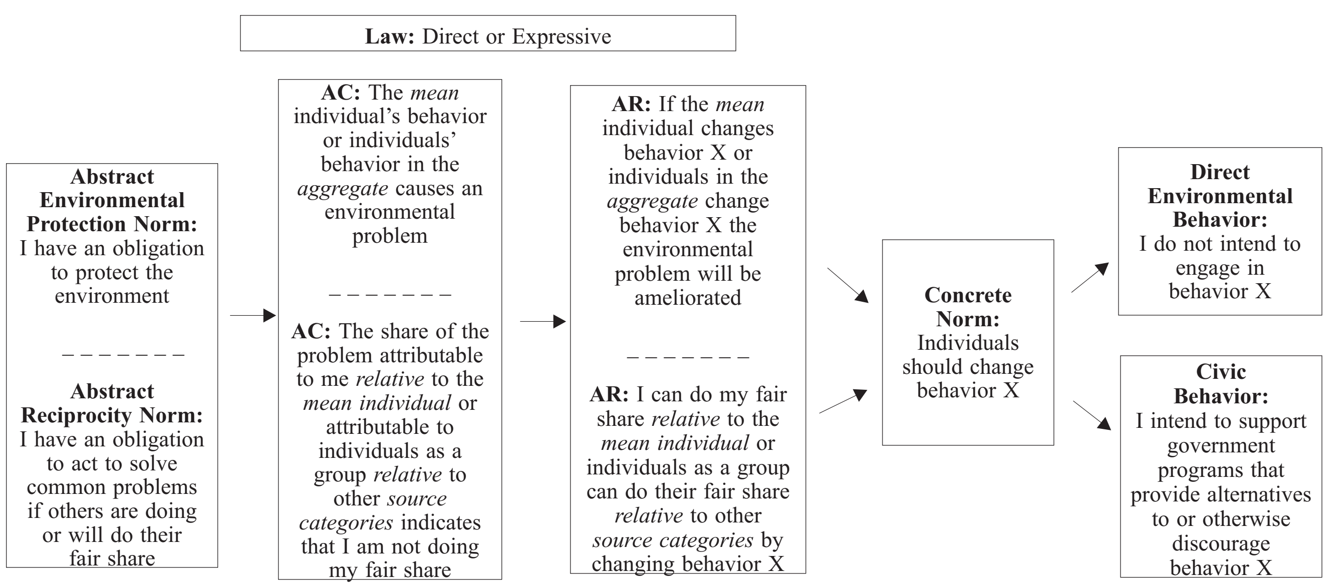
gage in either a direct environmental behavior or a civic behavior, and the individual will engage in the behavior absent other constraints.

Even if the new beliefs about the mean or aggregate environmental effects create a sense of obligation, the individual may not change behavior if she also believes that others are not doing their fair share.[161] "Others" in this case could mean other individuals or other source categories, e.g., industry or agriculture. Additional information may change the behavior of those who hold the reciprocity norm if the information leads the individual to believe that others either have reciprocated or will reciprocate cooperative acts, and thus that the individual is not a sucker.[162] To the extent the individual's reference point is other individuals, the information will be most influential if it induces the individual to believe that she is responsible for a meaningful *relative* share of the environmental problem (AC) as compared to the *mean individual*, and that because the mean individual has changed or will change behavior, doing her fair share to ameliorate the problem requires behavior change (AR).[163] If this information activates norms and changes behavior, the mean will decline over time, providing a downward ratchet on the measure against which individuals assess their behavior.[164]

To the extent the individual's reference point is other source categories, the information will be most influential if it induces the individual to believe that individuals in the aggregate are responsible for a meaningful *relative* share of the environmental problem (AC) as compared to other *source categories*, and that because other source categories have changed or will change behavior, individuals should change behavior to do their fair share to ameliorate the problem (AR). These beliefs about the consequences of and acceptance of responsibility for behavior will then tie the abstract reciprocity norm to concrete norms against those who do not do their fair share to solve collective problems. The product of this belief change will be norm activation and an increased likelihood that individuals will feel an obligation to change their behavior.[165]

In some cases, activating the environmental protection norm may be sufficient to induce an individual to change a direct environmental behavior, but in many cases change also may require activating the reciprocity norm.[166] In other cases, even if activation of both norms does not induce direct environmental behavior change, it may induce civic behavior change. Civic behavior change may be particularly important where the individual lacks control over the behavior or where changing the underlying direct environmental behavior, e.g., commuting by automobile, requires the individual to exert sustained or substantial effort. For these problems, norm activation may overcome the policymaker's dilemma by changing the civic behavior necessary to enable government to invest in financial incentives, e.g., bus subsidies, or new infrastructure, e.g., new mass transit systems. Figure 1 provides a schematic diagram of environmental norm activation.

Figure 1: Environmental Norm Activation



161. *See, e.g.*, Christopher Bratt, *The Impact of Norms and Assumed Consequences on Recycling Behavior*, 31 Envt. & Behav. 630, 631 (1999) (noting that data on environmental harms may be insufficient to induce behavior change without information that focuses on beliefs about others' contributions).

162. *See* Ostrom, *supra* note 114, at 40.

163. *See infra* notes 167-73 as to whether the others must be other specific individuals, individuals as a group, or other pollution source categories.

164. Although the mean also could shift upward over time, information about the shift will provide policymakers with an opportunity to respond. *See* discussion *infra* note 188.

165. The adaptations from the VBN theory can be seen by comparing the description in the text with Stern et al., *supra* note 136, at 84, fig.1. For brevity, the language used in the examples of direct environmental and civic behavior describe behavioral intentions. As discussed in the text, the Article assumes that absent other constraints behavioral intentions will lead to behavior.

Perhaps the most important challenge for the theory is whether norm activation will occur if an individual believes that all individuals in the aggregate cause an environmental problem but that the individual's personal contribution is inconsequential. The concern is that environmental protection norm activation may not occur if an individual believes that she personally does not cause a perceptible environmental problem, even if she believes that individuals do in the aggregate, and even if she believes that the mean individual will do so over an extended period. Similarly, reciprocity norm activation may not occur if the individual does not believe that her relative share of the problem is large, even if she believes that the aggregate individual share is large relative to other source categories, e.g., industry or agriculture, or if she believes that her personal share is large relative to the individual mean. This is a particularly difficult challenge because in most cases an individual's behavior will not cause a perceptible problem and her relative share will not be large, at least as compared to industrial sources. In addition, it is often prohibitively expensive and intrusive to generate information about the problems caused by specific individuals.

Several empirical studies in the social psychological literature, however, provide reason for cautious optimism. Studies of personal identity theory suggest that individuals tend to form categories to facilitate cognitive processing, and the categorization tends to lead individuals to ignore differences among the items assigned to a particular category and to accentuate the differences between the items in different categories.[167] This categorization extends to groups of people, and when an individual categorizes herself as a member of a group, she may view herself to be an example of the group as much as an autonomous individual.[168] Studies also indicate that information that makes an individual's group identity more salient can influence the personal norms that individuals apply to a given situation and can influence their behavior.[169] Although group identity typically relates to various subcategories of individuals, e.g., the elderly, baseball fans, or lawyers,[170] if given sufficient information individuals also may conceive of themselves as members of the individual category of polluters, as compared to other categories such as industry. If so, information that makes the individual's membership in the individual source category salient may enable information about the aggregate impacts of individuals to activate norms.

In addition, several empirical studies suggest that information about the aggregate effects of individual behavior can activate norms and change behavior. For example, the study of backyard burning discussed above found that increases in AC and AR were associated with personal norm activation and attendant decreases in backyard burning. The questions that examined AC and AR asked about aggregate effects: the harms caused by backyard burning in general, not the harms caused by the specific respondent's backyard burning.[171] A more recent study did not examine norm activation explicitly but asked respondents about three situations in which the researchers made it clear that although the respondent's individual behavior would not have a perceptible effect on an environmental problem, aggregate behavior change would.[172] The study concluded that many individuals will take some types of initial cooperative environmental action even in hard case situations.[173] Although further empirical work will be necessary, these studies suggest that information about the aggregate environmental effects of individual behavior may induce cooperative acts in some individuals, even if any one individual's contribution to the problem is inconsequential.

B. Implications: The ITRI

Environmental norm activation theory can enhance the evaluation of existing regulatory measures and the development of new ones. For example, several recent efforts are likely to activate norms, whether or not by design. One such program is the effort to label storm drains with information that runoff flows to a nearby water body. The information provided may increase the individual's awareness of the consequences of her actions, e.g., disposing of motor oil down a storm sewer, and the ascription of responsibility may be implicit in the message as well (it does not take a genius to conclude that not dumping motor oil in the storm sewer will help ameliorate the problem). Norm activation theory also has implications for efforts to require producers to take back consumer products at the end of their useful life. Depending on how these programs are structured, the infor-

166. Although the information about the *mean* and *aggregate* effects of behavior may be particularly important for the influence exerted by the abstract environmental protection norm, and the *relative* share information may be particularly important for the influence exerted by the abstract reciprocity norm, in some situations both types of information may affect both norms.

167. *See* Alex Geisinger, *A Group Identity Theory of Social Norms and Its Implications*, 78 Tul. L. Rev. 605, 632-34 (2004). Further testing of the effects of norms is necessary. *See* Stern et al., *supra* note 136, at 85 (noting that as of the late 1990s social scientists had developed at least six theories of the origins of environmentalism but had not compared their predictive capacity).

168. Geisinger, *supra* note 167, at 635.

169. *See id.* at 630-31 (noting a study that concluded that individuals who were induced to view themselves as "elderly" walked more slowly than those who were not exposed to the same information).

170. *See* Geisinger, *supra* note 167, at 632-39.

171. *See* Van Liere & Dunlap, *supra* note 148, at 180 (including "some people" and "the smoke from backyard burning" in a question asked to assess AC and "other sources" in a question asked to assess AR). Although Van Liere and Dunlap found that both AR and AC were related to yard burning behavior, the association with AC was indirect. *Id.* at 184-85. In one study, Stern and colleagues defined AC on solely individual terms. Stern et al., *supra* note 136, at 83 (referring to whether "one's own actions" cause harm as the issue to be queried to assess AC). They also asked questions about AC that are more general, however. *Id.* at 96 (asking the respondent about "the problem of toxic substances in air, water and the soil" rather than about her personal contribution to the problem). They concluded that beliefs about AC held on this general level were much more strongly correlated with changes in civic behavior than with changes in consumer behavior.

172. *See* Pellikaan & van der Veen, *supra* note 127, at 205-06. The study was conducted in the Netherlands and included roughly 900 respondents.

173. *See id.* Two of the behavior changes, taking household chemical waste to recycling centers and reducing home energy use, involved small, although not insubstantial, costs to the individual. The third situation, changing holiday travel, involved more substantial costs to the individual. *Id.* at 73. *See also* Johannes Moisander, *Attitudes and Ecologically Responsible Consumption: Moral Responsibility and Concern as Attitudinal Incentives for Ecologically Sound Consumer Behavior*, *in* Tutkimuksia Forskningsrapporter Research Reports 218 (1996) (concluding that consumers will purchase green products only to the extent doing so constitutes their "fair share" of pro-environmental behavior).

mation conveyed to the individual through take-back programs could increase AC and AR, or it could simply perpetuate the view that industry bears sole responsibility for environmental harms, even when harms arise from disposal of consumer products.[174]

Looking through the lens of environmental norm activation also can generate new regulatory measures. The TRI release-reporting scheme included in the Emergency Planning and Community Right-To-Know Act (EPCRA) provides a model for one such measure. In particular, release reporting can be directed at individual behavior in a way that will provide the types of information necessary to activate norms with less cost and government intrusion than traditional command-and-control measures. Norm activation, in turn, may begin the process of changing behavior in easy and hard case situations.

The TRI provisions of EPCRA require large industrial facilities to report releases of TRI-listed toxic chemicals. EPA has not required individuals to complete the TRI reporting form for toxic chemical releases, and EPCRA does not appear to authorize EPA to do so.[175] Although EPA could simply collect and report data on individual and household emissions on its own initiative, a statutory amendment to the TRI provisions to require EPA to expand the TRI release reporting concept to individuals may be preferable.[176] In particular, Congress could amend the TRI provisions of EPCRA to create an ITRI.

The ITRI amendments could encompass the toxics that are now subject to TRI reporting by industrial facilities and the approach of requiring disclosure of the quantities of chemicals released. Rather than imposing TRI-type reporting requirements on individuals, the ITRI could require EPA to gather toxic release information by conducting an annual survey of individuals and households.[177] Although individuals are often not aware of the toxics they release, the surveys could gather information on activity types and levels, e.g., hours of lawnmower use, and could include a sufficiently large sample size to enable state-by-state and regional variations to be detected. EPA could validate the survey results with more intensive, focused studies. EPA could then use emissions factors, e.g., the pounds of pollutant X released per hour of lawnmower use, to convert activity levels to toxic chemical release amounts.[178]

The ITRI could require EPA to compile and disseminate several types of information for each toxic chemical: (1) mean individual and household releases; (2) aggregate releases from all individuals; and (3) the types of individual behaviors that release the largest quantities. The ITRI also could require EPA to provide the data in a format that would enable comparisons of the aggregate individual releases with the industrial releases currently subject to TRI reporting requirements. EPA also could provide the mean, aggregate, and relative data on a state-by-state and regional basis.

The ITRI also could require EPA to release the individual data at the same time and in the same documents as the current TRI large industrial facility data. By piggybacking on the news peg formed by the annual TRI data, the ITRI should receive widespread newspaper, television, and radio coverage. Environmental and industry interest groups should be able to use the data in reports targeted at the public and policymakers. The ITRI data also should stimulate a secondary market for environmental information. Government agencies and private organizations should be able to include the data in reports that now often ignore individual behavior as a source category altogether.

To focus the public debate on the most important toxics, the ITRI ideally would include information about risk creation, not just the quantities of toxics released. As with data on the risk created by industrial toxic releases, however, publishing data about individual and household risk creation often would require information that is currently unavailable. Nevertheless, identifying quantities released is an important first step in the process of assessing the risks posed by individual behavior.[179] The ITRI data would provide a starting point for government agencies, academicians, and interest groups to prepare and debate risk characterizations and to evaluate trends over time.[180] Table 5 provides a sample ITRI for air toxics.

174. For example, proposed TRI reforms regarding consumer products often are directed solely at the firms that produce the consumer products, not the individuals who use them. *See*, *e.g.*, NATIONAL ENVIRONMENTAL TRUST, CABINET CONFIDENTIAL: TOXIC PRODUCTS IN THE HOME (2004) (advocating product content disclosure by industry). For recent reviews of take-back proposals, see Noah Sachs, *Planning the Funeral at the Birth: Extended Producer Responsibility in the European Union and the United States*, 30 HARV. ENVTL. L. REV. (forthcoming 2006); Megan Short, *Taking Back the Trash: Comparing European Extended Producer Responsibility and Take-Back Liability to U.S. Environmental Policy and Attitudes*, 37 VAND. J. INT'L L. 1217 (2005).

175. The statutory language provided in EPCRA §313 limits reporting to large industrial facilities. *See* 42 U.S.C. §11023(b)(1)(A). The legislative history also doesn't appear to support inclusion of individuals in the current TRI program. *See* Vandenbergh, *Order Without Social Norms*, *supra* note 1, at 1147.

176. Putting aside EPCRA §313, it is unclear whether EPA has the inherent authority to collect data on individual releases of toxics. *See, e.g.*, William F. Pedersen, *Regulation and Information Disclosures: Parallel Universes and Beyond*, 25 HARV. ENVTL. L. REV. 151, 171-72 (2001) (reviewing authority of federal agencies to gather and report on data).

177. *See id.* at 153, 168-69 (proposing small business toxics survey).

178. *See* U.S. EPA, *Compilation of Air Pollutant Emission Factors*, *at* http://www.epa.gov/otaq/ap42.htm (last visited Aug. 21, 2005) (using emissions factors to estimate air emissions); U.S. GENERAL ACCOUNTING OFFICE (GAO), AIR POLLUTION: EPA SHOULD IMPROVE OVERSIGHT OF EMISSIONS REPORTING BY LARGE FACILITIES 3 (2001) (GAO-01-46) (available from the ELR Guidance & Policy Collection, ELR Order No. AD04973) (noting that approximately 80% of the air pollutant emissions reported nationally are estimated from emissions factors).

179. *See* 2003 NRC REPORT, *supra* note 72, at 17.

180. Table 5 allocates toxic chemical releases to individuals where individuals have a substantial degree of control over the releases, including private motor vehicle use and residential electricity use.

Table 5: Sample ITRI for Air Toxics[181]

Chemical	*Mean Individual Amount*	*Aggregate Individual Amount*	*Aggregate Industrial Amount*	*Individual Relative Share*
Acetaldehyde	2.36	20,598	6,410	76.3%
Acrolein	0.38	3,295	41	98.7%
Benzene	23.20	203,751	4,092	98.0%
1,3-Butadiene[182]	2.65	23,279	1,347	94.5%
Dioxin	2.46	692	414	62.6%
Formaldehyde	6.21	54,489	5,765	90.4%
Mercury	3.82	33,538	117,925	22.1%

As Table 5 demonstrates, individuals release substantial quantities of these toxics in the aggregate and in some cases a relative share that is far more than all large industrial sources combined.[183] Not surprisingly, the mean individual releases are generally small, often only several ounces per year, although they provide a valuable benchmark for assessing changes over time. In addition, if expressed over a lifetime, the totals are often striking, e.g., the 3.82 ounces of mercury per year translate to almost 17 lbs. over a 70-year lifetime. The individual behaviors that release the toxics included in the sample ITRI range from backyard burning of garbage (the leading source of dioxin), to automobile use (a leading source of acetaldehyde, acrolein, benzene, and formaldehyde), to residential electricity use (a leading source of mercury).

1. Effects of ITRI Data on Individual Behavior

The potential effects of the ITRI information on direct environmental behavior can be evaluated by examining the release of dioxin from backyard burning. The ITRI would provide data regarding individuals' mean and aggregate releases of dioxin and the types of behavior that cause the releases. The subsequent debate about the effects of individuals' dioxin releases would provide information about the risks created by these releases. The data on the *mean* and *aggregate* quantities of toxics released by private individuals may be particularly important for linking the abstract environmental protection norm to concrete norms against specific individual behaviors, such as burning garbage in backyard barrels.

The norm activation process for dioxin would occur in several steps. First, information would be conveyed through media stories that report on the ITRI data, as well as government and interest group follow-up reports. The individual would then form a new belief about the consequences of backyard burning (AC). Government- or interest group-generated information would then identify steps that individuals can take to ameliorate the problem. This information would change beliefs about the individual's responsibility for reducing the releases of dioxin through backyard burning (AR). The belief change would activate a concrete norm against backyard burning and the individual would feel an obligation to act.[184]

As discussed above, the effect of belief change on norms regarding backyard burning has been examined empirically, although the study examined the burning of yard waste, not garbage.[185] The study concluded that those who believe that adverse consequences (AC) arise from backyard burning and believe that they could reduce those adverse consequences (AR) burned less.[186] The effects of the ITRI information on backyard garbage burning are likely to be at least as pronounced, given the toxicity of dioxin and of other chemicals released from garbage burning.[187]

Nevertheless, in many cases activation of the environmental protection norm alone may be insufficient for behavioral change. In particular, individuals may not act if they conclude that others have not done or will not do their fair share. Reciprocity norm activation may be necessary in these situations. The ITRI may accomplish this task by providing data from which individuals can assess the dioxin releases by all individuals relative to other source categories and their own behavior relative to the mean individual. Norm entrepreneurs will have the information necessary to frame arguments for individual change in terms of individuals' "fair share" in response to actions taken by other pollut-

181. All aggregate totals are for 1996, and the mean individual figure is the estimated total toxic chemical releases for individuals in 1996, divided by 281 million, the United States in 2000. *See* U.S. EPA, PBT List, *supra* note 11. With the exception of dioxin, all mean totals are in ounces and all aggregate totals are in tons. For the methodology used to calculate the aggregate individual amounts of acetaldehyde, acrolein, benzene, formaldehyde, mercury, and 1,3-butadiene, *see supra* notes 22 and 27, and *infra* note 182. The dioxin estimate includes all dioxin and dioxin-like compounds and the aggregate totals are expressed in gTEQs, not tons. *See* NIM Dioxin Report, *supra* note 12, tbl. A-28. The mean individual total for dioxin is expressed in millionths of a gTEQ. The categories included as individual dioxin emissions are "backyard barrel burning, air," "residential wood burning, air" and "cigarette smoke, air," and the total for industrial emissions is the total of all other dioxin emissions from the National Institutes of Medicine report, not from TRI data. *See id.* tbl. A-28. All dioxin figures are for 2002 to 2004. *Id.*

182. Mobile sources comprised approximately 60% of all 1,3-butadiene emitted in the United States in 1996, or 41.8% of the total national emissions. *See* U.S. EPA, Mobile Source Projection, *supra* note 20, tbls. 5 & 8. Based on mobile source emissions alone, individuals emitted 23,279.6 tons of 1,3-butadiene in 1996. TRI air emissions of 1,3-butadiene were only 1,347 tons in 1996, or 2.4% of the total national amount of 1,3-butadiene emitted. *See* U.S. EPA, *1996 TRI Explorer Database*, *supra* note 25. In 2007, the volume of 1,3-butadiene emitted from mobile sources is expected to decrease 43% from 1996 levels. *See* U.S. EPA, Mobile Source Projection, *supra* note 20, tbl. 4. Nevertheless, in 2007 the motor vehicles of private individuals are projected to emit 12,453.9 tons of 1,3-butadiene, or 69.1% of the emissions from all mobile sources. *Id.* tbls. 5 & 8.

183. For some toxics, other categories of sources such as small businesses may comprise a large percentage. As is the case with TRI, however, these sources are not accounted for in this analysis.

184. Of course, even if the information provided is accurate, complete, and clearly communicated, the public will not necessarily act rationally in response. *See* Richard B. Stewart, *A New Generation of Environmental Regulation?*, 29 Cap. U. L. Rev. 21, 141-43 (2001).

185. *See* Van Liere & Dunlap, *supra* note 148, at 179-80, 187.

186. *Id.* at 184-85 (finding that significant zero-order relationship existed between AR and yard burning behavior and that AC is indirectly involved, and noting that due to widespread media coverage "the negative consequences of burning were made so obvious that differences in awareness had little effect").

187. *See* Stern et al., *Role of Moral Norms*, *supra* note 148, at 220 (concluding that awareness of consequences regarding human health effects of toxics can activate norms against harming innocent people).

ing sectors.[188] The sample ITRI provided in Table 5 demonstrates that individuals in the aggregate release far more dioxin than do all large industrial sources combined. Moreover, as Table 1 earlier in the Article demonstrates, if the ITRI data had been in place since 1987, the comparisons over time would demonstrate that dioxin emissions from individuals have increased slightly, while industrial sources have reduced emissions dramatically. The relative share data should change beliefs regarding the individual's share of dioxin releases as compared to the mean individual, and all individuals' relative share (AC) as compared to large industrial sources. The ITRI and the secondary information market will identify the steps individuals could take to reduce their share as compared to large industrial sources (AR). Changes in beliefs about these issues should link the abstract reciprocity norm to concrete norms regarding backyard burning and other dioxin-releasing behaviors.

In addition to changes in direct environmental behavior, the ITRI information may induce changes in civic behavior, such as voting or expressing support for government investments or policy changes.[189] Studies suggest that less normative influence is often needed to change civic behaviors than direct behaviors.[190] The ITRI information thus may build public support for government investments even when it does not change the underlying direct behavior.

2. Effects of ITRI on the Allocation of Regulatory Resources

The ITRI also would enable government officials to make more informed regulatory targeting decisions and to evaluate the effectiveness of those measures. The data on overall quantities of toxic chemicals released by individuals in the sample ITRI do not indicate that a regulatory response is required for any one chemical, but they raise a red flag, much like the red flag that was raised when the TRI data were first released in 1989. EPA staff at that point indicated that the quantities of industrial toxic chemical releases were "startling," and various risk assessment and risk management steps were then taken.[191] The ITRI information may have the same effect on policymakers that the TRI information had in 1988: it may open regulators' eyes to the magnitude of the source and the need to reexamine regulatory priorities.

IV. Conclusion and Implications

Rational risk regulation has been the focus of extensive debate among academicians and policymakers over the last two decades. In its simplest form, rational risk regulation seeks to allocate regulatory resources in ways that best serve societal interests.[192] Rational risk regulation enthusiasts have argued that government should improve priority setting through more rational approaches to reducing environmental risks.[193] They point to methods ranging from greater use of cost-benefit analysis,[194] to accounting for risk-risk tradeoffs,[195] to the use of regulatory budgets. Critics suggest that rational risk regulation often does not emerge from greater use of cost-benefit analysis and the other favored tools of rational risk regulation enthusiasts. In particular, they argue that shortcomings in the quantification of costs and benefits may lead to less, rather than more, rational regulatory priority setting.[196]

Although the debate over the particular methodology for evaluating regulatory options is critically important, it is also important not to lose sight of the fact that the debate concerns only one of the steps in the process of developing a rational response to various societal risks. If we take a step back from questions about the attributes of cost-benefit analysis and ask more broadly whether we are deploying rational approaches to regulation, an important but often overlooked question emerges: have we adequately identified the sources of the risks we are seeking to ameliorate? In fact, EPA's *Guidelines for Preparing Economic Analyses* reflect this basic step. The guidelines indicate that the initial problem identification in an economic analysis of environmental policy should include a discussion of the "private and public sector sources responsible for creating the problem."[197]

The regulatory debate and many analyses of specific environmental regulations often give only cursory attention to the sources of any given environmental risk.[198] The data pre-

188. The ITRI data will make it more possible for government and non-profit groups to develop reports and other ways of educating individuals about how their behavior compares to the mean. Some of these efforts are already underway. *See, e.g.*, Airhead, *Emissions Calculator*, *at* http://www.airhead.org (last visited Aug. 21, 2005) (providing web-based calculator of individual air emissions).

189. The ITRI also may save public funds by reducing the financial incentives necessary to change targeted behaviors. *See* Stern, *supra* note 126, at 473-74 (noting that financial incentives are important, but that information at some point may predict more variance than the size of the financial incentives). As Stern notes, in these situations, "[r]esponse to a financial incentive cannot be adequately modeled by applying a standard estimate of the price elasticity of demand." *Id.*

190. *See, e.g.*, *id.* at 466 (noting that "[w]hen capabilities and constraints strongly predispose for or against action, attitudes and other personal-domain variables matter little in the short-run, even though in the longer run they may impel people to political or other actions to gain needed capabilities or remove constraints").

191. *See* Vandenbergh, *Order Without Social Norms, supra* note 1, at 1164 n.262.

192. W. Kip Viscusi, Rational Risk Policy 2 (1998).

193. *See*, *e.g.*, Stephen Breyer, Breaking the Vicious Circle: Toward Effective Risk Regulation (1993); Cass R. Sunstein, Risk and Reason: Safety, Law, and the Environment (2002).

194. *See*, *e.g.*, Robert W. Hahn & Cass R. Sunstein, *A New Executive Order for Improving Federal Regulation? Deeper and Wider Cost-Benefit Analysis?*, 150 U. Pa. L. Rev. 1489, 1494 (2002).

195. *See*, *e.g.*, Risk Versus Risk: Trade Offs in Protecting Health and the Environment (John D. Graham & Jonathan Baert Wiener eds., 1995).

196. *See*, *e.g.*, Lisa Heinzerling & Frank Ackerman, Pricing the Priceless: Cost-Benefit Analysis of Environmental Protection 14 (2002) (noting the importance of nonquantifiable information); Sidney A. Shapiro & Robert L. Glicksman, Risk Regulation at Risk 49-66 (2003) (providing a pragmatic critique of economic rational risk regulation methodologies); Lisa Heinzerling, *Regulatory Costs of Mythic Proportions*, 107 Yale L.J. 1981, 2042-64 (1998) (noting subjective determinations involved in assessing costs and benefits of regulations).

197. Office of the Administrator, U.S. EPA, Guidelines for Preparing Economic Analyses 9 (2000) (EPA 240-R-00-003).

198. Proponents of cost-benefit analysis often suggest that environmental regulations achieve disproportionately low benefits in contrast to other, unrelated means of reducing risk or improving welfare, *see, e.g.*, Breyer, *supra* note 193, at 19 (comparing the costs of environmental regulations to "the need for better prenatal care, vaccinations, and cancer diagnosis, let alone daycare, housing, and education"), yet they rarely examine whether regulatory schemes addressed to other sources of the same environmental risks might generate more cost-effective solutions. *See, e.g.*, Hahn & Sunstein, *supra* note 194, at 1492 (identifying the costs of implementing the ozone national

sented in this Article suggest that after more than 30 years of regulation largely directed at industry, individual behavior now accounts for a remarkably large share of the emissions of many pollutants. Furthermore, although influencing individual behavior will be difficult, information-based measures, and particularly those designed to activate environmental norms, either alone or in combination with economic and formal legal measures, offer the prospect of behavior change at relatively low cost. The difficulties of changing individual behavior are substantial, but they are not so great that individual behavior should not take its place as a source category next to large industrial sources, agriculture, small business, government, and other sources of pollution.

At least three implications arise from treating individual behavior as a discrete source of pollution. The first involves regulatory changes. EPA and other federal agencies will need to refocus data gathering and analysis in ways that enable regulators and the public to understand the individual contribution to environmental risks. EPA and other agencies also will need to place greater emphasis on developing the regulatory tools that can influence individual behavior, as well as the staffing, resources, and organizational structure necessary to design and implement those tools. If misuses of information are to be avoided, a better understanding will be required of the appropriate role of government in creating and activating norms. A deep ambivalence about whether government should be in the business of norm shaping or norm activation is probably healthy. Certainly history provides examples of egregious uses of norm campaigns. The Administrative Procedure Act (APA) constrains agency behavior when an agency engages in notice-and-comment or adjudicatory rulemaking, but information disclosure and norm campaigns often are not subject to APA procedural protections.[199] Amendments may be required to extend APA procedural protections to agency efforts that use information to change behavior.

Second, understanding individual environmental behavior may be a predicate to addressing unsustainable levels of consumption. Ultimately, environmental scholars and policymakers will need to grapple with the relationship between consumption and environmental risks. Interest in this topic has been largely displaced by more urgent efforts to regulate large industrial sources over the last three decades, but it is beginning to reemerge in the legal literature and in other fields.[200] Whether the resource involves fisheries, wetlands, arable land, fresh water, or energy, viewing individuals as a source of environmental risks will facilitate the development of the behavioral models and regulatory measures necessary to achieve sustainable levels of consumption.

Finally, the focus on individual behavior may enhance efforts to change the behavior of other sources of pollution. Private firms behave largely as profit-maximizers, but they function through owners, directors, managers, and employees, all of whom are influenced by personal and social norms.[201] Many small businesses, small farmers, and other new generation sources may behave in ways that more closely resemble individuals than large industrial firms. The effort to understand the social influences on individual behavior may generate more cost-effective—and therefore often more rational—measures for regulating these other sources as well.

ambient air quality standard, which are almost exclusively costs imposed on industrial sources and automobile manufacturers).

199. *See* 5 U.S.C. §553.

200. *See* sources cited *supra* note 8.

201. *See* Cohen, *supra* note 9; Farber, *supra* note 9; Michael P. Vandenbergh, *Beyond Elegance: A Testable Typology of Norms in Environmental Compliance*, 22 Stan. Envtl. L.J. 55, 71-72 (2003).