2007

Overcoming the Behavioral Impetus for Greater U.S. Energy Consumption

John C. Dernbach

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I. INTRODUCTION

The subtitle of a recent book by Alfred W. Crosby, "A History of Humanity's Unappeasable Appetite for Energy,"[1] squarely addresses the relationship between human development and energy consumption. Crosby, a historian, describes human history as a story about the continuing growth in human ability to extract energy from nature. It started with the discovery of fire; cooked food enables humans to absorb more of that food's energy.[2] Another major advance was agriculture, which is a much more efficient way of extracting calories from the

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* Professor of Law, Widener University. Librarian Ed Sonnenberg conducted a very helpful literature search for this article. Thanks to Dan Farber for reviewing a draft. Comments or questions can be addressed to jcdernbach@widener.edu.

1. ALFRED W. CROSBY, CHILDREN OF THE SUN: A HISTORY OF HUMANITY'S UNAPPEASABLE APPETITE FOR ENERGY (2006).

2. *Id.* at 12-13.

environment than hunting and gathering.[3] The story then moves from food energy to mechanical energy, drawn first from coal, then oil, and more recently nuclear power, all capable of doing vastly more work than human or animal muscle power.[4] The scale of this growing energy use, which has made possible vast increases in human population and economic activity, is enormous. Another historian, J.R. McNeil, points out that humans used one-third more energy in the twentieth century than they had in the preceding 10,000 years.[5]

This trend toward increasing energy consumption flies straight in the face of a great many challenges to greater energy production, including the increasing cost and difficulty associated with extracting, transporting, and safeguarding oil and natural gas; higher energy prices; and the environmental and public health consequences of growing energy use, especially climate change. Crosby believes that energy consumption cannot simply keep growing at this rate; supplies, environmental impacts, and population growth will operate as brakes, he argues.[6] He is not alone. A great many writers have described the risks of growing energy consumption.[7]

When the world's nations agreed to work toward sustainable development at the United Nations Conference on Environment and Development in 1992, they concluded that the two greatest challenges to sustainable development are population growth and increased consumption.[8] Sustainable development would foster human quality of life and well-being by reconciling and furthering national and international goals for peace and security, social development, economic development, *and* environmental protection.[9] According to demographers, world population is likely to grow from 6.5 billion at present to more than 9 billion in 2050, and then begin to decline sometime after 2050 from the peak.[10] Whatever

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3. *Id.* at 40.

4. *Id.* at 63-100, 127-46.

5. J.R. MCNEIL, SOMETHING NEW UNDER THE SUN: AN ENVIRONMENTAL HISTORY OF THE TWENTIETH-CENTURY WORLD 15 (2000).

6. CROSBY, *supra* note 1, at 161-63. *But see* PETER W. HUBER AND MARK P. MILLS, THE BOTTOMLESS WELL: THE TWILIGHT OF FUEL, THE VIRTUE OF WASTE, AND WHY WE WILL NEVER RUN OUT OF ENERGY xxvi (2005) ("Humanity is destined to find and consume more energy, and still more, forever.").

7. *See, e.g.,* RICHARD M. HAASS, THE OPPORTUNITY: AMERICA'S MOMENT TO ALTER HISTORY'S COURSE 134-35 (2005); Daniel Yergin, *Ensuring Energy Security*, FOREIGN AFFAIRS, Mar./Apr. 2006, at 69.

8. U.N. Conference on Environment and Development, Rio Declaration on Environment and Development, UNCED, U.N. Doc. A/CONF.151/5/Rev.1, 31 I.L.M. 874, principle 8 (1992), *available at* http://www.unep.org/Documents.multilingual/Default.asp?DocumentID=78&ArticleID=1163 ("To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies."); U.N. Conference on Environment and Development, Agenda 21, ¶ 4.3, U.N. Doc. A/CONF.151.26, ("the major cause of the continued deterioration of the global environment is the unsustainable pattern of consumption and production, particularly in industrialized countries").

9. John C. Dernbach, *Sustainable Development as a Framework for National Governance*, 49 CASE W. RES. L. REV. 1 (1998).

10. UNITED NATIONS POPULATION FUND, STATE OF WORLD POPULATION 2006 at 98 (2006), *available at* http://www.unfpa.org/swp/2006/pdf/en_sowp06.pdf.

comfort one may derive from that projection, there is no comparable projection for stabilizing and then reducing world energy consumption (or the impacts of that consumption).

The United States produces and consumes more energy than any country in the world, now or in history. The United States also emits more greenhouse gases than any other country.[11] Energy consumption is expected to grow by an average of 1.1% per year between 2004 and 2030.[12] Per capita energy consumption in the United States is also high—more than double than that of the average Western European and ten times that of the average Chinese.[13] Of course, people in developing countries—where most of the world's population growth occurs—aspire to a lifestyle that is inspired, to a great degree, by large and increasing energy consumption in the United States. Thus, the reality of ever-growing energy consumption is on a collision course with many constraints and risks.

The key to preventing such a collision is to distinguish energy itself from the services it provides. People don't want kilowatts of electricity or gallons of gasoline; they want warm showers and cold beer.[14] Energy efficiency involves doing the same amount of work, or producing the same amount of goods or services, with less energy.[15] Conservation, a broader term, simply involves the use of less energy.[16] Thus, if energy services could be provided with much greater efficiency, and the need for energy services could be reduced, quality of life could continue to improve while using less energy.

This article builds on another recent article. The other article, which grew out of a seminar, argues that the United States could stabilize and begin reducing its energy consumption over the next several decades.[17] That article also describes a variety of legal and policy tools for energy efficiency and energy conservation that could be employed to achieve that objective. These tools and approaches

11. U.S. DEP'T OF STATE, U.S. CLIMATE ACTION REPORT—2002: THIRD NATIONAL COMMUNICATION OF THE UNITED STATES OF AMERICA UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE 14 (2002), *available at* http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SHSU5 BWHU6/ $File/uscar.pdf [hereinafter CLIMATE ACTION REPORT 2002]; George W. Bush, President Bush Discusses Global Climate Change (June 11, 2001), *available at* http://www.whitehouse.gov/news/releases/2001/06/20010611-2.html (last visited May 19, 2007).

12. U.S. DEP'T OF ENERGY, ENERGY INFO. ADMIN., ANNUAL ENERGY OUTLOOK 2006 WITH PROJECTIONS TO 2030 at 136 (2006), *available at* http://www.eia.doe.gov/oiaf/aeo/index.html [hereinafter ANNUAL ENERGY OUTLOOK 2006].

13. U.S. DEP'T OF ENERGY, ENERGY INFO. ADMIN., INTERNATIONAL ENERGY ANNUAL 2003, Table E.1c, World Per Capita Total Primary Energy Consumption (Million Btu), 1980-2003 (2005*), available at* http://www.eia.doe.gov/pub/ international/iealf/tablee1c.xls (last visited June 21, 2006).

14. L. HUNTER LOVINS, NATURAL CAPITALISM: PATH TO SUSTAINABILITY? 4 (2004), *available at* http://rmi.org/images/other/Businesses/NC01-30_NatCapPathToSus.pdf.

15. NAT'L ENERGY POL'Y DEVELOPMENT GROUP, NAT'L ENERGY POL'Y 1-3 (2001), *available at* http://www.whitehouse.gov/energy/National-Energy-Policy.pdf.

16. *Id.*

17. John Dernbach, *Stabilizing and Then Reducing U.S. Energy Consumption: Legal and Policy Tools for Efficiency and Conservation*, 36 ENVTL. L. REP. 10,003 (2007), *available at* http://ssrn.com/abstract=957061.

include improving efficiency in existing buildings, greater use of rail freight, transit-oriented development, taxation of transportation fuels, real-time pricing for electricity to encourage energy efficiency, and public-benefit funds. The article reviews many of the studies on the potential for improvements in energy-efficiency. Though some of these studies indicate that energy consumption in particular sectors can be stabilized and reduced, no recently published studies examine the entire economy. Studies that indicate some potential for improvement, moreover, invariably rely on a limited menu of legal and policy tools. Thus, there is substantial reason to believe that overall energy consumption could be stabilized and reduced by employing a comprehensive portfolio of tools and approaches.[18]

This article addresses the same problem from a somewhat different direction. In November 2005, the Environmental Law Reporter published a symposium entitled *The Next Environmental Frontier: Individual and Household Environmental Behavior.*[19] The symposium brought together a number of scholars who have made significant contributions at the crossroads of environmental law and individual behavior. This article's object is to use the symposium as a primary lens through which to gain greater understanding into how law can be used to stabilize and reduce energy consumption. Its thesis, based on the symposium and supplemented with work by economists and social scientists on energy efficiency, is that many opportunities exist to influence individual behavior to increase energy efficiency and reduce energy consumption. More broadly, the options suggested by this literature provide an important bridge between purely regulatory approaches and purely voluntary approaches. They provide a way of addressing the seemingly intractable problem of individual choices that lead to greater and greater energy consumption. To be sure, a variety of technological, economic, legal, and other barriers to energy efficiency also exist.[20] Thus, the approaches suggested here are largely in addition to those needed to overcome these other obstacles. The object here is simply to sketch what could be done to overcome the behavioral barriers, particularly in the United States.

Part II of this article describes three major laws or types of laws that are employed in the United States to foster energy efficiency and shows how the effectiveness of each of these laws is constrained by growing consumption. Part III provides a brief overview of the key insights of the symposium. Part IV suggests a set of options for reducing energy consumption that draws on this symposium. While there are good arguments to be made for each of the options identified in this part, the key point is that empirical study of individual behavior

18. *Id.*

19. Symposium, *The Next Environmental Frontier: Individual and Household Environmental* Behavior, 35 ENVTL. L. REP. 10, 723 (2005).

20. Udo Bacchiesl, Measures and Barriers Toward a Sustainable Energy System (2004), *available at* http://www.wec-austria.at/en/files/download/bachhiesl0904.pdf.

can help address the most seemingly intractable challenges to sustainable development, including that of growing energy consumption.

II. MAJOR FEDERAL LAWS FOR GREATER EFFICIENCY

In the United States, significant efforts have been made over several decades to use law to improve energy efficiency in three areas: appliances and related equipment, buildings, and motor vehicles. These three energy uses involve approximately 56% of the nation's overall energy consumption.[21] The efficiency of industrial production and electricity-generating plants, which also consume significant amounts of energy, are outside the control of individual purchasing decisions. Thus, these three energy uses actually capture a much higher fraction of the energy consumption that is driven by individual decisions. These three efforts provide a sense of the strengths and weaknesses of existing law to address energy efficiency and energy consumption, including the particular behavioral barriers that exist.

A. Appliances

1. Appliance and Equipment Efficiency Standards

Federal efficiency standards for appliances and other equipment were first required by the National Appliance Energy Conservation Act of 1987.[22] The Act establishes energy efficiency standards for certain consumer products and authorizes the Department of Energy ("DOE") to set new or amended energy conservation standards for a variety of consumer products, including refrigerators, washing machines, and clothes dryers.[23] New or amended standards are to be based on the "maximum improvement in energy efficiency. . .which the Secretary determines is technologically feasible and economically justified."[24] As a consequence, standards have been established (and often subsequently made more stringent) for a variety of appliances.[25] The DOE is also required to adopt testing procedures for the standardized determination of energy efficiency and

21. Residential and commercial buildings are responsible for about 38% of the nation's energy consumption, and gasoline from motor vehicles another 16%. ANNUAL ENERGY OUTLOOK 2006, *supra* note 12, at 134-35.

22. Pub. L. 100-12, 101 Stat. 103, codified at 42 U.S.C. §§ 6291-97, 6299, 6302, 6303, 6305, 6306, 6308, & 6309 (2006).

23. 42 U.S.C. § 6295 (2006). Water conservation standards are also authorized. Water conservation furthers energy efficiency to the extent that it reduces the amount of water that needs to be heated or cooled.

24. § 6295(o)(2)(A). The Energy Policy Act of 2005 requires new or more stringent standards for a variety of products, as well as commercial and industrial equipment. Energy Policy Act of 2005 § 136; 42 U.S.C. § 6311-6316 (2006).

25. 10 C.F.R. § 430.32 (2006). There are also water conservation standards for water closets and urinals, which do not ordinarily involve heating or cooling of water. 10 C.F.R. § 430.32(q) & (r).

energy use for particular products.[26] Another agency, the Federal Trade Commission, is required to adopt labeling rules based on energy use, stating the estimated annual operating costs of the particular product and the range of annual estimated operating cost for such products.[27] These rules are intended to inform consumers about a product's energy use and costs at the time of purchase. The energy efficiency of many appliances significantly increased between 1972 and 2001. Gas furnaces became 25% more efficient, central air conditioners became 40% more efficient, and refrigerators became more than 75% more efficient.[28]

A somewhat similar set of testing, labeling, and standard-setting requirements exists for commercial and industrial equipment.[29] The DOE has adopted efficiency standards for, among other things, electric motors, warm-air furnaces, air conditioners, heat pumps, clothes washers, and illuminated exit signs.[30]

The benefits of these programs are considerable. According to a 2001 analysis by the American Council for an Energy Efficient Economy, existing appliance and equipment efficiency standards reduced U.S. electricity consumption by 2.5% in 2000, and should reduce electricity consumption by an even greater amount (7.8%) by 2020.[31] These standards reduced U.S. carbon emissions from fossil fuels by 1.7% in 2000, and should lead to a 3.8% reduction by 2020.[32] Overall, these standards are projected to save consumers $186 billion by 2030.[33]

The Environmental Protection Agency's ("EPA") Energy Star program provides a means of reinforcing and improving on the federal standards. Energy Star criteria are more stringent voluntary targets that manufacturers commit to when they participate in the program. This typically requires appliances to be 10% to 25% more efficient than applicable minimum requirements.[34] Energy Star criteria also apply to personal computers and other appliances and equipment for which no standards have been set.[35] American consumers have purchased more

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26. 42 U.S.C. § 6293. For showerheads, faucets, water closets and urinals, the test procedures are required to cover water use.

27. § 6294(c)(1).

28. Steven Nadel, *Appliance and Equipment Efficiency Standards*, 27 ANN. REV. ENERGY & ENVT. 159, 168 (2002).

29. 42 U.S.C. §§ 6311-17 (2006).

30. 10 C.F.R. Part 431 (2006).

31. HOWARD GELLER ET AL., OVERALL SAVINGS FROM FEDERAL APPLIANCE AND EQUIPMENT EFFICIENCY STANDARDS 3 (2001), *available at* http://www.standardsasap.org/stndsvgs.pdf#search=%22projected%20use%20 central%20air%20 conditioning%20u.s.%22.

32. *Id.*

33. *Id.*

34. U.S. Environmental Protection Agency, ENERGY STAR, Product Specifications, Eligibility Criteria, & Partner Commitments, *available at* http://www.energystar.gov/index.cfm?c=product_specs.pt_product_specs (last visited Mar. 24, 2006).

35. U.S. ENVIRONMENTAL PROTECTION AGENCY, ENERGY STAR, PRODUCT SPECIFICATIONS, ELIGIBILITY CRITERIA, & PARTNER COMMITMENTS, *available at* http://www.energystar.gov/index.cfm?c= product_specs.pt_product_specs (last visited Mar. 24, 2006)

than one billion products qualified by Energy Star.[36] While Energy Star criteria are not generally required by statute or regulation, some state and federal procurement programs either encourage or mandate the purchase of Energy Star-qualified equipment when those products are available.[37]

2. *Consumption Challenges*

Appliances used today are unquestionably more energy efficient than those in use two decades ago.[38] Yet the most basic consumption challenge that appliances face is consumer demand for more appliances. While overall energy use for space-heating, water-heating, and refrigeration is projected to decline because of more energy-efficient appliances, electricity use from computers, larger televisions, and the like is projected to increase significantly.[39] This projected growth would continue a decades-long trend. For instance, central air conditioning was available in 55% of U.S. homes in 2001, compared with 27% in 1980.[40] Between 1984 and 2001, the fraction of U.S. households with two or more refrigerators increased from 12% to 17%.[41] In 2001, personal computers, which did not exist several decades earlier, were in 60 million homes.[42]

Another challenge is turnover in the existing stock of particular appliances. The entire stock of refrigerators and freezers, for instance, is expected to be replaced over about 19 years.[43] For room air conditioners, the turnover rate is 15 years.[44] The turnover rate is particularly important because the annual improvement in energy efficiency in new appliances has been estimated to be as high as 5%.[45] Thus, longer turnover periods mean a longer time period for the full benefit of the more efficient appliance to be achieved.

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36. U.S. ENVIRONMENTAL PROTECTION AGENCY, PROTECTING THE ENVIRONMENT—TOGETHER: *ENERGY STAR* AND OTHER VOLUNTARY PROGRAMS 2003 ANNUAL REPORT 6 (2004) *available at* http://www.energystar.gov/ia/news/downloads/annual_report_2003.pdf. The DOE and EPA are also launching an Energy Efficiency Action Plan for electricity. U.S. Dep't of Energy and Envtl. Protection Agency, Energy Efficiency Action Plan (2005), *available at* http://www.epa.gov/cleanrgy/pdf/ee_plan.pdf.

37. *See e.g.,* Greening the Government Though Efficient Energy Management, Exec. Order No. 14123, 64 Fed. Reg. 30,851 (June 3, 1999) (encouraging procurement of Energy Star qualified products). The Energy Policy Act of 2005 encourages public housing agencies to purchase Energy Star products where it is cost effective to do so. 42 U.S.C. §§ 15841, 16001 (2006).

38. U.S. DEP'T OF ENERGY, ENERGY INFO. ADMIN, REGIONAL ENERGY PROFILE: U.S. HOUSEHOLD ELECTRICITY REPORT (2005), *available at* http://www.eia.doe.gov/emeu/reps/enduse/er01_us.html (last visited Sept. 3, 2006) [hereinafter U.S. Household Electricity Report].

39. U.S. DEP'T OF ENERGY, ENERGY INFO. ADMIN, ANNUAL ENERGY OUTLOOK 2006 WITH PROJECTIONS TO 2030 at 67 (2006), *available at* http://www.eia.doe.gov/oiaf/archive/aeo06/index.html [hereinafter ANNUAL ENERGY OUTLOOK 2006].

40. U.S. Household Electricity Report, *supra* note 38.

41. *Id.*

42. *Id.*

43. GELLER, *supra* note 31, at 3.

44 . *Id.*

45. Kornelis Blok, *Improving Energy Efficiency by Five Percent and More per Year?,* 8 J. INDUS. ECOLOGY 87 (2005).

Growth in consumption and the turnover rate for existing stocks of appliances often reinforce each other to increase energy consumption in at least two ways. First, many new appliances are used in households or businesses where they were not previously used; they are not replacing existing, less efficient appliances. Central air conditioning is an example, although it is likely that central air conditioning units in many cases replace existing room units. Second, the introduction of a new appliance does not necessarily mean that the existing appliance is discarded. The median age of primary household refrigerators in 2001 was five to nine years, compared to a median age of 10-19 years for secondary refrigerators.[46] This suggests that a great many households keep their existing less-efficient refrigerator when they buy a new, more-efficient refrigerator. This is likely true for other appliances as well.

B. Buildings

1. State Building Codes

Greater energy efficiency in buildings is achieved in two ways: more-efficient air conditioners and other appliances and more-effective insulation in a building's "envelope"—its roof, walls, doors, and windows. Both can be, and often are, required under state building codes.

State energy-efficiency standards for buildings are prompted to some degree by federal legislation. The Energy Policy Act of 1992 required each state to review the energy-efficiency provisions of its residential and commercial building codes, and to determine within two years whether it should adopt model energy-efficiency codes prepared by third parties.[47] Whenever either code is revised, the act requires states to consider or adopt updated provisions that the DOE determines "would improve energy efficiency" in residential or commercial buildings.[48] About half of the states have the most recent and energy-efficient residential codes, and the rest have less-recent codes or none at all.[49] The situation with commercial codes is very similar.[50] Unlike many federal environmental laws, the Energy Policy Act does not require a state to choose between implementing its code to meet a national standard or having the federal government implement the standard within that state's boundaries, and does not seem to require rigorous state enforcement of the standard. The latter point is

46. U.S. Household Electricity Report, *supra* note 38.

47. 42 U.S.C. §§ 6832(15), 6833(a) (2006) (residential building code); 42 U.S.C. §§ 6832(16) 6833(b) (2005) (commercial building code). The Model Energy Code (residential buildings) and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) code (commercial buildings), are revised periodically.

48. *Id.* §§ 6833(a)(5), 6833(b)(2).

49. MARILYN A. BROWN ET AL., TOWARDS A CLIMATE-FRIENDLY BUILT ENVIRONMENT 2-3 (2005), at 46-47, (on file with *Pacific McGeorge Global Business & Development Law Journal*).

50. *Id.*

particularly important because code enforcement requires significant resources.[51] The act is supported by some federal grant money, however.[52] The Energy Policy Act of 2005 authorizes the Department of Energy to provide $25 million annually to states to improve existing energy-efficiency codes and to improve compliance with such codes.[53]

2. *Consumption Challenges*

Substantial progress has been made in energy efficiency in commercial and residential buildings in the past few decades. Between 1978 and 2001, residential energy use per household fell by 37% and commercial energy use per square foot of building space dropped by 25%.[54] But several significant consumption challenges have reduced the effect of these changes. The average size of new homes has increased from 1,500 to 2,300 square feet in the past 30 years.[55] In addition, average family size has declined by one-fourth during the same period,[56] meaning that larger houses are serving fewer people. Finally, as described more fully above, houses contain a greater number and variety of electrical appliances than they once did, including central air conditioning and personal computers.[57] Population pressure over the next half-century will increase both the number of new commercial and residential buildings, as well as their energy use. U.S. population is projected to grow from 295 million in 2005 to 420 million in 2050, increasing the built environment by an amount equal to 70% of existing building stock.[58]

The turnover rate for existing building stock magnifies these consumption challenges, since building codes generally do not apply to existing buildings. "The vast majority of the buildings that exist today will still exist in 2015, and at least half of the current stock will still be standing by mid-century."[59] Broadly speaking, newer buildings tend to be more energy efficient than older buildings on a per-square-foot basis, and are often substantially more efficient. Sixty percent of residences are not well insulated, for example, and 70% or more of commercial buildings lack roof or wall insulation.[60]

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51. STATE AND TERRITORIAL AIR POLLUTION PROGRAM ADMINISTRATORS (STAPPA) AND ASSOCIATION OF LOCAL AIR POLLUTION CONTROL OFFICIALS (ALAPCO), REDUCING GREENHOUSE GASES AND AIR POLLUTION: A MENU OF HARMONIZED OPTIONS—FINAL REPORT 182-83 (1999) (on file with author).

52. 42 U.S.C. § 15822 (2005).

53. 42 U.S.C. § 6833(e) (2005).

54. TOWARDS A CLIMATE-FRIENDLY BUILT ENVIRONMENT, *supra* note 49, at 2-3.

55. *Id.* at 3.

56. *Id.*

57. *Id.*

58. *Id.* at 4.

59. *Id.* at 11.

60. *Id.* at 14.

Most new residential and commercial structures, however, are not replacing existing structures; they are needed to provide housing and commercial space for a growing population and smaller families. Thus, a substantial fraction of the nation's most efficient housing and appliances is used to meet new demand, not to reduce existing demand. Except for normal turnover of appliances in existing buildings, and the extent to which new building code standards are applied to retrofits of existing buildings, existing residential and commercial and residential building stock is unaffected by new building code requirements. In addition, as many as half a million homes are demolished annually rather than retrofitted or renovated. Their demolition means a loss of the energy used to construct them, as well as the expenditure of new energy for the construction of replacement structures.[61] Beyond that, the new houses will likely be larger than those they replace and will probably consume more energy as a result (even if they are more efficient on a per-square-foot basis).

C. Motor Vehicles

1. CAFE Standards

Energy efficiency standards for automobiles exist primarily in the form of corporate average fuel economy ("CAFE") standards for motor vehicles. These standards are established by the Department of Transportation under the Energy Policy and Conservation Act, which was first adopted in 1975 in the wake of the 1973-74 Arab oil embargo.[62] Standards are to be based on the "maximum feasible fuel economy" that can be achieved for a particular year.[63] The agency must consider "technological feasibility, economic practicability, the effect of other motor vehicle standards of the Government on fuel economy, and the need of the United States to conserve energy."[64] To ensure that prospective buyers can incorporate a car's fuel efficiency into their purchasing decision, automobile dealers are obliged to attach a label in a prominent place on each new car offered for sale, stating the fuel economy of that car.[65] Congress also authorized the Department of Transportation to set fuel economy standards for light trucks, which include sport utility vehicles, minivans, and pickup trucks.[66]

The mandated average fuel economy for automobiles increased from 18.0 to 27.5 miles per gallon ("mpg") between 1978 and 1990, a level that has remained unchanged.[67] The required average fuel economy for light trucks, which at least

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61. John C. Dernbach & Scott Bernstein, *Pursuing Sustainable Communities: Looking Back, Looking Ahead*, 35 URB. LAW. 495, 524-25 (2003).

62. 49 U.S.C. §§ 32901-19 (2006).

63. § 32902(a).

64. § 32902(f).

65. § 32908(b)(1)A).

66. § 32902(a).

67. 49 C.F.R. § 531.5(a) (2006).

until recently represented a large and rapidly growing share of the motor-vehicle market, is much lower. From the 1996 to 2004 model years, the average required fuel economy for light trucks has been 20.7 miles per gallon, rising to 21.0 miles per gallon for 2005 and 22.2 miles per gallon for the 2007 model year.[68] From the late 1980s to the present, light trucks gained market share and began to slowly pull the mpg-combined-average rating for cars and light trucks below the 1988 peak. As a result, average 2005 fuel economy was 24.7 mpg for cars and 18.2 mpg for light trucks.[69]

In April 2006, the Transportation Department adopted a final rule increasing the average fuel economy standard for light trucks to 23.5 miles per gallon for model year 2010.[70] The same final regulation introduced a new method (called Reformed CAFE) for calculating average fuel economy that is optional for light trucks in model years 2008-2010 and required for the 2011 model year.[71] Under Reformed CAFE, each vehicle is assigned a "footprint" value based on the size of the vehicle and a specific fuel-efficiency target for that "footprint."[72] Reformed CAFE contrasts with the fleet-wide averages for each manufacturer that have been employed for the life of the program.[73]

2. *Consumption Challenges*

Overall, automobiles now use 40% less gasoline than they did in 1972.[74] A 2002 report by the National Research Council concluded that the CAFE program "has clearly contributed to increased fuel economy during the past 22 years."[75] The report said that national gasoline consumption would otherwise be "about 2.8 million barrels per day greater than it is, or about 14% of today's consumption."[76] Because so little progress on fuel economy has been made in more than a decade, fuel economy of U.S. cars and light trucks is now substantially lower than that in the European Union, Japan, Australia, Canada, and China.[77]

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68. 49 C.F.R. § 533.5(a), Table IV.

69. U.S. EPA, OFFICE OF TRANSPORTATION AND AIR QUALITY, LIGHT-DUTY AUTOMOTIVE TECHNOLOGY AND FUEL ECONOMY TRENDS: 1975 THROUGH 2005, *available at* http://www.epa.gov/OTAQ/cert/mpg/fetrends/420r05001.pdf.

70. Average Fuel Economy Standards for Light Trucks Model Years 2008-2011, 71 Fed. Reg. 17566 (Apr. 6, 2006) (to be codified at 40 C.F.R. Parts 523, 533 and 537).

71. *Id.*

72. *Id.*

73. *Id.* at 17568.

74. NAT'L ENERGY POL'Y, *supra* note 12, at xi-xii.

75. COMMITTEE ON THE EFFECTIVENESS AND IMPACT OF CORPORATE AVERAGE FUEL ECONOMY (CAFE) STANDARDS, NATIONAL RESEARCH COUNCIL, EFFECTIVENESS AND IMPACT OF CORPORATE AVERAGE FUEL ECONOMY (CAFE) STANDARDS 3 (2002), *available at* http://www.nap.edu/catalog/10172.html#toc.

76. *Id*. ("[T]he CAFE program has been particularly effective in keeping fuel economy above the levels to which it might have fallen when real gasoline prices began their long decline in the 1980s.").

77. FENG AN & AMANDA SAUER, COMPARISON OF PASSENGER VEHICLE FUEL ECONOMY AND

The quest for greater fuel efficiency is hampered by several challenges relating directly or indirectly to consumption. Most obviously, Americans have been driving more every year for decades, despite growing awareness of the air pollution, congestion, and other environmental problems that driving causes. The novelist T.C. Boyle, who lives in California, has described himself "as much a schizophrenic about the rift between environmental consciousness and the need, right and consuming passion for the automobile as any of my fellow Californians."[78] Vehicle-miles traveled by passenger cars increased from 587 million to 1,661 million between 1960 and 2003.[79] The number of miles driven continued to increase despite higher gas prices in the summer of 2005, although the rate of increase was slower.[80]

American consumers have been concerned more about power and size than fuel efficiency. Light-duty vehicles for the 2005 model year continued a "twenty-plus-year trend of increasing weight and power, and faster acceleration."[81] The average power/drive of a U.S. passenger car in 2006 is roughly double that of 1987.[82] From this perspective, the maintenance of fuel economy standards over this period, as opposed to their decline, is a greater achievement than might first appear.

Safety considerations also have played a role in the choice of larger vehicles. The 2002 National Research Council ("NRC") report concluded that automobile downsizing, "some of which was due to CAFE standards, probably resulted in an additional 1,300 to 2,600 traffic fatalities in 1993."[83] To some degree, the reformation of CAFE standards is a response to the evident tradeoff between safety and fuel economy. The NRC report recommended consideration of "an approach with fuel economy targets that are dependent on vehicle attributes, such as vehicle weight, that inherently influence fuel use."[84]

GREENHOUSE GAS EMISSION STANDARDS AROUND THE WORLD 1 (2004), *available at* http://www.pewclimate.org/global-warming-in-depth/all_reports/fuel_economy/index.cfm.

78. T.C. Boyle, *To Pump or Not to Pump*, N.Y. TIMES, Apr. 30, 2006, at D14.

79. Bureau of Transportation Statistics, Dep't of Transportation, Table 1-32: U.S. Vehicle-Miles, (2004), *available at* http://www.bts.gov/publications/national_transportation_statistics/2004/html/table_01_32.html (last visited July 14, 2006). Vehicle miles traveled by tractor-trailers increased from 29 million in 1960 to 138 million in 2003.

80. Tom Vanden Brook & Paul Overberg, *High Gas Prices Alter Driving Habits*, USA TODAY (Dec. 8, 2005), *available at* http://www.usatoday.com/news/nation/2005-12-08-gas-prices_x.htm (conclusion based on analysis of Federal Highway Administration data).

81. U.S. EPA, *supra* note 69, at i.

82. *Id.*

83. *Id. But see* MARC ROSS & TOM WENZEL, LOSING WEIGHT TO SAVE LIVES: A REVIEW OF THE ROLE OF AUTOMOBILE WEIGHT AND SIZE IN TRAFFIC FATALITIES (EXECUTIVE SUMMARY) (2001), *available at* http://www.aceee.org/store/proddetail.cfm?CFID=421765&CFTOKEN=69178468&ItemID=263&CategoryID=7 ("Making heavier vehicles lighter (but not smaller) and making lighter cars larger (but not heavier) would not only increase safety but also increase fuel economy.")

84. NATIONAL RESEARCH COUNCIL, *supra* note 75, at 5-6. If Reformed CAFE works as the federal government would like, each vehicle size class will be pushed toward higher and higher levels of mileage efficiency. Thus, the most efficient vehicles will no longer simply offset the least efficient vehicles for the

More stringent fuel-economy standards reduce the cost of driving on a per-mile basis and thus encourage more driving and greater fuel consumption. This is known as the "rebound effect."[85] Though there is considerable disagreement about its magnitude, there is no disagreement about whether it exists. In the April 2006 rulemaking that led to somewhat more stringent CAFE standards for light trucks, auto makers and their allies argued that the rebound effect would be as much as 50% of the expected energy savings, while environmental groups argued that the rebound effect would only be 5% of expected savings.[86] The Department of Transportation stated that published studies indicate that the range could be 10% to 30% of expected savings and chose the midpoint (20%) to calculate the size of the rebound effect.[87]

Finally, the turnover rate for the motor vehicle stock also affects efficiency. The turnover rate for existing personal vehicle stock is estimated at 14 years.[88] Studies comparing a gasoline tax with strengthened CAFE make the point that strengthened CAFE standards would not be in place for the entire fleet for at least 14 years.[89]

III. ENVIRONMENTAL LAW AND INDIVIDUAL BEHAVIOR

Our environmental laws are by and large directed toward large sources of pollution, particularly industrial sources. These could be described as "small-number, large-payoff" environmental problems because they involve a relatively small number of actors who make a substantial contribution to environmental pollution and who, primarily as a result of government regulation, have a strong interest in addressing these problems.[90] Considerable attention has been devoted to the ways in which these laws can be made more effective. A different but growing area of academic and policy inquiry is the role of individual behavior in environmental protection.[91] Several different types of human behaviors are relevant to environmental protection, including committed activism, financial and other support for environmental causes and policies, and influencing the organizations to which individuals belong.[92]

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overall fleet average; both the most efficient and the least efficient vehicles will need to get even more fuel efficient. For this to work, the federal government will need to continually strengthen standards requiring the "maximum feasible fuel economy" for each class of vehicle.

85. Average Fuel Economy Standards for Light Trucks, *supra* note 70, 71 Fed. Reg. at 17632.

86. *Id.* at 17632-33.

87. *Id.*

88. CONGRESSIONAL BUDGET OFFICE, THE ECONOMIC COSTS OF FUEL ECONOMY STANDARDS VERSUS A GASOLINE TAX 1-2 (2003).

89. *Id.*

90. Ann E. Carlson, *Social Norms and Individual Environmental Behavior*, 35 ENVTL. L. REP. 10, 763-64 (2005).

91. *See, e.g.,* Michael P. Vandenbergh, *The Individual as Polluter*, 35 ENVTL. L. REP. 10, 723, 738-40 (2005); Michael P. Vandenbergh, *Order Without Social Norms: How Personal Norms Can Protect the Environment*, 99 NW. U. L. REV. 1101 (2005); 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).

92. Paul C. Stern, *Understanding Individuals' Environmentally Significant Behavior*, 35 ENVTL. L. REP. 10, 785-86 (2005).

A fourth type, of particular interest here and in this literature, is "personal, private-sphere, environmentally significant behavior—the purchase, use, and disposal of personal and household products that have environmental impact."[93] This type of behavior has obvious relevance to energy efficiency and energy consumption. At least tens of millions of Americans, and most probably hundreds of millions, purchase and use appliances, equipment, residential and commercial buildings, and motor vehicles. The individual environmental behavior literature provides important clues about how to achieve the goals of stabilizing and reducing U.S. energy consumption. This literature suggests that law can intervene at two key points; it can require or prohibit particular individual behaviors, but it can also change what people believe and how they act.[94]

Contextual factors are among the most important variables that foster or hinder environmentally significant behavior. These factors include, but are not limited to, the law. Among these other factors are available technology, the environmental impact that is already built in to a particular product, legal requirements, financial payoff, convenience, and social norms.[95] Energy-efficiency standards for new products and buildings obviously influence the energy efficiency of those products and buildings that are available for purchase. Such standards appear to have less influence, however, on the existing stock of appliances, equipment, and motor vehicles. A period of approximately 14 to 19 years is needed until they are replaced with new, more-efficient technologies. Nor do they affect the timing or comprehensiveness of energy-efficiency upgrades or renovations at existing commercial or residential buildings, which can last a century or longer. Thus, a major behavioral challenge is accelerating the replacement of less-efficient appliances, equipment, and automobiles with more-efficient technologies. A second behavioral challenge is encouraging wholesale efficiency improvements in existing residential and commercial buildings. And wholly apart from technology turnover, the recurring energy-consumption challenge is conservation—the extent to which appliances, equipment, motor vehicles, and energy-consumption technologies in buildings are actually used.

Personal factors also influence environmental behavior. These include personal capabilities, such as financial resources, literacy, and social status, as well as knowledge and skills relevant to particular behaviors. Personal attitudes

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93. *Id.*

94. A law addressing a particular problem validates the existence of that problem and indicates the existence of sufficient consensus to address it. The law may thus change beliefs about the nature of that problem and the social support for addressing it, which increase the likelihood that both the law and the problem will be taken more seriously. Richard McAdams, *The Origin, Development, and Regulation of Norms*, 96 MICH. L. REV. 338, 343-47 (1997). However, law can also affect individual behavior in another way—through "the required disclosure of information that is targeted at the types of beliefs that activate norms." *The Individual as Polluter*, *supra* note 91, at 10, 738.

95. *The Individual as Polluter*, *supra* note 91, at 10, 738.

matter as much as personal capabilities. These attitudes include personal values (e.g., egoism, openness to change), abstract environmental belief norms (e.g., belief that the environment is fragile or resilient), norms and beliefs about specific behaviors (e.g., recycling, minimizing the use of a car), and perceived costs and benefits of particular actions.[96] This range of personal environmental values has led social science and legal scholars to develop an approach to understanding how to change individual behavior on behalf of the environment.

Paul Stern and others have developed a "value-belief-norm" theory of environmentally significant behavior.[97] The key to this approach, according to Stern, is that "individual choice can be driven by personal norms, that is, an internalized sense of obligation to act in a certain way."[98] In the absence of contextual restraints (e.g., price, availability of technology), personal norms for pro-environmental behavior can be activated in a specific situation when 1) a person is made aware that a particular action would adversely affect something the person values (awareness of consequences, or "AC"), and 2) by taking that action, the person would have "significant responsibility for those consequences" (ascription of responsibility, or "AR").[99] Thus, Stern says, "it is possible to influence individual behavior, within the limits set by context, habit, personal capability, and the like, by making people aware of the consequences, particularly adverse ones, for things they value, and by showing them that their personal behavior is important enough to make a difference."[100]

The type of information and the manner of its delivery can have considerable effect on whether it motivates pro-environmental behavior. Educating people on environmentally preferable behaviors and predicting environmental doom are not particularly helpful. "Information is most likely to be effective when it arrives at the time and place of decision, is linked to the available choices, is delivered from trusted sources, and is delivered personally."[101]

Environmental norm activation theory applies these insights more specifically to law. This approach, as articulated by Michael Vandenbergh, focuses on the aggregate consequences of individual behavior.[102] Instead of focusing only on individual consequences and responsibility for a particular decision, Vandenbergh focuses on overall consequences and responsibility for groups of similarly situated persons. These groups might include, for example, persons who use a backyard burn barrel or persons who drive their car to work.[103] This theory also

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96. *Id.* at 10, 786-87.

97. *Id. See also* Paul C. Stern et al., *A Value-Belief-Norm Theory of Support for Social Movements: The Case of Environmentalism,* 6 HUM. ECOLOGY REV. 81 (1999).

98. Stern, *supra* note 92, at 10, 787.

99. *Id.*

100. *Id.* at 10, 787-88.

101. *Id.* at 10, 789 ("That is in part how salespeople earn their commissions.").

102. *See supra* note 91.

103. *The Individual as Polluter*, *supra* note 91, at 10, 738-40.

suggests that reciprocity—the understanding that others in the group will also do their fair share--can significantly contribute to the activation of abstract environmental norms.[104]

Thus, environmental norm activation theory describes the circumstances under which *law* can activate abstract personal environmental norms by providing individuals with information. This information would need to show 1) that the average or aggregate individual behavior for a particular activity causes an environmental problem (AC) and 2) that average or aggregate reductions in that behavior by individuals would significantly reduce the problem (AR). This information would be more effective if it also shows that others in the group have done, or will do, the same thing, and that everyone's effort is necessary to achieve a good outcome.[105]

At least two other significant variables influence the likelihood of changes in behavior. One is the intensity of economic incentive or interest that a group member has in solving the problem. The easy cases, of course, occur when a group member has sufficient financial or other reasons to act in a particular way without any outside intervention. But even financial self-interest is often not enough to prompt changes in behavior. Many cost-effective opportunities for energy efficiency are simply not employed. Economist Stephen DeCanio refers to this unwillingness as the energy efficiency paradox; legal instruments thus appear to be needed to ensure actions that are cost effective in their own right.[106] Because human behavior is influenced not just by economic factors, but by social and moral factors as well,[107] the intensity of a group member's interest need not be limited to the economic realm. Thus, social norms are more likely to produce pro-environmental behavior if they are convenient, particularly if the behavior needs to be sustained over a significant time period.[108] The more effort a changed behavior requires, the stronger belief in the norm must be.[109] By contrast, "social

104. *Id.* at 10, 739.

105. *Id.* at 10, 738-39.

106. *See* Stephen J. DeCanio, *The Efficiency Paradox: Bureaucratic and Organizational Barriers to Profitable Energy-Saving Investments*, 26 ENERGY POL'Y 441, 453 (1998) (data from EPA's Green Lights energy-efficiency program reinforce the view that there is a large potential for profitable energy-saving investments that is not being realized because of [non-economic] impediments that are internal to private and public-sector organizations.). To some degree, this occurs because cost effectiveness for individuals and firms tends to be calculated more narrowly—primarily in terms of the benefits and costs to the individual or firm—rather than a broader macroeconomic perspective that would involve a greater range of costs and benefits. Eberhard Jochem et al., *Energy End-Use Efficiency, in* UNITED NATIONS DEVELOPMENT PROGRAMME, WORLD ENERGY ASSESSMENT: ENERGY AND THE CHALLENGE OF SUSTAINABILITY 173, 184 (2000).

107. STEVEN D. LEVITT & STEPHEN J. DUBNER, FREAKONOMICS: A ROGUE ECONOMIST EXPLORES THE HIDDEN SIDE OF EVERYTHING (2005). *See also* Mark A. Cohen, *Individual and Household Environmental Behavior: What Does Economics Contribute to the Discussion?*, 35 ENVTL. L. REP. 10, 754, 760 (2005) (summarizing empirical studies of recycling showing that knowledge and social influence are important determinants of behavior).

108. Carlson, *supra* note 90 at 10, 764.

109. *Id.* at 10, 767. "And the strength of belief in the social norm at issue must be even stronger if the behavior requires both high effort *and* repetition." *Id.* (emphasis in original).

norms are likely to work less well if an individual gains something from engaging in the environmentally harmful behavior—driving or using air conditioning are obvious examples."[110]

The second significant variable influencing the likelihood of behavior change is group size. Thus, our ability to harness social norms on behalf of the environment increases if large groups understand themselves as also being members of much smaller groups, organized by neighborhood or workplace.[111] Smaller groups tend to work better because members are more likely to know each other, because they can communicate directly with each other, because they are more likely to be influenced by each other's behavior, and because they can work out their own ways for achieving a particular goal.[112]

IV. A FRAMEWORK FOR MOVING AHEAD

This literature, much of which has an empirical basis, provides a framework for thinking about how to chart a course from a broad social goal of greater energy efficiency to appropriate individual behaviors and including a variety of intermediate public and private actors, particularly government, business, and schools. The following is intended as a framework, not a detailed plan, and includes few, if any, purely regulatory or voluntary measures, but rather measures that are some of both.[113]

A. National Goal for Stabilizing and Reducing Energy Consumption

A useful starting point is the adoption of national goals. Goals are social norms. Goals motivate behavior if they are seen as necessary, credible, and achievable.[114] The authority setting the goal—whether it is the President, Congress, a government agency, or another entity—adds legitimacy to the goal and indicates that the goal has substantial support.[115] Specific goals also translate a general sentiment or recognition concerning the problem into a discrete objective. This is particularly true when the specific goal is coupled with a timetable for its achievement.[116]

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110. *Id.* at 10, 764.

111. *Id.*

112. *Id.* at 10, 765-66, 768.

113. Of course, higher energy prices are a major driver for greater energy efficiency and reduced consumption. One way of achieving higher prices is to employ some form of energy tax. The focus here, however, is not on taxation or even other regulatory measures.

114. John C. Dernbach, *Targets, Timetables and Effective Implementing Mechanisms: Necessary Building Blocks for Sustainable Development*, 27 WM. & MARY ENVTL. L. & POL'Y REV. 79 (2003).

115. *Cf.* NATIONAL RESEARCH COUNCIL, *supra* note 75, at 5-6

116. *Targets, Timetables*, *supra* note 114, at 89.

A necessary, credible, and achievable goal is to stabilize, and then reduce, U.S. energy consumption over the next decade or two.[117] This would be accomplished by substantial and continuing improvements in energy efficiency and conservation. The case for energy efficiency has probably never been stronger. It is the cheapest, least environmentally damaging, and most sustainable approach to the energy and climate challenges that confront us. Energy efficiency can reduce demand pressure on prices, protect against the risk that oil production has peaked or will peak soon, reduce stress on our electricity supply system, strengthen the economy, create more opportunities for job creation and technology development, protect the poor and those on fixed incomes, reduce U.S. vulnerability to supply cut-offs or disruptions, and mitigate climate change.

Moreover, unlike many environmentally oriented activities in which individuals and businesses can participate, it also promises reduced energy costs. Even though an up-front investment is often required, that investment is likely to be repaid through reduced energy use over a number of years. While altruism, civic-mindedness, expectations of reciprocal behavior on the part of others, and other motivations all play a role, economic self-interest is an inherent core element of behavior related to energy efficiency.

Energy efficiency is in many ways the most attractive of the major approaches to addressing climate change. The other three major approaches—emissions reduction, long-term carbon storage, and adaptation—all involve additional financial outlays that are not likely to be recouped, except in the form of avoided future increased costs. They will probably prevent future damage, in other words, but they are not likely to reduce current operating costs. Energy efficiency, by contrast, can actually reduce short-term costs. The money that is saved, in turn, can be used by individuals and businesses for other purposes. From an economic standpoint, energy efficiency can thus help foster greater competitiveness, job growth, and innovation. Virtually every company that has established and achieved greenhouse gas reduction goals has used energy efficiency and conservation as primary tools, and with substantial cost savings.[118] Improving energy efficiency and reducing energy consumption, in sum, involve more than the environment; they are also necessary for economic, security, and social reasons.

Not surprisingly, the energy efficiency of the U.S. economy improves every year. The standard measure for improvement in energy efficiency is energy intensity, or energy consumption per dollar of gross domestic product ("GDP"). Energy intensity improves because of technological change, legal requirements, the cost of energy, and shifts in the U.S. economy from manufacturing to services. Because GDP grows at a faster rate than these improvements in energy

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117. *Stabilizing and Then Reducing U.S. Energy Consumption*, *supra* note 17.

118. Michael Northrop, *Leading by Example: Profitable Corporate Strategies and Successful Public Policies for Reducing Greenhouse Gas Emissions,* 14 WIDENER L.J. 21 (2004); THE CLIMATE GROUP, CARBON DOWN PROFITS UP (2d ed. 2005).

intensity, however, U.S. energy use continues to grow. In its *Annual Energy Outlook 2006*, the Energy Information Administration projected GDP to increase by 3% per year between 2004 and 2030, but energy intensity to decline at an average annual rate of 1.8% during the same period.[119] Thus, U.S. energy consumption is projected to increase by slightly more than one percent annually until 2030.[120] This growth in consumption occurs notwithstanding laws to improve energy efficiency in appliances, buildings and motor vehicles.

The only way to stabilize and reduce U.S. energy consumption then, is for annual improvements in energy intensity to be greater than growth in GDP. The idea is an energy-efficiency analogue to Moore's Law.[121] In 1965, Gordon Moore, one of the founders of Intel Corporation, observed that the computing power of integrated circuits (processors or chips) was doubling every two years, and likely would continue to double at this rate for at least another decade.[122] Moore's observation and prediction became a galvanizing challenge for the computer industry, driving companies to achieve the kind of improvements that Moore described.[123] Moore's Law, as it is now described, captures a powerful truth about the continuous and dramatic increase in computing power over the past four decades. Computing power, measured in numbers of transistors in a processor, increased from 4,004 in 1970 to more than one billion by 2005.[124] This dramatic increase in computing power has been accompanied by continuing cost reductions. Anyone who has purchased personal computers or laptops over the past several decades is well aware that newer units tend to cost less and have much greater power than their predecessors. Even more dramatic improvements in computing power appear to be in sight.[125]

There is no energy-efficiency analogue to Moore's Law, because there are many and more diverse sources of energy use and because no one appears to have calculated any mathematical formula for improvements in energy intensity over time. But it is possible to capture the aspirational and motivational part of Moore's Law for energy efficiency—an intensive and focused goal for continued improvement in energy intensity that is backed by substantial resources and rewarded in the marketplace. Recasting the consumption goal as an ambitious

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119. ANNUAL ENERGY OUTLOOK 2006, *supra* note 12, at 65.

120. *Id.*

121. I am grateful to Bryson Danner, retired general counsel at Southern California Edison and a member of the adjunct law faculty at the University of Southern California, for this idea.

122. Gordon E. Moore, *Cramming More Components Onto Integrated Circuits*, ELECTRONICS (April 19, 1965), *available at* ftp://download.intel.com/research/silicon/moorespaper.pdf.

123. W. Wayt Gibbs & Gordon E. Moore, *The Intel Co-founder and Chairman Emeritus Discusses Growth Projection that Bears His Name,* SCIENTIFIC AMERICAN (September 22, 1997), *available at* http://www.sciam.com/article.cfm?articleID=000C8D8B-7E63-1CDA-B4A8809EC588EEDF.

124. INTEL, MOORE'S LAW: MADE REAL BY INTEL INNOVATION, *available at* http://www.intel.com/technology/mooreslaw/index.htm (last visited July 31, 2006).

125. John Markoff, *A Chip That Can Move Data at the Speed of Laser Light*, N.Y. TIMES, Sept. 18, 2006, at C1 (describing a new silicon-based chip that enables use of laser light rather than wires to move information between chips, meaning that data can be transferred 100 times faster at a fraction of current cost).

energy-intensity goal also makes that goal seem more positive and more obviously supportive of continued increases in GDP. The more that energy-intensity improvement can outpace GDP growth, the better.

National goals work best when supported and explained at the highest levels of government. Energy intensity declined by approximately 2.3% annually from 1970 to 1986, a period of higher energy prices, an economic shift from manufacturing toward services, and the introduction of new and more efficient technologies.[126] While much of this improvement is also due to specific governmental laws and policies adopted during this period, a public desire to support national goals also appears to have played a role. In fact, evidence from the 2000-2001 California energy crisis indicates that households are more responsive to both public appeals and higher prices than previously believed.[127]

As the behavioral literature indicates, such a goal would likely work better if it were broken into discrete parts, so that each affected sector could better understand how the goal applied to it. Energy consumption in the United States ordinarily is divided into four sectors—industrial, residential, commercial, and transportation.[128] A fifth category, electricity, cuts across all four sectors. Thus, it is possible to suggest that each of these sectors or categories of energy use stabilize and then reduce their energy consumption over the next decade or two. Each of these sectors or categories, in turn, can be further subdivided, by category of energy use (e.g., mode of transportation, Standard Industrial Classification ("SIC") code, type of housing, or commercial activity), region (e.g., multi-state region, state, multi-municipality region, or municipality), or in other ways. In that way, the goal would not be something broad and abstract but would pertain specifically to smaller groups of similarly situated individuals.

B. Public Information

Another way to motivate improvements in energy intensity and reductions in energy consumption is to provide the public with information about energy use and changes in energy use. On the most basic level, public information about progress toward the goals described in the previous section could be useful in fostering progress toward those goals. If this information were provided for particular categories of energy use or particular regions, or according to similar subdivisions, it would help smaller groups of similarly affected individuals understand how energy efficiency and use is changing within their group, and could be a further impetus for progress.

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126. U.S. DEP'T OF ENERGY, ENERGY INFO. ADMIN, ANNUAL ENERGY OUTLOOK 2004 WITH PROJECTIONS TO 2025 at 69 (2004), http://www.eia.doe.gov/oiaf/archive/aeo04/pdf/0383(2004).pdf.

127. PETER C. REISS & MATTHEW W. WHITE, WHAT CHANGES ENERGY CONSUMPTION HABITS? PRICES VERSUS PUBLIC PRESSURES (2005), *available at* http://bpp.wharton.upenn.edu/mawhite/Papers/PricesVersusPressures.pdf.

128. ANNUAL ENERGY OUTLOOK 2006, *supra* note 12, at 65.

Other options are also available. Energy use labeling requirements are now employed for new appliances and other equipment as well as motor vehicles. But no such labeling requirements exist for most new and existing homes. Home purchasers say that energy efficiency is an important factor in choosing a home, but they are often wrong in assuming that new homes are energy efficient.[129] Thus, public information or labeling requirements for all new homes would at least ensure that potential home buyers are able to factor that information into their purchasing decisions.

Such information could be made even more relevant to purchasing decisions if it were accompanied by estimates of the average monthly or annual energy cost. Labeling requirements of this kind exist for appliances but not for motor vehicles or commercial or residential buildings. For motor vehicles, this information would enable a prospective buyer to add the monthly payment for the vehicle and a monthly estimate of its average fuel cost. Because this information would more readily enable a purchaser to understand the impact of her purchasing decision on her budget, it may have some effect in steering purchasing decisions toward more fuel-efficient vehicles.

Similarly, because residential and commercial buildings are sold and resold, it may also be appropriate to require the seller of an existing building to provide an energy-cost disclosure statement to prospective buyers. As with existing disclosure requirements for material defects and the like, an energy-cost disclosure requirement probably would influence many buying decisions. Such a requirement also would encourage existing owners who are considering the future sale of their properties to make them more energy efficient to avoid disclosure of higher costs. A softer form of this disclosure requirement would oblige the seller to provide this information if requested by a prospective buyer. The effectiveness of either disclosure requirement would, of course, depend, on other variables, including recent energy prices in the area where the building is located, the energy efficiency of the particular building in question, and the income of the buyers. Still, such a requirement would validate energy efficiency and energy consumption as important issues in real estate transfers and would encourage both buyers and sellers to give greater consideration to both.

Yet another approach is to modify labeling requirements for energy use to enable comparison with energy use by others in the same neighborhood or same size house, or who are members of some other group. Thus, Ann Carlson suggests, utilities could provide information in their bills that shows average energy for a house with a certain number of square feet and contrast that average energy use with that of the bill-payer. This information would need to be provided in an "accessible and noticeable" form, and contain appropriate suggestions for saving energy.[130] Such information might be more effective if it explained the positive aggregate consequences of reducing household energy use.

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129. Kate McQueen, *Promoting Energy Efficiency through Building Codes*, 12 NAT. RESOURCES & ENVT 122, 124 (1997).

130. Carlson, *supra* note 90, at 768.

Finally, Congress could require the collection and publication of information on individuals' energy footprint.[131] The DOE would build on its existing data-gathering activities to develop energy-use profiles for individuals and families of particular sizes in different parts of the country and in rural and urban areas. The data would also aggregate energy use by similarly situated individuals in particular regions and describe activities that lead to the greatest levels of energy use. This information could be published and updated on a regular basis, along with information on how to reduce energy use. Such information likely would help activate environmental norms held by many individuals by making them aware of their individual and aggregate impact and by making them aware of available choices for reducing that impact.

C. Readily Available Choices

The behavioral literature emphasizes the importance of making environmentally oriented activities easily available and convenient. An oft-repeated option, for example, is to make it easier for people to walk, bicycle, or use public transit to go to school or work. So much of our transportation and other infrastructure has been designed solely for motor vehicles that other transportation options often do not exist as a practical matter. Improvements in government transportation planning, local zoning, and local tax collection and distribution are among the identified remedies.[132]

Another set of options involves the removal or reduction of subsidies that encourage greater energy use. Fossil fuel subsidies, for example, reduce the cost of energy supplied by fossil fuels, and make it harder for new energy-efficient technologies to compete in the market.[133] Removal or reduction of those subsidies would facilitate greater and more rapid development and deployment of these technologies. In many cases, it would likely also accelerate replacement of older and less-efficient technologies with new and more-efficient technologies.

Improved energy intensity and reduced energy consumption are also economic-development opportunities. Traditional economic-development tools could be deployed for the purpose of making energy-efficient options available and attractive.

For energy users, in principle, reducing energy use and improving efficiency are opportunities to save money. But it is not always clear to energy users how to save money. Many replacements of existing furnaces, air conditioners, and other

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131. This suggestion is an adaptation of Michael Vandenbergh's proposal for an individual Toxics Release Inventory to inform individuals about their contribution to the release of toxic chemicals. *The Individual as Polluter, supra* note 91, at 740-44.

132. *See, e.g.,* Trip Pollard, *Driving Change: Public Policies, Individual Choices, and Environmental Damage*, 35 ENVTL. L. REP. 10, at 791 (2005).

133. Doug Koplow & John Dernbach, *Federal Fossil Fuel Subsidies and Greenhouse Gas Emissions: A Case Study of Increasing Transparency for Fiscal Policy*, 26 ANN. REV. ENERGY & ENVT. 361 (2001).

appliances and equipment occur when they break down--often suddenly, without notice, at inconvenient times—and need to be replaced. For the purchaser, energy use is often (and understandably) subordinate to simply getting the appliance or equipment replaced. More generally, hundreds of thousands of builders, contractors, architects, and purchasers make decisions about whether to seek, design, build, or operate more energy-efficient appliances, equipment, buildings, and motor vehicles. To be very sure, a great many factors are involved in such decisions, and it is abundantly clear that energy efficiency and energy consumption are not the only important factors, or even always among the important factors. Still, a variety of energy efficiency options or opportunities are not readily available that, if made convenient and accessible, would likely be used to a much greater degree.

Many of these options and opportunities could be provided by the private sector with the help of appropriate governmental assistance. A key example is energy-efficiency upgrades at existing residential and commercial energy buildings. Such upgrades could have considerable impact on energy efficiency while reducing energy costs for businesses and individuals, including people living in poverty. While energy service companies do this kind of work for large institutional and commercial clients, much less is done for smaller businesses, smaller institutions, and residential buildings. If improved energy efficiency in one's home or business were as easily available as having a roof replaced or a driveway paved, many more individuals would use those services. The standard explanation for the relative unavailability of such services is that economies of scale are too small to make this kind of work economically attractive to business.

At both the federal and state levels, though, government has a standard set of economic development tools that are used to solve this kind of problem. These include grants, loans, subsidies, tax incentives, locational assistance, and expedited permits and other approvals. These tools are also employed or assisted by specialized economic development agencies with considerable experience in this field. Because government support for economic development has so often been used to damage the environment, some might be skeptical about the use of such economic development tools and the agency experts who use them. While some such skepticism is warranted, it is also true that these tools are environmentally neutral, and there is no inherent reason they cannot be environmentally protective. Similarly, government environmental agencies already provide a range of technical and financial assistance to business for pollution prevention and even energy efficiency.

In other fields, government, nongovernmental organizations, and the private sector have formed partnerships to address problems none of them could effectively address alone. The broad lessons from their experience could be of considerable value to any effort to make energy efficiency and reduced consumption more accessible and convenient to individuals. A major goal of the Roll Back Malaria partnership, for example, is to make millions of insecticide-treated malaria nets easily available throughout much of sub-Saharan Africa and other parts of the world that are susceptible to that disease.[134] The nets are regarded as an effective and inexpensive way of reducing infection from mosquitoes carrying the disease. Yet these nets were not being produced and distributed on a massive scale until the partnership organized government donors, manufacturers, vendors, and suppliers to do so.

Similarly here, state and federal government could create partnerships with manufacturers, contractors, architects, builders, vocational and technical schools, community colleges, and others to create and stimulate markets for energy-efficiency technologies and know-how as well as energy-efficiency services. The building trades, including roofers, electricians, plumbers, and their labor unions, could be natural allies in this effort because their work so directly involves the use of energy. As part of this energy-efficiency partnership, the government could provide support services for the development or expansion of new energy-efficiency businesses, and could help businesses identify those markets where efficiency improvements would be the greatest. Vocational and technical schools and community colleges, in partnership with manufacturers and others, could provide training concerning new technologies and developments. Career development officials in these institutions as well as high schools could help identify individuals who might be interested in pursuing a trade that has a significant energy-efficiency component. In these and other ways, energy efficiency could also provide significant job creation opportunities.[135]

D. Financial Incentives

The most obvious way to make energy efficiency more attractive is to provide greater financial incentives. In the Energy Policy Act of 2005, Congress provided a range of tax credits and deductions for energy efficiency.[136] Many states also provide tax credits, deductions, and other incentives to encourage energy efficiency.[137] Tax incentives help overcome the obstacle provided by the initial investment often required for energy efficiency, and they can have a noticeable effect on behavior. Their disadvantage is that they result in reduced revenue collections, which has a particularly chilling effect on their size and permitted duration during financial downturns or periods when the budget runs a

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134. AFRICAN MEDICAL AND RESEARCH FOUNDATION, MALARIA PREVENTION AND CONTROL STRATEGY 2006-2010 (2006), *available at* http://www.amref.org/docs/malaria_strategy.pdf.

135. To be sure, some of this activity is already underway as part of President Bush's goal of reducing the greenhouse gas intensity of the U.S. economy by 18% over 10 years. THE WHITE HOUSE, GLOBAL CLIMATE CHANGE POLICY BOOK (2002), *available at* http://www.whitehouse.gov/news/releases/2002/02/climatechange.html (last visited July 5, 2006).The initiative involves partnerships with a variety of private companies as well as training and technical assistance. Because the goal described in this article is substantially more ambitious than the President's goal, such activities would need to be greatly increased in scale and intensity.

136. Energy Policy Act of 2005, Pub. L. No. 109-058, 119 Stat. 594 (2005).

137. WILLIAM PRINDLE ET AL., ENERGY EFFICIENCY'S NEXT GENERATION: INNOVATION AT THE STATE LEVEL 32 (2003), *available at* http://www.aceee.org/pubs/e031full.pdf.

deficit. A small tax on energy could be used to generate compensating revenues, but tax increases are politically challenging as well.

Another option, and one that does not necessarily involve government, would link providers of energy-efficiency services and providers of financing services. Energy-service corporations already provide this type of service for large commercial and institutional customers; the cost of efficiency renovations is paid from subsequent energy savings. As a consequence, up-front costs are avoided or minimized, and the costs are paid over a period of time. This kind of approach has not been widely employed for smaller institutions or businesses, nor is widely used for residences. Financial incentives could also be used to encourage the immediate renovation or upgrade of the least efficient buildings.

For replacement of less efficient technologies, for example, a furnace manufacturer could offer to replace specified furnace models that are highly inefficient with more efficient models, using a small down payment or perhaps none at all. Government energy agencies or one of the national energy laboratories could be asked to develop a list of such furnace models. The cost of the new furnace would be paid over a period of time on an installment contract. The monthly payment under the installment contract would be calculated to not exceed the difference between prior energy costs with the old furnace and reduced energy costs with the new furnace. Government encouragement or support of such a program would likely make it more publicly credible, and could include public endorsement of the program and distribution of relevant information. Financing terms could be made more attractive than conventional financing terms, including lower interest rates and longer repayment terms.

Financial incentives are particularly necessary to overcome obstacles to earlier replacement of less energy-efficient technologies. Speeding up the turnover rate for existing appliances, equipment, and motor vehicles could be done in a variety of ways. A manufacturer could offer discounts or rebates when individual owners of appliances and equipment made by that manufacturer purchase new and more energy-efficient appliances and equipment made by that manufacturer. Alternatively, manufacturers could lease major appliances and equipment to customers, replacing the appliances and equipment periodically with newer and more efficient technologies. At least one major company, Interface, has already implemented this business model; it leases rather than sells carpet to customers.[138] When the carpet is replaced, Interface installs new carpet and recycles the old carpet into its manufacturing process.

138. Press Release, Interface Celebrates 10 Years and Nearly 60 Million Pounds of Reclaimed Carpet (Oct. 25, 2004), *available at* http://www.interfaceinc.com/news/press/reclaimed_carpet.html.

E. Regulatory Requirements

Regulatory options could also influence individual behavior. Two are particularly illustrative. Companies could be required to reduce energy use by a specific amount, for instance, but be given credit for reductions by their customers.[139] Another approach would be to require companies (e.g., utilities) to provide information on best practices and incentives to customers. Such requirements would lead to context-specific information about opportunities for energy efficiency and help people understand what their most informed peers are doing.

V. CONCLUSION

The behavioral obstacles to reducing U.S. energy consumption are, of course, considerable and deeply entrenched. The purpose of this article has been to show that more particularized analysis of these obstacles, and the major behavioral options that might be employed to address them, provide useful insights on how to proceed as well as some reason for optimism. The options described here are not exhaustive, and they may not even turn out to be the most effective. But the literature on human behavior and environmental protection provides a useful set of starting points. As Daniel Farber observes: "The important thing is not to identify the ideal set of techniques but to get started on the problem. Experience rather than theory will teach us the most about what techniques work."[140] We need to address the challenge of growing energy consumption, and we do not have the luxury of simply ignoring it or writing it off as intractable.

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139. Daniel A. Farber, *Controlling Pollution by Individuals and Other Dispersed Sources*, 35 ENVTL. L. REP. 10 at 745, 752-53 (2005).

140. *Id.* at 753.