

ARTICLES

Stabilizing and Then Reducing U.S. Energy Consumption: Legal and Policy Tools for Efficiency and Conservation

by John Dernbach and the Widener University Law School Seminar on Energy Efficiency

Editors' Summary: Rising global demand for energy, high energy prices, climate change, and the threat of terrorism all point to the need for greater energy efficiency and conservation in the United States. While technological innovation is plainly needed, our laws and institutional arrangements must also play an important role. The United States has scores of legal and policy tools from which to choose to improve energy efficiency and curb energy consumption. This Article, which grows out of a Spring 2006 seminar at the Widener University School of Law, evaluates a handful of these tools: transit-oriented development; fuel taxation; real-time pricing for electricity use; public benefit funds; improving the efficiency of existing residential and commercial buildings; and expanding the use of rail freight. Greater efficiency and conservation based on those and other tools may allow us to stabilize U.S. energy consumption and then reduce it. As challenging as that goal might be, there is considerable evidence to believe that it is achievable.

I. Introduction

No energy policy choices available to the United States are as attractive and necessary as energy efficiency and conservation. Energy efficiency involves doing the same amount of work, or producing the same amount of goods or services, with less energy.¹ Energy conservation is a broader term; it involves using less energy, regardless of the whether energy efficiency has changed.² Energy efficiency and conservation provide environmental benefits, to be sure; the gallon of gas or the kilowatt of electricity that is not used is the cleanest of all. That unused gallon or kilowatt, moreover, is also

John Dernbach is a Professor at Widener University School of Law. From July 2003 to December 2005, he was on leave, serving as Director of the Policy Office at the Pennsylvania Department of Environmental Protection. The students participating in the seminar were Robert Altenburg, Thomas Corcoran, Norman Marden, Allison Rafferty, Christopher Reibosome, Edward Ruud, and David Sunday. Robert Altenburg also provided research assistance. Don Brown, Bry Danner, Will Delavan, Chuck Kutscher, Dan Lashof, Sonny Popowsky, and Bob Power provided helpful comments on a draft of the Article. Professor Dernbach is responsible for any errors. Please send comments or questions to jdernbach@widener.edu.

1. NAT'L ENERGY POLICY DEV. GROUP, NATIONAL ENERGY POLICY 1-3 (2001), available at <http://www.whitehouse.gov/energy/National-Energy-Policy.pdf>. One common approach is to measure the amount of heat energy needed to generate a given amount of electrical energy. This is typically measured in British thermal units (Btus) per kilowatt hour (kWh). As a general rule, the more efficient the process, the less fuel is consumed and the lower the environmental and economic impacts.

2. *Id.*

the cheapest of all. Even though energy efficiency often involves additional up-front investment, savings from efficiency provide a return on that investment and often exceed it. Energy efficiency and conservation can also increase national security by reducing dependence on foreign sources and reducing stress on energy infrastructure, such as transmission lines and pipelines. Efficiency and conservation can strengthen, and have strengthened, the national economy, creating jobs and reducing energy costs for businesses and individuals, including the poor. Unlike many other energy policy choices, which involve long-term investments and technology development, increased emphasis on efficiency and conservation can deliver results in the short to medium term.

Energy efficiency has an impressive track record. Energy-efficiency improvement can be measured in terms of energy intensity—energy consumption per dollar of gross domestic product (GDP). Energy intensity reductions occur for a variety of reasons, including higher energy prices, technological improvements, economic restructuring, and legal requirements. Between 1949 and 2004, energy intensity in the United States (measured in 2000 dollars) declined from 19.57 to 9.20 thousand British thermal units (Btus) per dollar.³ A number of factors contributed to the improvement in energy efficiency during this period, including more efficient industrial and transportation equipment, more effi-

3. U.S. Dep't of Energy (DOE), Energy Info. Admin., *Energy Consumption, Expenditures, and Emissions Indicators, 1949-2004*, <http://www.eia.doe.gov/emeu/aer/txt/ptb0105.html> (last visited July 21, 2006).

cient lighting and appliances, and more efficient electric generating equipment.⁴ The savings to consumers and businesses from energy intensity improvements in just one part of that 55-year period—1973 to 2000—were more than \$430 billion.⁵ Between 1972 and 2000, energy intensity declined at an average annual rate of about 2% per year.⁶ In its *Annual Energy Outlook 2006*, the Energy Information Administration projected energy intensity to decline at an average annual rate of 1.8% from 2004 until 2030.⁷

Yet no energy policy choice creates as much ambivalence as energy efficiency and, perhaps more pointedly, energy conservation. The United States produces and uses a great deal of energy,⁸ and many equate American affluence with energy use. They thus see using less energy as inconsistent with the American lifestyle, and even as a form of martyrdom or impoverishment. When the bipartisan National Commission on Energy Policy issued recommendations on national energy policy in 2004, it felt compelled to define energy efficiency as “doing more with less, as opposed to suffering hardships or closing businesses.”⁹ So our national understanding of energy efficiency has been defined by two conflicting story lines—one about opportunities and the other about limits.¹⁰

Our energy-efficiency and conservation laws reflect that ambivalence. On one hand, energy-efficiency laws for appliances and electrical equipment have achieved considerable energy and cost savings.¹¹ On the other hand, the average required fuel economy for new cars has not changed since 1990.¹² In the Energy Policy Act of 2005,¹³ the U.S. Congress saw fit to expand or strengthen efficiency standards for a variety of products¹⁴ as well as commercial and industrial equipment.¹⁵ But much of its work on energy effi-

ciency consisted of symbolic or token actions. The Act extends Daylight Savings Time by a month in the spring and a month in the fall, beginning in 2007, which will save a real but modest amount of energy.¹⁶ The Act also provides a generous and widely publicized tax credit for the purchase of hybrid vehicles after January 1, 2006.¹⁷ But for any given manufacturer, the tax credit begins to expire after it has sold its first 60,000 hybrid cars. Because Toyota already sold its 60,000th Prius in May 2006, its tax credit will end in late 2007.¹⁸

At least three converging factors indicate that the United States needs to resolve this ambivalence on behalf of an intense commitment to increasing energy efficiency *and* reducing energy consumption throughout all sectors of the national economy and at all levels of government. These three factors—growth in global energy demand and consequent higher fuel prices, climate change, and terrorism—all occur in the context of an increasingly interconnected and competitive world.

Growth in world energy demand is exemplified in recent years by economic growth and energy demand in China and India. Annual growth in energy demand from these and other countries is expected to be three times as fast as annual energy demand growth in developed countries.¹⁹ Growing energy demand and other factors are leading to high and fluctuating energy prices and the prospect of permanent high (and fluctuating) energy prices. The aspirations of the people in developing countries underscore another dimension to growing demand—sharp differences in per capita energy use. Per capita energy consumption in the United States is 340 million Btus per year, almost 10 times that of the average Chinese citizen, and more than 25 times that of the average Indian citizen.²⁰ To the extent that people in these countries aspire to the same standard of living as the United States, and thus the same energy use, it is difficult to conceive how the world can supply that energy at a reasonable economic or environmental cost.

The steadily accumulating evidence on climate change indicates that the problem is more severe and challenging than we may have previously thought. Peer-reviewed science journals and reports contain a steady stream of evidence that climate change is occurring and that humans bear most of the responsibility.²¹ Scientific evidence indicating

4. U.S. DOE, ENERGY INFO. ADMIN., EMISSIONS OF GREENHOUSE GASES IN THE UNITED STATES 2004: EXECUTIVE SUMMARY 4 (2006), available at [http://www.eia.doe.gov/oiaf/1605/ggrpt/summary/pdf/0573\(2004\)es.pdf](http://www.eia.doe.gov/oiaf/1605/ggrpt/summary/pdf/0573(2004)es.pdf).
5. American Council for an Energy-Efficiency Economy, *Energy Efficiency Progress and Potential*, <http://www.aceee.org/energy/effact.htm> (last visited July 21, 2006).
6. Lynn Price & Mark D. Levine, *Production and Consumption of Energy*, in *STUMBLING TOWARD SUSTAINABILITY* 79, 87 (John C. Dernbach ed., 2002).
7. U.S. DOE, ENERGY INFO. ADMIN., ANNUAL ENERGY OUTLOOK 2006 WITH PROJECTIONS TO 2030, at 65 (2006), available at [http://www.eia.doe.gov/oiaf/aeo/pdf/0383\(2006\).pdf](http://www.eia.doe.gov/oiaf/aeo/pdf/0383(2006).pdf) [hereinafter ANNUAL ENERGY OUTLOOK 2006].
8. See *infra* Part II.
9. NAT'L COMM'N ON ENERGY POLICY, ENDING THE ENERGY STALEMATE: A BIPARTISAN STRATEGY TO MEET AMERICA'S ENERGY CHALLENGES 30 (2004). Part of the reason, no doubt, stems from confusion of energy efficiency with energy conservation. Conservation, the broader term, includes changes in life style that involve the use of less energy. NATIONAL ENERGY POLICY, *supra* note 1, at 1-3.
10. Cf. THOMAS L. FRIEDMAN, THE WORLD IS FLAT: A BRIEF HISTORY OF THE TWENTY-FIRST CENTURY 452-53 (2005) (explaining that imagination is shaped by “the narratives that people are nurtured on—the stories and myths they and their religious and national leaders tell themselves”).
11. Steven Nadel, *Appliance and Equipment Efficiency Standards*, 27 ANN. REV. ENERGY & ENVT. 159 (2002) (summarizing and explaining accomplishments).
12. 42 U.S.C. §32902(b); 40 C.F.R. §531.5(a).
13. Pub. L. No. 109-58, 119 Stat. 594 (compiled in scattered sections of the U.S. Code).
14. Energy Policy Act of 2005, §135; 42 U.S.C. §§6291-6297.
15. *Id.* §136; 42 U.S.C. §§6311-6316.

16. *Id.* §110; 15 U.S.C. §260a(a).

17. *Id.* §1341(a); 26 U.S.C. §30B(d).

18. David Leonhardt, *U.S. Hybrids Get More Miles Per Congress*, N.Y. TIMES, June 21, 2006, at C1.

19. By 2030, energy consumption is expected to triple for the part of Asia that is outside the Organization for Economic Cooperation and Development. This part of Asia includes China and India but excludes Japan. U.S. DOE, ENERGY INFO. ADMIN., INTERNATIONAL ENERGY OUTLOOK 2006, at 7-8 (2006), available at [http://www.eia.doe.gov/oiaf/ieo/pdf/0484\(2006\).pdf](http://www.eia.doe.gov/oiaf/ieo/pdf/0484(2006).pdf). In 2003, China and India together had a GDP nearly as large as that of the United States; in 2030, their combined GDP is projected to be almost double that of the United States. *Id.* at 18.

20. U.S. DOE, 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>. U.S. per capita energy use is also more than double that of the average west European and more than 21 times that of the average African. *Id.*

21. See, e.g., NATIONAL RESEARCH COUNCIL, SURFACE TEMPERATURE RECONSTRUCTIONS FOR THE LAST 2,000 YEARS 3 (2006) (concluding “with a high level of confidence that global mean surface temperature was higher during the last few decades of the 20th century than

that climate change is causing more intense hurricanes is perhaps the most dramatic example, particularly in light of recent hurricanes.²² The economic impact of climate change mitigation, of course, is a matter of considerable interest for policymakers. Because of the potential for cost savings, energy efficiency is a tool employed by virtually every corporation that has set greenhouse gas reduction goals. Many of these companies, including at least one major company (Dupont) that has held energy use flat since 1990, report considerable savings.²³ Many industry sectors, in fact, see high energy use as a growing business risk because of high energy prices, unreliable supplies, climate change, competition from other industries over energy resources, and other factors.²⁴

Third, the threat and reality of terrorism against energy supply chains increase the necessity of reducing dependence on those supply chains through any means possible, including reducing the need for that energy. The energy security policy developed in the wake of the 1973 Arab oil embargo was intended to protect against loss of supplies from producing countries. Daniel Yergin argues that energy security should now “be expanded to include the protection of the entire energy supply chain and infrastructure,” which he describes as “an awesome task.”²⁵ For these and

other reasons, a range of expert opinion strongly recommends that the United States—public and private sectors—make a substantially greater effort at energy conservation and efficiency.²⁶

This Article responds to these converging trends with a simple but positive thesis: We have at our disposal the legal and policy tools we need to stabilize the growth in U.S. energy consumption and, within a reasonable time, to reduce energy efficiency and by reducing the need to use energy. If the United States decides to pursue that course, in fact, it has scores of legal and policy tools from which to choose. Some of these laws address a broad range of sectors, and some are limited to particular economic sectors. Some of these laws would be new, and some would repeal or modify existing laws. Many have been implemented at the state level. These laws and policies, if crafted properly, would do much more than encourage or require energy efficiency. They would also foster economic growth, increase American competitiveness, encourage job growth, increase U.S. security, reduce dependence on foreign energy supplies, lessen demand pressure that is contributing to higher prices, and lessen emissions of greenhouse gases and other air pollutants. In so doing, they would model an alternative form of development—sustainable development—that would likely constructively influence the development model that other countries are pursuing.²⁷ These benefits, and this goal, may even be prerequisites for a growing economy in the years ahead.

This Article grows out of a Spring 2006 seminar at the Widener University Law School. Many of the students wrote about a legal tool for energy efficiency or energy conservation. These include transit-oriented development, fuel taxation, the use of real-time pricing for electricity to encourage energy efficiency, and the use of public benefit funds. Others wrote about a particular conservation or efficiency option and the many legal and policy tools that could be employed to address that issue. These options were improving the efficiency of existing residential and commercial buildings and expanding the use of rail freight. This Article synthesizes and summarizes the student papers as well as other information²⁸ and then evaluates these tools. In some cases, the list of tools and issues has been expanded beyond those addressed in the seminar. Even so, this analysis is illustrative, not exhaustive. A great many other tools and options exist to address the many energy consumption issues that we face.

This approach—focusing on legal and policy tools for energy efficiency and conservation—seems particularly ap-

during any comparable period during the preceding four centuries”); Jonathan T. Overpeck et al., *Paleoclimatic Evidence for Future Ice-Sheet Instability and Rapid Sea-Level Rise*, 311 *SCIENCE* 1747 (2006) (“record of past ice-sheet melting indicates that the rate of future melting and related sea-level rise could be faster than widely thought”); Isabella Velicogna & John Wahr, *Measurements of Time-Variable Gravity Shows Mass Loss in Antarctica*, 311 *SCIENCE* 1754 (2006) (describing significant loss of ice mass in Antarctica); J. Alan Pounds et al., *Widespread Amphibian Extinctions From Epidemic Disease Driven by Global Warming*, 439 *NATURE* 161 (2006) (concluding with greater than 99% level of certainty that “large scale warming is a key factor in the disappearances” of two-thirds of harlequin frog species in American tropics because warming creates an optimum environment for a bacteria that is lethal to them).

22. See, e.g., Carlos D. Hoyos et al., *Deconvolution of the Factors Contributing to the Increase in Hurricane Intensity*, 312 *SCIENCE* 94 (2006); Peter J. Webster et al., *Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment*, 309 *SCIENCE* 1844 (2005). There is also evidence indicating that climate change is contributing to an increase in the number of hurricanes. Michael E. Mann & Kerry A. Emanuel, *Atlantic Hurricane Trends Linked to Climate Change*, 87 *EOS* 233 (2006).
23. THE CLIMATE GROUP, *CARBON DOWN PROFITS UP* (2d ed. 2005); Michael Northrop, *Leading by Example: Profitable Corporate Strategies and Successful Public Policies for Reducing Greenhouse Gas Emissions*, 14 *WIDENER L.J.* 21 (2004). For example, “IBM has turned energy efficiency into a hidden profit center,” saving \$791 million since 1990. *Id.* at 34. Dupont saved \$2 billion between 1990 and 2000 by keeping energy use flat while increasing output by 40%. *Id.* at 36. The company is still holding energy use flat, not simply to save money, but as a strategic objective. John Kane, Senior Consulting Engineer, Dupont, Presentation at 2005 ENERGY STAR Leadership Conference (Oct. 26, 2005), http://www.energystar.gov/ia/business/industry/Kane_DuPont.pdf#search=%22dupont%20energy%20use%20flat%202005%22 (last visited Oct. 12, 2006). See also Carolyn Whetzel, *Companies Say Lower Energy Consumption Vital to Limiting Greenhouse Gas Emissions*, 37 *Env’t Rep.* (BNA) No. 4, at 169 (Jan. 27, 2006) (reporting that companies enrolled in EPA’s Climate Leaders program view energy-efficiency options as “among the easiest, quickest, and often most cost-effective strategies for managing greenhouse gas emissions”).
24. See, e.g., COMM. ON GRAND CHALLENGES FOR SUSTAINABILITY IN THE CHEMICAL INDUS., NAT’L RESEARCH COUNCIL, *SUSTAINABILITY IN THE CHEMICAL INDUSTRY: GRAND CHALLENGES AND RESEARCH NEEDS* 54-55 (2006).
25. Daniel Yergin, *Ensuring Energy Security*, *FOREIGN AFFAIRS*, Mar./Apr. 2006, at 69, 78.

26. See, e.g., *id.* at 80; RICHARD M. HAASS, *THE OPPORTUNITY: AMERICA’S MOMENT TO ALTER HISTORY’S COURSE* 134-35 (2005).

27. See *STUMBLING TOWARD SUSTAINABILITY*, *supra* note 6 (assessing U.S. progress on sustainable development for the 10-year period following the 1992 United Nations Conference on Environment and Development, and making recommendations for additional progress).

28. Students registered for the seminar knowing that an article like this would be prepared afterwards. They were informed of my two previous Articles based on seminar projects. John Dernbach & the Widener University Law School Seminar on Global Warming, *Moving the Climate Change Debate From Models to Proposed Legislation: Lessons From State Experience*, 30 *ELR* 10933 (Nov. 2000) [hereinafter *Lessons From State Experience*]; John Dernbach & the Widener University Law School Seminar on Law and Sustainability, *U.S. Adherence to Its Agenda 21 Commitments: A Five-Year Review*, 27 *ELR* 10504 (Oct. 1997).

appropriate for two additional reasons. Much of the media discussion about energy efficiency is about what individuals or businesses have done.²⁹ These examples are important; they make abstract ideas and policies appear more real and more achievable. But that approach, if taken to an extreme, would suggest that energy efficiency is a personal or business decision that has little to do with law. Vice President Dick Cheney famously characterized that approach in 2001 by describing energy efficiency as a matter of personal virtue. He has more recently described energy efficiency as an appropriate subject for law and policy, and this Article is intended to underscore that point.

In addition, this approach focuses on energy efficiency and conservation by themselves, for all of the reasons that can be brought to bear on their behalf, rather than as one suite of tools that can be used to address climate change or energy policy. Analyses of climate change or energy policy that conflate renewable energy, energy efficiency and conservation, greenhouse gas emissions reductions, and carbon sequestration sometimes miss what makes energy efficiency and conservation different. They are not merely another set of choices; they represent the approach that most directly addresses the core problem—high and growing energy consumption. This Article is not intended to discount the importance of reducing greenhouse gas emissions, increasing the use of renewable and other noncarbon-based energy sources, providing for long-term carbon storage, and protecting against the adverse effects of climate change. All of these are needed.³⁰ Nor does this Article take a position on the many other energy choices and decisions that the country faces in the decades ahead. Rather, this Article focuses on energy efficiency and conservation to provide a clearer picture of what these approaches, by themselves, could achieve. It also suggests that climate change would more effectively be addressed in combination with economic development and national security concerns than as a stand-alone issue.

Part II of this Article shows that U.S. energy consumption, which is already substantial, is projected to grow even more over the next quarter century in every sector of the economy. The George W. Bush Administration is working toward a modest reduction in greenhouse gas intensity—a measure of greenhouse gas emissions per dollar of GDP—but the goal is too modest to have a significant impact on greenhouse gas emissions or energy consumption. A

more direct and substantial approach, Section II suggests, is to stabilize and reduce U.S. energy consumption.

Part III reviews selected legal tools and policies for reducing energy consumption by increasing energy efficiency and conservation. It begins with an overview of perhaps the two most prominent and successful U.S. energy-efficiency programs—one directed at appliances and equipment and the other directed at fuel efficiency in motor vehicles. Part III then describes a variety of other options and legal tools that have been or can be employed to improve energy efficiency or conservation at the state or federal level, focusing on those tools described by students in the seminar.

Part IV examines additional evidence that the stabilization goal is achievable, including other available energy-efficiency options and legal tools, projected energy savings contained in a variety of energy-efficiency studies, and more detailed data on energy intensity. The legal and policy tools assessed by the students, as well as those contained in this additional evidence, indicate that a goal of stabilizing and then reducing U.S. energy consumption is within reach. They also indicate that achieving this goal would bring considerable economic, social, environmental, and security benefits to the United States.

II. U.S. Energy Consumption

All of America's energy challenges are rooted in two facts: we consume a great deal of energy, and we are on course to consume a great deal more. The United States is the world's largest energy consumer.³¹ On an annual basis, this country, which has roughly 5% of the world's population, is responsible for about 25% of the world's annual energy consumption.³² In addition, as President Bush has acknowledged, this country is the world's largest producer of greenhouse gases (as a percentage of the world's greenhouse gas emissions).³³ The United States is also the world's largest emitter of fossil fuel-related carbon dioxide. With 24% of the world's carbon dioxide emissions from fossil fuels, U.S. emissions are 66% greater than those of the next largest emitter, China.³⁴

U.S. energy use as well as greenhouse gas emissions are also projected to grow in the coming decades. These projections would not be changed in any substantial way by achievement of President Bush's 2002 goal of reducing the greenhouse gas intensity of the U.S. economy by 18% over 10 years.

A. Overview of Trends

Unless there are new energy conservation policies or behavior changes, total U.S. primary energy consumption is ex-

29. See, e.g., Chad Terhune, *Frito-Lay Aims to Cut Gas Bill's Bite*, WALL ST. J., June 5, 2006, at B2 (describing actions to reduce energy required to cook Doritos and other chips that the company says have saved \$40 million); Tom Kenworthy, *One Family Takes on Carbon Dioxide*, USA TODAY, June 1, 2006, at 7D (describing the actions of a Colorado family that claims to be causing one-fourth of the carbon emissions of a typical family in that state).

30. This is particularly true because of the substantial reductions in greenhouse gas emissions that will be required to stabilize "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." United Nations Framework Convention on Climate Change, art. 2, May 9, 1992, 1771 U.N.T.S. 107; James Hansen et al., *Global Temperature Change*, 103 PROC. NAT'L ACAD. SCI. 14288 (2006).

This Article's focus on energy consumption is premised in large measure on the substantial contribution that fossil fuel use makes to greenhouse gas emissions. There will hopefully come a time when energy use will not cause or contribute to greenhouse gas emissions. At that point, the climate change basis for reducing energy consumption will no longer exist, although other concerns with high energy consumption may remain.

31. 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/SHSU5BWHU6/\\$File/uscar.pdf](http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SHSU5BWHU6/$File/uscar.pdf).

32. U.S. DOE, Energy Info. Admin., *Energy Kid's Page*, <http://www.eia.doe.gov/kids/energyfacts/saving/efficiency/savingenergy.html> (last visited July 21, 2006).

33. George W. Bush, *President Bush Discusses Global Climate Change*, <http://www.whitehouse.gov/news/releases/2001/06/20010611-2.html> (last visited July 21, 2006).

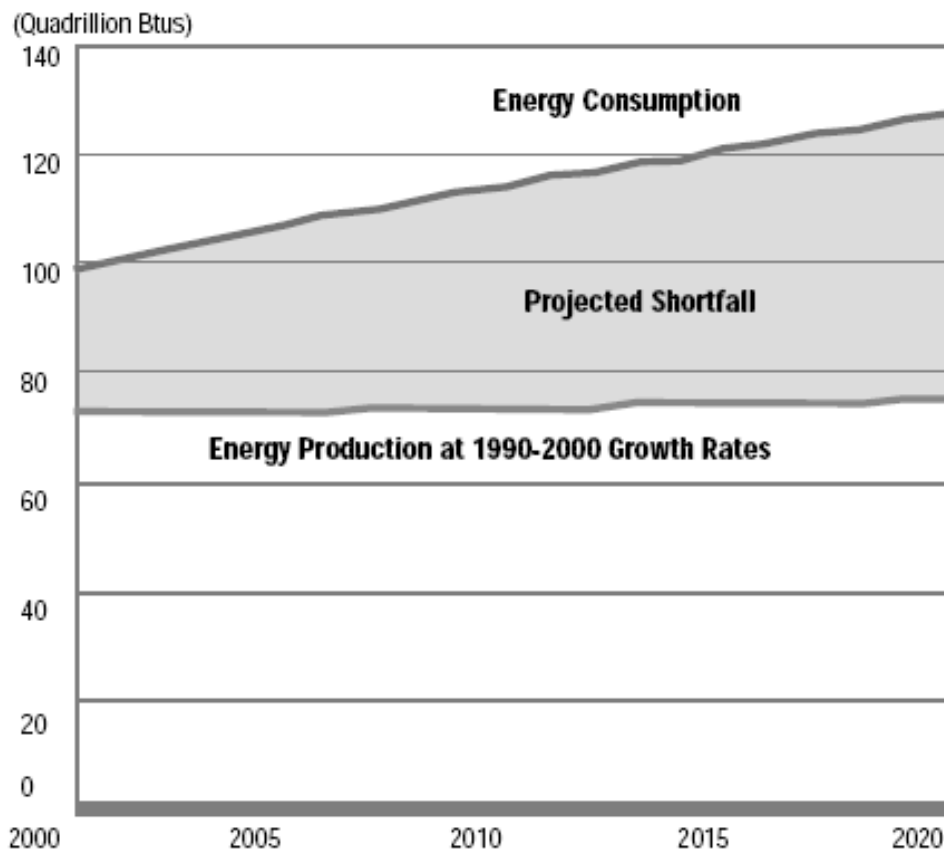
34. G. Marland et al., *Global, Regional, and National CO₂ Emissions*, http://cdiac.ornl.gov/trends/emis/tre_usa.htm (last visited July 21, 2006).

pected to grow by one-third over the next quarter century. Energy use is projected to grow from 98 quadrillion Btus, or quads, to 134 quads, or 1.1% per year until 2030, according to the Energy Information Administration.³⁵ These increases can be examined in three ways: (1) the projected shortfall between consumption and production; (2) the economic sector in which they occur; and (3) fuel type. These approaches, taken together, provide a sense of the landscape upon which any further effort to improve energy efficiency and conservation would need to be built. The data show that energy consumption is projected to increase for all economic sectors and for all fuel types. Differences in energy consumption exist across economic sectors and fuel types, however, in no small part because of the presence or absence

of laws that would drive greater efficiency. The data also indicate that energy efficiency has made, and will likely continue to make for the foreseeable future, a greater contribution than renewable energy.

The Bush Administration's National Energy Policy identifies projected growth in energy demand as the source of the nation's energy problems. Growing consumption is a problem, according to the Administration, because it will outpace the rate of energy production. "A fundamental imbalance between supply and demand defines our nation's energy crisis. As [Figure 1] illustrates, if energy production increases at the same rate as during the last decade our projected energy needs will far outstrip expected levels of production."³⁶

Figure 1
Growth in U.S. Consumption Is Outpacing Production³⁷



35. ANNUAL ENERGY OUTLOOK 2006, *supra* note 7, at 11, 65, 66. Total primary energy consumption or use "is the total consumption of all forms of energy in both the conversion of one form of energy to another, such as the production of electricity, and by end use sectors such as government, business and households." Australian Government, *Securing Australia's Energy Future: Energy in Australia*, http://www.dpmc.gov.au/publications/energy_future/chapter1/2_sector.htm (last visited July 12, 2006).

36. NAT'L ENERGY POLICY DEV. GROUP, *supra* note 1, at viii.

37. *Id.*

Figure 2 provides a broader perspective on U.S. energy use over the next several decades. It shows that GDP is projected to more than double by 2030, and that total U.S. energy use (and carbon dioxide emissions) will increase by about one-third.³⁸ That energy consumption is projected to increase by *only* one-third, rather than doubling, can be attributed in substantial part to energy-efficiency measures and practices that have been built into the U.S. economy over the past several decades.³⁹

Figure 2
Energy Use and Related Statistics
(Quadrillion Btus per year unless otherwise noted)⁴⁰

	2004	2030	Annual Growth 2004-2030 (percent)	Total Growth 2004-2030
Delivered Energy Use	73.18	98.40	1.1%	25.22
Total Energy Use	99.68	133.88	1.1%	34.20
Population (millions)	294.10	364.79	0.8%	70.69
GDP (billion 2000 dollars)	10,321	23,112	3.0%	12,791
Carbon Dioxide Emissions (million metric tons)	5,795.5	8,114.5	1.2%	2,319.0

As Figure 3 indicates, energy use is projected to grow in each of the four sectors into which the U.S. economy is divided—residential, commercial, industrial, and transportation. Electricity is listed separately, after the total, because it crosses all sectors.⁴¹

38. Figure 2 also shows a significant difference shown between total energy use and delivered energy use. For electricity, most of this difference occurs

at steam-electric power plants (conventional and nuclear) in the conversion of heat energy into mechanical energy to turn electric generators. . . . In addition to conversion losses, other losses include power plant use of electricity, transmission, and distribution of electricity from power plants to end-use consumers (also called “line losses”), and unaccounted for electricity. . . . Overall, approximately 67 percent of total energy input is lost in conversion; of electricity generated, approximately 5 percent is lost in plant use and 9 percent is lost in transmission and distribution.

U.S. DOE, ENERGY INFO. ADMIN., ANNUAL ENERGY REVIEW 2006 at 64 (2006), available at <http://www.eia.doe.gov/aer/pdf/aer.pdf>.

39. See *supra* note 4 and accompanying text.

40. ANNUAL ENERGY OUTLOOK 2006, *supra* note 7, at 136. The data in the right hand column was derived by calculation.

41. *Id.* at 66.

Figure 3
U.S. Energy Consumption by Sector
(Quadrillion Btus per year)⁴²

Sector	2004	2025	2030	Annual Growth 2004-2030 (percent)	Total Growth 2004-2030 (quadrillion Btus)
Residential	21.04	25.88	26.64	0.9%	5.60
Commercial	17.37	24.82	26.73	1.7%	9.36
Industrial	33.27	38.77	40.58	0.8%	7.31
Transportation	28.00	37.52	39.93	1.4%	11.93
TOTAL	99.68	126.99	133.88	1.1%	34.20
Electricity	38.57	50.86	53.71	1.3%	15.14

Two sectors are projected to grow faster than the 1.1% annual growth rate projected for total energy use—commercial and transportation. Together, these two sectors account for 21.29 quadrillion Btus, or about two-thirds of the projected overall growth in energy consumption. The growth in commercial energy consumption is driven in part by the growth in commercial floorspace, which is projected to increase at about 1.6% per year during this period. The transition to a more service oriented economy is also occurring at a time when these services require more electricity because of growing use of computers and Internet services. In addition, an aging population is expected to require more electricity for medical equipment where these people live or receive medical care.⁴³

The transportation sector is projected to account for more of the nation’s increased energy use than any other sector, and is projected to be nearly the largest sector by 2030. Growth in energy use for transportation is driven in large part by growth in automobile and other light-duty vehicle travel. Significantly, light-duty vehicle travel is projected to increase by 1.8% annually, compared to a 2.9% annual growth over the past three decades. By transportation mode, a somewhat different story emerges. Energy use by freight trucks is projected to increase 2.3% per year, compared to 3.0% annually in the past. Energy use for air travel is projected to increase 1.8% annually, compared to 3.3% historically.

The largest share of energy use by sector, now and in 2030, is in the industrial sector. This is also the sector in which energy use is growing most slowly. The manufacturing part of the industrial sector includes such energy intensive industries as cement, bulk chemicals, iron, and steel.⁴⁴ Overall industrial energy intensity dropped by 3.0% annually between 1980 and 2004, due in large part to greater attention to energy efficiency in the 1970s and the early

42. *Id.* at 134-35. The data in the right hand column was derived by calculation.

43. *Id.* at 69.

44. *Id.* at 72. The nonmanufacturing part of this sector is comprised of agriculture, mining, and construction. *Id.*

1980s, and also because of a decline in U.S. manufacturing.⁴⁵ Energy intensity in the industrial sector is expected to decline at a slower annual rate, 2.1%, between 2004 and 2030.⁴⁶ Projected changes in energy intensity tend to vary by industry. In the steel industry, for example, more efficient electric arc furnaces are being installed to meet new demand or to replace old and less efficient furnaces.⁴⁷

The residential sector is projected to be the smallest of the four sectors in 2030 in terms of overall energy use, although it will likely grow at a steady pace. Electricity use per capita has increased by more than 50% in this sector since 1980, even as natural gas and petroleum use per capita have declined. A major reason is demographic; as people move south and west, they require more electricity for air conditioning and less natural gas and petroleum for heating. Overall energy use for space heating, water heating, and refrigeration is projected to decline due to more energy efficient appliances. Electricity use from computers, larger televisions, and the like, however, is projected to increase significantly.⁴⁸

Electricity is used primarily in the residential, commercial, and industrial sectors. Electricity use is expected to grow by an average annual rate of 1.3% between 2004 and 2030. Overall, growth in electricity consumption is expected to account for almost one-half of the growth in U.S. energy use. Growth in electrical demand will require the construction of as many as 1,300 power plants, each with a generating capacity of 300 megawatts (MWs), during the same period. Some existing facilities will likely be shut down, but most of this generating capacity will be new.⁴⁹

Figure 4 provides an overview of the projected energy consumption during the same period by fuel type:

Figure 4
U.S. Energy Consumption by Fuel Type
(Quadrillion Btus per year)⁵⁰

Fuel Type	2004	2030	Annual Growth 2004-2030 (percent)	Total Growth 2004-2030 (quadrillion Btus)
Petroleum	40.08	53.58	1.1%	13.50
Natural Gas	23.07	27.66	0.7%	4.59
Coal	22.53	34.49	1.7%	11.96
Nuclear Power	8.23	9.09	0.4%	0.86
Renewal Energy	5.74	9.02	1.8%	3.28
Electricity Imports	0.04	0.05	0.9	0.01
TOTAL	99.68	133.88	1.1	34.20

45. *Id.* at 71.

46. *Id.* at 74.

47. *Id.* at 73.

48. *Id.* at 67.

49. ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, OECD ECONOMIC SURVEYS: UNITED STATES 176 (2005).

Renewable energy is the fastest growing but smallest fuel type (except for electricity imports); it is projected to be more than 50% larger in 2030 than it is today. State laws and policies that encourage the use of renewable energy, including renewable energy portfolio standards, provide much of the reason for this growth. New technologies, higher natural gas and oil prices, and federal tax credits provide other reasons.⁵¹

Just behind renewable energy in its annual growth is coal. Coal use is projected to grow more rapidly after 2020 because it is expected to replace natural gas for many uses and because coal-to-liquids production is expected to grow in earnest. Chief among these liquids would be petroleum products.⁵² Because coal is abundant in the United States, facilities that could turn coal into gasoline and oil would reduce the demand for foreign petroleum.

Coal and petroleum account for 25.46 quads of the projected growth of 34.20 quads in energy consumption, or about 60%. Petroleum, now and in 2030, is the largest type of fuel used in the United States; it represents about 40% of the total energy supplied by all fuels. The projected annual growth rate of 1.1%, however, is lower than the growth rate projected only one year earlier because of higher oil prices.⁵³

The two slowest growing fuel types are natural gas and nuclear power, both of which are expected to grow at rates that are much lower than the 1.1% annual growth rate for energy. The growth rate for natural gas, 0.7%, is lower than the growth rate projected in 2005, mostly because of higher natural gas prices, but also because it is expected to lose market share to coal.⁵⁴ Growth in nuclear power is nearly flat. Because of the Energy Policy Act of 2005, which included provisions to support development of new nuclear plants, increased production is projected from new plants that would begin to generate electricity after 2013.⁵⁵

B. Greenhouse Gas Intensity Goal

The United States has no goal concerning overall energy consumption or per capita energy consumption. Instead, the United States has a greenhouse gas intensity goal. While an ambitious greenhouse gas intensity goal could be employed to reduce overall greenhouse gas emissions, or even energy consumption, greenhouse gas intensity is not the same as either. Moreover, the U.S. goal does not appear likely to have a significant effect on greenhouse gas emissions or energy consumption.

In February 2002, President Bush established a goal of reducing the greenhouse gas intensity of the U.S. economy by 18% by 2012, which is projected to prevent the emission of 500 million metric tons of emissions over the decade.⁵⁶

50. ANNUAL ENERGY OUTLOOK 2006, *supra* note 7, at 136. The data in the right hand column was derived by calculation.

51. *Id.* at 6.

52. U.S. DOE, Energy Info. Admin., *The National Energy Modeling System: An Overview 2003*, <http://www.eia.doe.gov/oiaf/aeo/overview/petroleum.html> (last visited July 21, 2006) (explaining coal to liquids production).

53. ANNUAL ENERGY OUTLOOK 2006, *supra* note 7, at 6.

54. *Id.*

55. *Id.* at 7.

56. The White House, *Global Climate Change Policy Book* (2002), <http://www.whitehouse.gov/news/releases/2002/02/climatechange.html> (last visited July 21, 2006).

Greenhouse gas intensity (greenhouse gas emissions per dollar of GDP) is closely related to, but not the same as, energy intensity. The greenhouse gas intensity goal, which President Bush described as an alternative to the Kyoto Protocol, is a centerpiece of the Bush Administration's climate change strategy.⁵⁷ About one year earlier, in March 2001, President Bush repudiated the Protocol.⁵⁸ This greenhouse gas intensity policy works out to a 1.96% annual reduction.⁵⁹ The Administration claimed that this would be an improvement over the 1.4% annual improvement in greenhouse gas intensity that was then projected for the same period.⁶⁰ If the effort succeeds, U.S. greenhouse gas emissions for this decade will be 2% lower than otherwise projected.⁶¹ By contrast, the Kyoto Protocol would have reduced U.S. greenhouse gas emissions by about 30% below projected emissions.⁶²

The Administration has put in place a variety of voluntary programs to achieve this goal.⁶³ For example, the U.S. Department of Energy's (DOE's) Climate VISION (Voluntary Innovative Sector Initiatives: Opportunities Now) program is a voluntary government-industry partnership that involves the Business Roundtable as well as trade and business associations representing 14 energy-intensive industries.⁶⁴ In return for their commitment to adopt more advanced energy-efficiency practices, participating industries receive a variety of assistance for business planning, assessment, software, and energy technology.⁶⁵

In addition, the Energy Policy Act of 2005 directed that a newly created Committee on Climate Change Technology submit to the president 18 months after its enactment a "national strategy to promote the deployment and commercialization of greenhouse gas intensity reducing technologies and practices."⁶⁶ The Committee is also required to develop recommendations for the removal of barriers for the development and deployment of such technologies and practices.⁶⁷

Both energy intensity and greenhouse gas intensity are relative measures, and both are determined by their relationship to GDP. Neither measures absolute improvements in energy efficiency, absolute reductions in greenhouse gas emissions, or absolute reductions in energy consumption. In 2004, for example, U.S. greenhouse gas intensity was 2.1% lower than it was in 2003.⁶⁸ GDP grew by 4.2%, but U.S. greenhouse gas emissions were just 2% higher than they had been in 2003.⁶⁹ Because GDP grew faster than greenhouse gas emissions, the greenhouse gas intensity of the economy declined.

Both greenhouse gas intensity and energy intensity have been declining, in similar ways and by similar amounts, for decades. There have been considerable decade-to-decade variations in the rate of energy intensity decline. The annual average decline in energy efficiency was zero in the 1960s, 1.7% in the 1970s, and 2.4% in the 1980s.⁷⁰ Between 1992 and 2004, the average annual decline was 1.9%.⁷¹ Somewhat similarly, the average annual decline in carbon intensity (a proxy indicator for greenhouse gas intensity prior to 1990) was 0.3% in the 1960s, 1.9% in the 1970s, 2.7% in the 1980s, and 1.6% in the 1990s.⁷² In its *Annual Energy Outlook 2005*, the Energy Information Administration projected a 1.6% annual decline in energy intensity for the next several decades. One year later, in its *Annual Energy Outlook 2006*, it projected energy intensity to decline at an average annual rate of 1.8% from 2004 until 2030.⁷³ Higher energy prices, and consequent lower energy consumption, are the primary reasons for this change.⁷⁴ The projected 1.8% annual reduction for energy intensity is similar to the 18% reduction goal for greenhouse gas intensity by 2012 that President Bush established in 2002.⁷⁵

On the other hand, reducing greenhouse gas intensity involves a greater range of choices than reducing energy intensity. Approximately 80% of U.S. greenhouse gas emissions are energy-related,⁷⁶ but the rest are not. Reductions in

57. *Id.* The United States is a party to the U.N. Framework Convention on Climate Change, *supra* note 30. Parties to the Framework Convention subsequently agreed, at a meeting in Kyoto, Japan, to a protocol to that Convention under which developed countries would reduce greenhouse gas emissions by approximately 5% from 1990 levels by 2008 to 2012. Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 10, 1997, U.N. Doc. FCCC/CP/1997/L.7/Add. 1, reprinted in 37 I.L.M. 22 (1998). Under the Kyoto Protocol, the specific obligation of the United States was to reduce its emissions by 7% below 1990 levels. *Id.* Annex B.

58. Letter from President George W. Bush to Senators Chuck Hagel, Jesse Helms, Larry Craig, and Pat Roberts (Mar. 13, 2001), available at <http://www.whitehouse.gov/news/releases/2001/03/20010314.html>. The president claimed that the Kyoto Protocol would be costly to the American economy and that it failed to impose emissions reduction requirements on major developing country emitters such as China and India. *Id.*

59. Stephen Pacala & Robert Socolow, *Stabilization Wedges: Solving the Climate Problem for the Next 50 Years With Current Technologies*, 305 SCIENCE 968, 969 (2004).

60. *Global Climate Change Policy Book*, *supra* note 56. The 1.4% figure is slightly lower than the annual intensity reductions forecast during the same period. In 2002, a 1.5% annual energy intensity reduction was projected for 2002 to 2020. U.S. DOE, ENERGY INFO. ADMIN., ANNUAL ENERGY OUTLOOK 2002 WITH PROJECTIONS TO 2020: OVERVIEW (2002), available at <http://www.eia.doe.gov/oiaf/archive/aec02/index.html>. The projected energy intensity reduction one year earlier, in 2001, was 1.6%. U.S. DOE, ENERGY INFO. ADMIN., ANNUAL ENERGY OUTLOOK 2001 WITH PROJECTIONS TO 2020, at 5 (2001), available at [http://tonto.eia.doe.gov/FTP/ROOT/forecasting/0383\(2001\).pdf](http://tonto.eia.doe.gov/FTP/ROOT/forecasting/0383(2001).pdf).

61. Letter from John B. Stephenson, Director, Natural Resources and Env't, U.S. Gen. Accounting Office (GAO), to Senators Ernest F. Hollings & John F. Kerry (Oct. 28, 2003), available at <http://www.gao.gov/new.items/d04146r.pdf> (concerning climate change: trends in greenhouse gas emissions and emissions intensity in the United States and other high-emitting nations).

62. NAT'L COMM'N ON ENERGY POLICY, *supra* note 9, at 25.

63. See *Global Climate Change Policy Book*, *supra* note 56.

64. U.S. DOE et al., *Climate VISION: Program Mission*, <http://www.climatevision.gov/mission.html> (last visited July 21, 2006).

65. *Id.*

66. Energy Policy Act of 2005, § 1610(a), (b); 42 U.S.C. § 13389(a), (b).

67. 42 U.S.C. § 13389(g)(1).

68. EMISSIONS OF GREENHOUSE GASES IN THE UNITED STATES 2004, *supra* note 4, at 1.

69. *Id.*

70. ANNUAL ENERGY OUTLOOK 2001, *supra* note 60, at 23.

71. ANNUAL ENERGY OUTLOOK 2006, *supra* note 7, at 7.

72. EMISSIONS OF GREENHOUSE GASES IN THE UNITED STATES 2004, *supra* note 4, at 4.

73. ANNUAL ENERGY OUTLOOK 2006, *supra* note 7, at 65.

74. *Id.* at 6.

75. See *supra* note 60.

76. Carbon dioxide is the dominant greenhouse gas, contributing 5,988.0 of the 7,074.4 teragrams, or 84.6%, of carbon dioxide equivalent that were emitted in 2004. The overwhelming majority of carbon dioxide emissions, in turn, 5656.6 of 5988.0 teragrams in 2004, or 94.5%, are from fossil fuel combustion. U.S. EPA, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-

greenhouse gas intensity can be achieved through means that have little to do with energy consumption. On the energy side, many means other than energy efficiency are available to achieve reductions in greenhouse gas emissions. These include renewable energy, long-term carbon storage or sequestration, and fuel switching to lower carbon fuels (e.g., natural gas instead of coal).

The Bush Administration's greenhouse gas intensity goal may, if successful, achieve slightly more energy efficiency than would otherwise be achieved. Because the greenhouse gas intensity goal is so modest, however, it will be difficult to demonstrate that any further improvement was generated by this initiative. The 1.96% annual reduction over the 2002 to 2012 period is somewhat higher than the 1.6% annual reduction in the 1990s and the 1.4% annual reduction otherwise projected. On the other hand, it is comparable to the 1.9% annual reduction in carbon intensity achieved during the 1970s and lower than the 2.7% annual reduction achieved in the 1980s. These decade-to-decade fluctuations are much greater than the projected reduction in greenhouse gas intensity. This "background noise" is likely to be amplified by the impact of recent high energy prices. Energy Information Administration projections of greater future energy intensity are supported by abundant anecdotal evidence that higher energy prices are driving greater energy efficiency.⁷⁷

Despite the limitations of this particular goal, greenhouse gas intensity and energy intensity are useful indicators of U.S. climate change and energy policy. The relative nature of both measures is a strength because the measurement is explicitly connected to GDP. These indicators thus show the relationship between energy efficiency or greenhouse gas emissions, on one hand, and economic growth on the other.

The relative nature of these measures, on the other hand, can be confusing at best and misleading at worst. How did the United States do on greenhouse gas emissions in 2004? Some will say emissions were up, others will say greenhouse gas intensity was down, and many will not understand the difference. Similarly, energy intensity is an imperfect proxy for energy conservation. It is common for improvements in energy efficiency to be outpaced by greater energy consumption. Houses cost less to heat and light on a per-square-foot basis than they did several decades ago, but the average American now lives in a bigger house that uses more energy for electronic equipment than the average and smaller house of years past.⁷⁸

The National Commission on Energy Policy (NCEP) issued a report in 2004 recommending that the United States adopt, beginning in 2010, "an annual emissions target that reflects a 2.4 percent per year reduction in the average greenhouse gas emissions intensity of the economy."⁷⁹ Ac-

ording to the NCEP, this cap would cause U.S. greenhouse gas emissions in 2020 to be 6% to 11% below "business as usual" levels.⁸⁰ If the average annual reduction in greenhouse gas intensity is great enough, in other words, that reduction can effect absolute reductions in greenhouse gas emissions. Similarly, if the average annual reduction in greenhouse gas intensity or energy intensity is great enough, overall energy consumption will stabilize and then fall even as GDP continues to grow.

C. Stabilizing and Then Reducing U.S. Energy Consumption

The real problem—large and growing energy consumption—cannot be addressed successfully by proxies alone. Nor does it appear likely to go away on its own.⁸¹ The problem must be addressed, if it is to be addressed at all, directly and on its own terms. That is, we must consider what for many is unthinkable—stabilizing and then reducing U.S. energy consumption.

This is about maintaining, even increasing, GDP growth, not reducing it. There is no law of thermodynamics or economics that requires energy use to increase with GDP growth. The fact that U.S. energy consumption grows at only one-third the rate of GDP growth, rather than the same rate, is evidence that energy use and GDP growth do not need to march in lockstep. The NCEP proposal would have overall levels of greenhouse gas emissions being reduced even while GDP grows at almost the same rate as it would anyway.⁸² Because greenhouse gas intensity and energy intensity are closely related, GDP should be capable of growing at the same rate, or even a greater rate, with significantly increased energy intensity and thus reduced energy consumption.

The path to this approach is guided by three markers. First, increases in energy efficiency can be, and often are, driven by changes in law and policy. Second, a 2004 article in *Science* by Stephen Pacala and Robert Socolow⁸³ suggests that the problem of growing greenhouse gas emissions be addressed by dividing the growth curve into smaller parts or wedges and addressing these parts through a multifaceted set of legal and policy tools. The objective is to stabilize greenhouse gas emissions at a future point and then reduce them. Third, the "stabilization wedge" analysis in the Pacala and Socolow article can be applied to U.S. energy consumption. If we divide growth in U.S. energy consumption by economic sector and fuel type, and then identify cost-effective conservation and efficiency options for each sector and fuel type, we are likely to find that we can do the unthinkable and be better off for having done it. Much, of course, depends on the laws and policies that would be selected.

2004, at ES-4 (2006), available at [http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR6MBLP4/\\$File/06ES.pdf](http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR6MBLP4/$File/06ES.pdf).

77. See, e.g., Timothy Aeppl & Melanie Trotman, *As Energy Costs Soar, Companies Retool Operations*, WALL ST. J., Apr. 22-23, 2006, at A1; Dan Miller, *Fuel Costs Force Midstate Businesses to Adapt*, SUNDAY PATRIOT-NEWS (Harrisburg, Pa.), Apr. 23, 2006, at C1.

78. MARILYN A. BROWN ET AL., TOWARDS A CLIMATE-FRIENDLY BUILT ENVIRONMENT 2-3 (2005), available at <http://www.resourcestaver.org/file/toolmanager/CustomO16C45F65020.pdf> [hereinafter CLIMATE-FRIENDLY BUILT ENVIRONMENT].

79. NAT'L COMM'N ON ENERGY POLICY, *supra* note 62, at x.

80. *Id.* at 22.

81. A contrary set of scenarios involve abrupt loss of energy supply for a variety of reasons, and whose effects range from disruptive to apocalyptic.

82. NAT'L COMM'N ON ENERGY POLICY, *supra* note 9, at x and 22.

83. Pacala & Socolow, *supra* note 59.

1. Measuring the Potential for Greater Energy Efficiency

The potential for energy-efficiency improvements can be measured in different ways.⁸⁴ This set of approaches provides a structure for understanding how much is possible and under what circumstances. It also provides a way of understanding some of the obstacles to greater energy efficiency. Finally, it indicates that current levels of energy efficiency are not fixed or immutable, but rather are capable of being modified by changes in price, behavior, law and policy, and other factors. In fact, there is an enormous gap between what is theoretically and technically possible, on one hand, and what we now experience.

The *theoretical* potential represents the thermodynamic limit of what can be achieved. Many scientists and engineers believe that an 80% improvement or more over existing levels of energy efficiency is possible in this century.⁸⁵

The *technical* potential is what can be achieved by the most energy efficient technology that is commercially available, or nearly commercially available. Cost and investment cycles are not supposed to be factored into this method of measuring potential.⁸⁶ While the technical potential could, in principle, reach 100% because it is not bound by costs, most studies of technical potential only review measures that “may be cost-effective.”⁸⁷

The *market trend* potential is what can be expected under current and projected market conditions. This is essentially the business-as-usual approach and assumes the continued existence of behavioral and market obstacles that prevent greater improvements in energy efficiency.⁸⁸

The *economic* potential is what would be achieved if all investments “were shifted to the most energy-efficient technologies that are still cost-effective at given energy market prices.”⁸⁹ The economic potential assumes that many of the behavioral and market obstacles are removed.⁹⁰ Most estimates are based on economic potential, though economic potential is not always calculated from the same perspective.⁹¹

The *social* potential is based on a different understanding of cost-effectiveness. The social potential is what would be achieved if externalities (costs that are not included in the price, such as climate change, air pollution, and national security) were incorporated into conventional energy prices.⁹² Because the energy sector produces many external costs, the

social potential for energy efficiency is considerably greater than the economic potential.

Finally, the *policy-based achievable* potential is what would be achieved through a particular policy or package of policies.⁹³ The policy-based achievable potential depends on the choice of laws and policies proposed, as well as the intensity of the projected effort in implementing them. This policy-based potential is also the potential on which most of the studies are based that indicate greater opportunities for energy-efficiency improvement.

As these approaches indicate, there is a wide gap between what is possible and what we do now. In addition, studies of energy-efficiency potential all depend, to a great degree, on assumptions about the choice of legal and policy tools.

2. Stabilization Wedges for Global Climate Change

In their 2004 article, Pacala and Socolow introduced the concept of “stabilization wedges” for addressing climate change.⁹⁴ The concept of stabilization wedges can be applied, by analogy, to improving energy efficiency in the United States. The idea, as shown in Figure 5, is that greenhouse gas emissions are rising, and that we should implement a set of laws and policies that would, at a minimum, flatten those emissions. (In this way, they apply something akin to the policy-based achievable potential, described above, to climate change.) Each of those approaches is a slice or “wedge” in the triangle created by the rising business-as-usual line, the flat line, and the vertical line representing 2054, 50 years after the article’s publication. Pacala and Socolow provide insight into the multi-dimensional approach needed to address climate change. The article also underscores the importance of energy efficiency in addressing climate change.

The current atmospheric carbon dioxide concentration is about 375 parts per million (ppm), higher than the preindustrial level of about 280 ppm, but lower than the doubling of preindustrial levels that is expected to occur under a “business as usual” scenario. What would it take, Pacala and Socolow ask, to stabilize carbon dioxide emissions at 500 ppm, a level that many observers believe cannot be exceeded without causing the most serious damage? Stabilization at that level is possible, they say, if carbon dioxide emissions are kept to 7 billion tons of carbon per year, rather than the 14 billion tons per year that are expected by 2054.⁹⁵ They conceptualize the challenge through the use of seven equal stabilization “wedges,” each of which begins at zero and increases in a linear manner until it reaches one billion tons of carbon per year.⁹⁶ These wedges can be depicted as shown in Figure 5:

84. Eberhard Jochem et al., *Energy End-Use Efficiency, in UNITED NATIONS DEVELOPMENT PROGRAMME, WORLD ENERGY ASSESSMENT: ENERGY AND THE CHALLENGE OF SUSTAINABILITY* 173, 183-84 (2000) [hereinafter *Energy End-Use Efficiency*].

85. *Id.* at 183, 199.

86. *Id.* at 183.

87. Steven Nadel et al., *The Technical, Economic, and Achievable Potential for Energy-Efficiency in the U.S.—A Meta-Analysis of Recent Studies* 3 (2004), available at <http://www.aceee.org/conf/04ss/memeta.pdf> [hereinafter *Meta-Analysis*].

88. *Energy End-Use Efficiency, supra* note 84, at 183-84.

89. *Id.* at 184.

90. *Id.*

91. *Id.* “In all definitions of the economic potential of energy efficiency, the core cost-effectiveness test is the life-cycle cost of providing a given level of energy services.” But the financial perspective of an individual investor is narrower than a macroeconomic perspective, even though both perspectives fit within the definition of economic potential. *Id.*

92. *Id.*

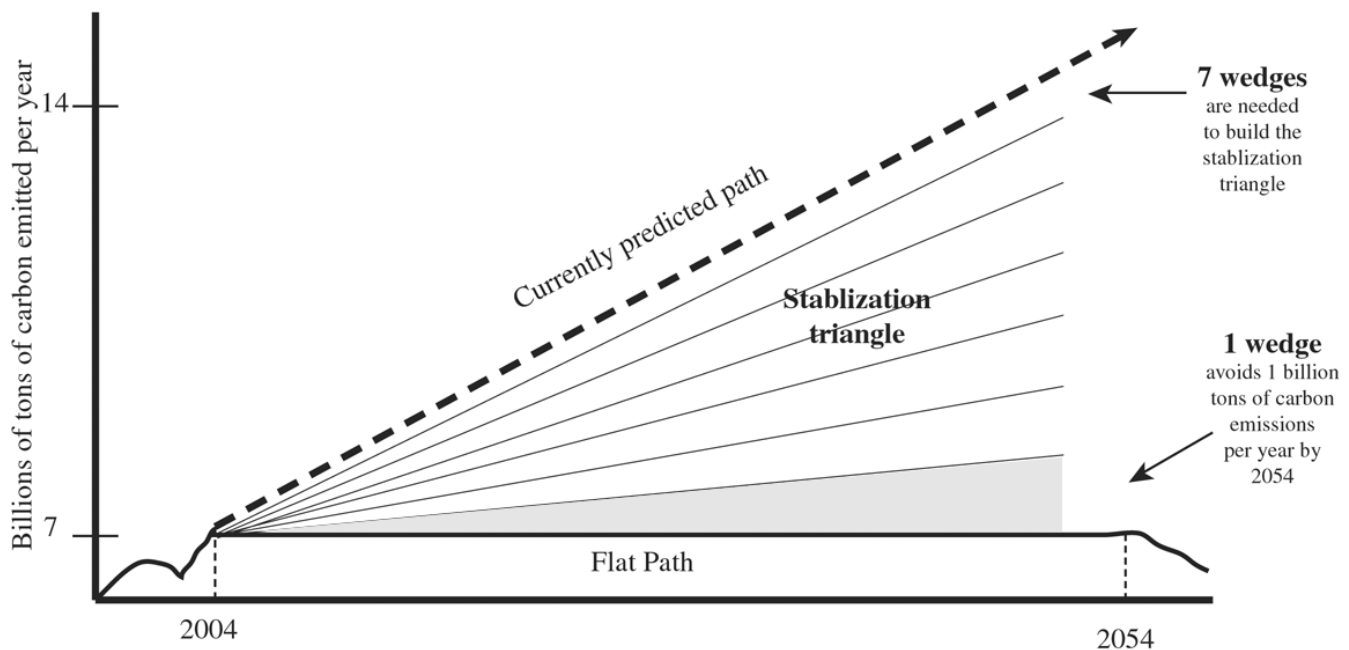
93. *Id.*

94. Pacala & Socolow, *supra* note 59.

95. *Id.* at 968. They acknowledge that further reductions after 2054 are likely necessary, and describe a model in which there is a linear decline for about 50 years after 2054 that results in levels that are two-thirds those of 2054 levels, with a slight decline after that. *Id.*

96. *Id.*

Figure 5
Stabilization Wedges for Global Climate Change⁹⁷



Pacala and Socolow identify 15 options, “each of which is already implemented at an industrial scale and could be scaled up further over 50 years to provide at least one wedge.”⁹⁸ As Figure 5 shows, full implementation of only 7 of the 15 options would be needed to stabilize greenhouse gas emissions. “Improvements in efficiency and conservation probably offer the greatest potential to provide wedges,” they say, and identify four energy-efficiency options.⁹⁹ One wedge would be created if the United States were to increase its carbon intensity goal to a reduction of 2.11% from the current 1.96% and maintain that goal for 50 years, and if every other country were to reduce its carbon intensity by an additional 0.15% for the same period. Another wedge would be achieved if the world’s two billion cars drove an annual distance of 5,000 miles instead of 10,000 miles and averaged 30 miles of gasoline per gallon. A third wedge would be achieved if existing practices for heating and cooling space, heating water, lighting, and refrigeration were applied to residential and commercial buildings in the United States and the rest of the world. Finally, a fourth wedge would be achieved if the amount of electricity now produced at coal-fired power plants at 40% efficiency were produced instead at 60% efficiency.¹⁰⁰ If all

four of these were fully employed, they would together represent more than one-half of the reduction from business-as-usual that is needed to stabilize carbon dioxide concentrations in the atmosphere.

3. Stabilization Wedges for U.S. Energy Consumption

Pacala and Socolow make a significant contribution by showing what is needed to stabilize and reduce greenhouse gas emissions. In addition, the “stabilization wedge” approach can be usefully applied in other contexts, including energy efficiency in the United States. Like greenhouse gas emissions, energy consumption is increasing over time. Like stabilization of greenhouse gas emissions, the problem of stabilizing U.S. energy consumption can be addressed by dividing the projected growth pattern into wedges. Figure 6 shows stabilization wedges (based on Figure 3) for the residential, commercial, industrial, and transportation sectors. In Figure 6, each of these four sectors is a wedge. This approach recognizes that all four sectors are responsible for growing energy consumption, not just one of them. Unlike the approach taken by Pacala and Socolow, however, these wedges (like consumption and projected growth in the sectors themselves) are not of equal value. Cross-cutting wedges could be created for electricity and other energy uses that involve more than one sector. Further wedges could be created by dividing individual sectors into smaller wedges (e.g., by particular industries or forms of transportation).

97. Robert Socolow et al., *Solving the Climate Problem: Technologies Available to Curb CO₂ Emissions*, ENVIRONMENT (Dec. 2004) at 8, 11.

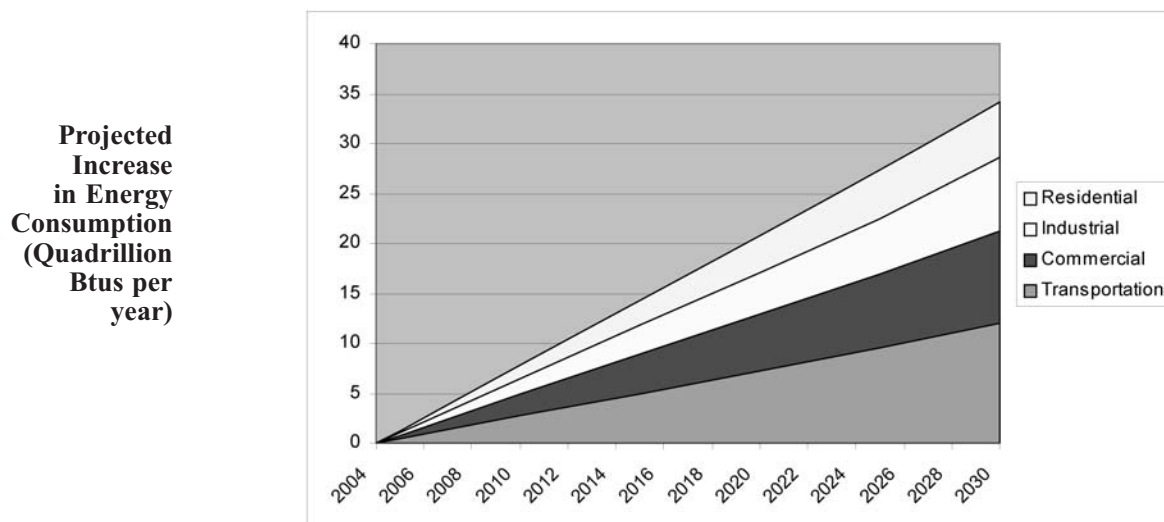
98. Pacala & Socolow, *supra* note 59, at 971.

99. *Id.* at 969.

100. *Id.* The other 11 wedges would be achieved by replacing coal with natural gas; storing carbon captured from power plants, hydrogen plants, and synfuels plants; using nuclear fission; using wind and so-

lar photovoltaics to produce electricity; using renewable hydrogen and biofuels; and managing forests and agricultural soils to store carbon. *Id.* at 969-71.

Figure 6



A number of U.S. studies have already focused on stabilization of consumption based on particular wedges or parts of those wedges. A report by Marilyn Brown and her colleagues at the Oak Ridge National Laboratory, for instance, indicates that the United States could stabilize energy consumption in the residential and commercial sectors by about 2015 and, by 2025, approach 2004 energy consumption levels.¹⁰¹ Similarly, a 2003 report by the Congressional Budget Office looked at different legal tools for reducing gasoline consumption (part of the transportation sector wedge) by 10% and justified a reduction on the basis of climate change mitigation, energy security, and human quality of life.¹⁰² More broadly, a 2000 report by five government laboratories developed a scenario in which overall U.S. energy consumption would be nearly stabilized after 20 years.¹⁰³

The European approach to energy consumption also indicates that U.S. energy consumption could be reduced below current levels. In October 2006, the European Commission issued an action plan for improving energy efficiency enough to reduce energy consumption in 2020 by 11% below current levels. The plan, which is projected to save more than €100 billion annually in reduced energy costs, contains a detailed set of cost-effective policies and measures to achieve that goal.¹⁰⁴ The European Commission describes

energy efficiency as “by far the most effective way concurrently to improve security of energy supply, reduce carbon emissions, foster competitiveness, and stimulate the development of a large leading-edge market for energy-efficient technologies and products.”¹⁰⁵ Per capita energy consumption in western Europe, which contains most of the European Union countries, is one-half of that in the United States.¹⁰⁶ Despite lower per capita energy use, the European Union has identified cost-effective ways to reduce energy consumption even more.

III. Legal and Policy Tools for Reducing Energy Consumption

A variety of tools and options exist to improve energy efficiency and reduce energy consumption. Perhaps the two most dominant tools over the past several decades, however, have involved appliances and motor vehicles. Because they so strongly influence our understanding of conservation and efficiency, they provide a framework for understanding the tools and options developed in the seminar.

A. Two (Somewhat) Contrasting Story Lines

The greatest energy savings in the United States over the past several decades have been achieved for passenger vehicles and appliances.¹⁰⁷ National experience with energy-efficiency laws for each of these, which is to some extent a study in contrasts, suggests both the potential and limita-

(Mtoe) in 2005 to 1,950 Mtoe in 2020. *Id.* at 3 (1,950 Mtoe figure derived from statement that 20% reduction of projected 2020 energy use is 390 Mtoe) and 13 (1,750 Mtoe stated in Figure 4). Reducing 2020 energy by 20% from business-as-usual projections for 2020 would mean that primary energy use is 1,560 Mtoe, or 11% below 2005 levels. For a list of proposed measures, see *id.* at 20-25.

101. CLIMATE-FRIENDLY BUILT ENVIRONMENT, *supra* note 78, at 60-61. Marilyn Brown is now a Professor in the School of Public Policy, Georgia Institute of Technology.
102. CONGRESSIONAL BUDGET OFFICE, THE ECONOMIC COSTS OF FUEL ECONOMY STANDARDS VERSUS A GASOLINE TAX 1-2 (2003), available at http://www.cbo.gov/ftpdocs/49xx/doc4917/12-24-03_CAFE.pdf [hereinafter FUEL ECONOMY STANDARDS VERSUS A GASOLINE TAX].
103. INTERLABORATORY WORKING GROUP, SCENARIOS FOR A CLEAN ENERGY FUTURE (2000), available at <http://www.nrel.gov/docs/fy01osti/29379.pdf>.
104. COMM'N OF THE EUROPEAN COMMUNITIES, ACTION PLAN FOR ENERGY EFFICIENCY: REALISING THE POTENTIAL (2006), available at http://ec.europa.eu/energy/action_plan_energy_efficiency/doc/com_2006_0545_en.pdf. Primary energy consumption in the European Union is expected to grow from 1750 million tons of oil equivalent

105. *Id.* at 3.

106. See *supra* note 20.

107. Steven Nadel, *Appliance and Equipment Efficiency Standards*, 27 ANN. REV. ENERGY & ENVT. 159, 170 (2002).

tions of law in achieving energy efficiency. Appliance and equipment efficiency standards have significantly reduced the energy that would otherwise be used, and both regulatory and voluntary efforts are being used to enhance efficiency. The United States has a more complete set of appliance efficiency standards than any other country.¹⁰⁸ On the other hand, while motor vehicle standards were initially successful in improving energy efficiency, little progress has been made in more than a decade. Fuel economy of U.S. cars and light trucks is now substantially lower than that in Australia, Canada, China, the European Union, and Japan.¹⁰⁹

1. Appliance and Equipment Standards

Appliance and equipment efficiency standards have enjoyed considerable success. Energy Star®, perhaps the nation's most effective "voluntary" program, is based to a considerable extent on those standards. Because these standards have been implemented with relatively little public controversy, however, their scope and effectiveness are likely not fully known or appreciated.

The Energy Policy and Conservation Act of 1975, as amended most recently by the Energy Policy Act of 2005,¹¹⁰ requires DOE to adopt testing procedures for the standardized determination of energy efficiency, energy use, or estimated annual operating cost for particular products.¹¹¹ The Federal Trade Commission is required to adopt labeling rules based on energy use, including the estimated annual operating cost of the particular product and the range of annual estimated operating cost for such products.¹¹² These rules are intended to inform consumers about a product's energy use and costs at the time of purchase. The Act also establishes energy-efficiency standards for certain consumer products and authorizes DOE to set new or amended energy and water conservation standards for a variety of consumer products other than automobiles.¹¹³

New or amended standards are to be based on the "maximum improvement in energy efficiency, or, in the case of showerheads, faucets, water closets, or urinals, water efficiency, which the Secretary determines is technologically feasible and economically justified."¹¹⁴ As a consequence, standards have been established (and often subsequently made more stringent) for a variety of appliances, including refrigerators, central air conditioners and central air conditioning heat pumps, water heaters, furnaces, dishwashers, and clothes washers.¹¹⁵ A somewhat similar set of testing,

labeling, and standard-setting requirements exist for commercial and industrial equipment.¹¹⁶ DOE has adopted efficiency standards for, among other things, electric motors, warm air furnaces, air conditioners, heat pumps, clothes washers, and illuminated exit signs.¹¹⁷

Primarily because of these standards, significant improvements in efficiency were achieved between 1972 and 2001. Gas furnaces became 25% more efficient, central air conditioners became 40% more efficient, and refrigerators became over 75% more efficient.¹¹⁸ In the early 1970s, refrigerators consumed enormous amounts of electricity—equivalent to the energy production of 30 large coal-fired power plants.¹¹⁹ Although it appears possible to build refrigerators that are 50% more efficient than the currently applicable 2001 standard, the improvement in refrigerator efficiency has been so great that it is possible to envision a point at which "refrigerators will use so little energy that it may well make sense to focus attention on other products."¹²⁰ Residential appliance efficiency standards are projected to reduce annual carbon emissions between 1990 and 2010 by an amount equal to 4% of 1990 U.S. carbon emissions and at a net savings to the U.S. economy.¹²¹

The Energy Policy Act of 2005 requires new or more stringent standards for a variety of products¹²² as well as commercial and industrial equipment.¹²³ The Act also establishes a federal tax credit for the purchase of certain energy efficient appliances.¹²⁴ In addition, the Act instructs the Federal Trade Commission to consider improvements to product labeling.¹²⁵ Ten states have also adopted more stringent efficiency standards or efficiency standards for different appliances and equipment than those covered by federal standards.¹²⁶

The Energy Star® program builds on the federal standards. Energy Star® is a government-industry energy-efficiency partnership involving more than 8,000 public and private entities. It was begun by the U.S. Environmental Protection Agency (EPA) in 1992 "as a voluntary labeling program designed to identify and promote energy-efficient products to reduce greenhouse gas emissions." It now covers a variety of office and residential equipment as well as

108. *Id.* at 167.

109. FENG AN & AMANDA SAUER, COMPARISON OF PASSENGER VEHICLE FUEL ECONOMY AND GREENHOUSE GAS EMISSION STANDARDS AROUND THE WORLD 1 (2004), available at <http://www.pewclimate.org/docUploads/Fuel%20Economy%20and%20GHG%20Standards%5F010605%5F110719%2Epdf>.

110. 42 U.S.C. §§6291-6309.

111. *Id.* §6293. For showerheads, faucets, water closets, and urinals, the test procedures are required to cover water use. *Id.* §6293(b).

112. *Id.* §6294(c)(1).

113. *Id.* §6295. Water conservation furthers energy efficiency to the extent that it reduces the amount of water that needs to be heated or cooled.

114. *Id.* §6295(o)(2)(A).

115. 10 C.F.R. §430.32. There are also water conservation standards for water closets and urinals, which do not ordinarily involve heating or cooling of water. *Id.* §430.32(q), (r).

116. 42 U.S.C. §§6311-6317.

117. 10 C.F.R. pt. 431.

118. Nadel, *supra* note 107, at 168.

119. NAT'L COMM'N ON ENERGY POLICY, *supra* note 9, at 32.

120. Nadel, *supra* note 107, at 188.

121. JONATHAN G. KOOMEY ET AL., PROJECTED REGIONAL IMPACTS OF APPLIANCE EFFICIENCY STANDARDS FOR THE U.S. RESIDENTIAL SECTOR (1998), available at <http://enduse.lbl.gov/info/LBNL-39511.pdf>.

122. Energy Policy Act of 2005, §135; 42 U.S.C. §§6291-6297.

123. *Id.* §136; 42 U.S.C. §§6311-6316.

124. *Id.* §1334; I.R.C. §45M.

125. *Id.* §137; 42 U.S.C. §6294(a)(2)(F).

126. STEVEN NADEL ET AL., LEADING THE WAY: CONTINUED OPPORTUNITIES FOR NEW STATE APPLIANCE AND EQUIPMENT EFFICIENCY STANDARDS 4-5 (2006), available at <http://www.standardsasap.org/a062.pdf>. In general, federal standards for a particular product preempt state standards for the same product, unless the state files a petition with DOE and convinces the agency that the state's interests are substantially different from, or greater than, those in the United States generally, and that the state regulation is preferable or necessary based on "costs, benefits, burdens, and reliability of energy or water savings." 42 U.S.C. §6297(d)(1).

homes and commercial and industrial buildings.¹²⁷ According to EPA, in 2005 alone, Energy Star® “prevented 35 million metric tons of greenhouse gas emissions” and saved an amount of electricity equivalent to four percent of total demand. These figures, EPA said, are more than twice those in 2000.¹²⁸

The Energy Star® label can be placed on products that meet certain efficiency standards. Some of these standards are the same as those required for appliances and certain commercial and industrial equipment. Energy Star® criteria, however, represent 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.¹²⁹ Energy Star® criteria also apply to appliances and equipment for which no standards have been set, including personal computers and computer monitors. Since the program’s inception, American consumers have purchased more than one billion products qualified by Energy Star®.¹³⁰

2. Corporate Average Fuel Economy Standards for Motor Vehicles

The quest for greater efficiency in motor vehicles began in earnest in 1975 but has been mostly stalled since 1990. The reasons for this—differences in car size based on gasoline mileage efficiency and attendant safety consequences, as well as the desire by many for larger vehicles—have been widely described and debated. What is often missed is the considerable initial improvement in mileage efficiency. While the story line here is of less success than that for appliances and equipment, it is not a story about policy failure.

The Energy Policy and Conservation Act, which was first adopted in 1975 in the wake of the 1973 to 1974 Arab oil embargo, directs the U.S. Department of Transportation (DOT) to adopt corporate average fuel economy (CAFE) standards for automobiles.¹³¹ Each standard is to be based on the “maximum feasible fuel economy” that the DOT Secretary determines can be achieved for a particular year.¹³² In determining what the maximum feasible fuel economy is, the Secretary is required to 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.”¹³³ Automobile dealers are also obliged to attach a label in a prominent

place on each new car offered for sale, stating the fuel economy of that car.¹³⁴

Rapid improvement occurred at first. Regulations adopted under the Act increased average fuel economy for automobiles from 18.0 miles per gallon (mpg) in 1978 to 27.5 mpg in 1990.¹³⁵ As a result, fuel efficiency in new automobiles grew steadily, peaking in 1988 at about 28.5 mpg.¹³⁶ The average fuel economy standard has not increased since 1990, however; it continues to be 27.5 mpg.¹³⁷ Stalled progress is related to the preferences of American consumers, who are concerned about more 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.”¹³⁸ Still, automobiles now use 40% less gasoline than they did in 1972.¹³⁹

Congress also authorized the DOT to set fuel economy standards for light trucks, which include sport utility vehicles, minivans, and pickup trucks. From the 1996 to 2004 model years, the average required fuel economy for light trucks has been 20.7 mpg, rising to 21.0 mpg for 2005 and 22.2 mpg for the 2007 model year.¹⁴⁰ 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.¹⁴¹

A 2002 report by the National Research Council indicates the strengths and weaknesses of CAFE standards.¹⁴² “The CAFE program has clearly contributed to increased fuel economy during the past 22 years,” the report said, adding 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.”¹⁴³ On the other hand, automobile downsizing, “some of which was due to CAFE standards, probably resulted in an additional 1,300 to 2,600 traffic fatalities in 1993.”¹⁴⁴ While the report recommended that the federal government continue to set standards, it also suggested adoption of a trading program for

127. U.S. EPA, *ENERGY STAR, History of ENERGY STAR*, http://www.energystar.gov/index.cfm?c=about.ab_history (last visited July 21, 2006).

128. U.S. EPA, *ENERGY STAR, ENERGY STAR® Overview of 2005 Achievements* (2006), available at http://www.energystar.gov/ia/news/downloads/2005_achievements.pdf.

129. U.S. EPA, *ENERGY STAR, Product Specifications, Eligibility Criteria, & Partner Commitments*, http://www.energystar.gov/index.cfm?c=product_specs.pt_product_specs (last visited July 21, 2006).

130. U.S. EPA, *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. DOE and EPA have also launched an Energy Efficiency Action Plan for electricity. U.S. DOE AND U.S. EPA, *ENERGY EFFICIENCY ACTION PLAN* (2005), available at http://www.epa.gov/cleanrgy/pdf/ee_plan.pdf.

131. 42 U.S.C. §§32901-32919.

132. *Id.* §32902(a).

133. *Id.* §32902(f).

134. *Id.* §32908(b)(1)A).

135. 40 C.F.R. §531.5(a).

136. U.S. EPA, OFFICE OF TRANSP. 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>.

137. 42 U.S.C. §32902(b); 40 C.F.R. §531.5(a).

138. U.S. EPA, *supra* note 136.

139. NAT’L ENERGY POLICY DEV. GROUP, *supra* note 1.

140. 40 C.F.R. §533.5(a), tbl. IV.

141. U.S. EPA, *supra* note 136.

142. COMM. ON THE EFFECTIVENESS AND IMPACT OF CAFE STANDARDS, NAT’L RESEARCH COUNCIL, *EFFECTIVENESS AND IMPACT OF CORPORATE AVERAGE FUEL ECONOMY (CAFE) STANDARDS* (2002) [hereinafter *EFFECTIVENESS AND IMPACT OF CAFE STANDARDS*].

143. *Id.* at 3. “[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.” *Id.*

144. *Id.* (footnote omitted). *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*), <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.”) (last visited July 21, 2006).

fuel economy credits to reduce costs for manufacturers. In addition, it recommended consideration of “an approach with fuel economy targets that are dependent on vehicle attributes, such as vehicle weight, that inherently influence fuel use.”¹⁴⁵

On April 6, 2006, the DOT’s National Highway Traffic Safety Administration adopted a final rule increasing the average fuel economy standard for light trucks to 23.5 mpg for model year 2010.¹⁴⁶ The same final regulation introduced a new method for calculating average fuel economy that is optional for light trucks in model years 2008 to 2010 and required for the 2011 model year. The agency describes the traditional way of calculating fuel efficiency as “Unreformed CAFE” and the new methodology as “Reformed CAFE.” Under Unreformed CAFE, automobile efficiency standards were essentially the same for every manufacturer’s fleet, regardless of the composition of that fleet. Thus, a manufacturer could produce and sell a certain number of larger and less fuel-efficient vehicles if it produced and sold an offsetting number of more efficient vehicles. Under Reformed CAFE, by contrast, each vehicle is assigned a “footprint” value and a specific fuel efficiency target for that “footprint”—in essence, the larger the vehicle, the larger the footprint.¹⁴⁷ Because the fuel efficiency target is based on the “maximum feasible fuel economy” for each size of vehicle, the agency said, the final regulation would achieve fuel efficiency improvements for all sizes of vehicles. Projected fuel efficiency levels for the 2011 model year vary by manufacturer, ranging from 23.2 mpg (General Motors) to 27.1 mpg (Suzuki), all at least a little higher than the 22.2 mpg required for 2007 under Unreformed CAFE.¹⁴⁸ Estimated fuel savings range from 0.6 billion gallons in model year 2008 (Unreformed CAFE) to 2.8 billion gallons in model year 2011 (Reformed CAFE).¹⁴⁹

B. Selected Additional Tools and Options

A great many other legal and policy tools and options are available, or are being deployed to some degree, to increase energy efficiency and conservation and to decrease energy consumption. Six are featured here. Taken together, they indicate that reducing energy consumption can bring about substantial economic, social, environmental, and national security benefits. These other benefits are so significant that reduction of energy consumption or greenhouse gas emissions often appear to be secondary considerations—even though they are quite real. These tools and options indicate that reducing energy consumption can be a constructive exercise in seizing opportunities and reducing risks. They suggest some of the building blocks for a positive future story line on energy efficiency and conservation in the United States. They also indicate that the negative story line about reduced energy use—a bleak future based on oppressive government regulation—is inconsistent with most of our experience.

Beyond that, they help us understand the path ahead. To begin with, increased efficiency and conservation are to a great degree about better technology, but they are not only about technology. It is one thing to introduce a new technology; it is quite another to get it widely used.¹⁵⁰ New automobiles, appliances, industrial equipment, and buildings are usually more energy efficient than existing ones. Laws and policies can play a major role in introducing new technologies, but they can also play a role in creating incentives for upgrading or replacing existing technologies. Existing residential and commercial buildings are an example. Second, a great deal of additional energy efficiency can be gained by simply employing—on a wider scale, with greater intensity, and with better public information—legal and policy tools that are already being employed successfully. Many of the tools being used to improve efficiency in residential and commercial buildings, including tax incentives and low-income weatherization, could be deployed more widely. Public benefit funds could be used to achieve much greater electric efficiency. We could make much greater use of intermodal rail freight as well as housing and other development around transit stations. Third, a considerable amount of additional efficiency and conservation is theoretically available from tools that have not yet been deployed or that have been deployed for other purposes. Electric rates that vary by time of day or by season have not been widely used to increase energy efficiency, but could be. Finally, energy efficiency and conservation give individuals and businesses more and better choices, not fewer choices. Each of these tools provides additional options.

There is a challenging side to this story as well, and it indicates why the negative energy-efficiency story line still maintains considerable vitality. Increased taxes for transportation fuels would likely lead to greater efficiency and reduced consumption in the motor vehicle fleet. Even though (and perhaps because) such taxes imitate the effect of fuel price increases, increased taxes may be a political nonstarter. The challenge, as Figures 3 and 6 indicate, is that energy use in transportation is projected to grow more than any other sector by 2030. Transportation raises particularly

145. EFFECTIVENESS AND IMPACT OF CAFE STANDARDS, *supra* note 142, at 5-6; *see also* Paul R. Portney et al., THE ECONOMICS OF FUEL ECONOMY STANDARDS 15-16 (2003), <http://www.rff.org/documents/RFF-DP-03-44.pdf> (concluding that fuel taxes are more efficient than CAFE standards but that CAFE standards should be modified to allow trading of credits between passenger car and light truck fleets and between manufacturers).

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

147. This target for a given footprint is the same for each manufacturer. The footprint is derived by multiplying the distance between right and left wheels by the distance between the front and back axles. Compliance is determined by comparing an average of a particular manufacturer’s averaged fuel economy in a particular year, on one hand, with the required fuel economy for each vehicle footprint and the production level of that vehicle, on the other. 71 Fed. Reg. at 17568.

148. *Id.* at 17624.

149. *Id.* at 17618-19. The agency also estimated that the regulation would reduce greenhouse gas emissions, but refused to monetize those benefits because of uncertainties “in developing a proper estimation of avoided costs due to climate change.” *Id.* at 17644.

On May 2, 2006, 10 states, including California and New York, filed a petition for review in the U.S. Court of Appeals for the Ninth Circuit challenging these regulations. The states claim that the standards should be more rigorous and that the agency did not give adequate consideration to the effect of fuel economy standards on climate change. Petition for Review, California v. National Highway Traffic Safety Admin., No. 06-046 (9th Cir. 2006).

150. *See generally* EVERETT M. ROGERS, DIFFUSION OF INNOVATIONS (5th ed. 2003) (classic work on how new technologies and know-how are brought into widespread use).

important energy security concerns because transportation relies overwhelmingly on petroleum and because 58% of the petroleum we use is imported.¹⁵¹ If certain choices are off the table, then it is important to deploy other options. Otherwise, the story is one of inaction or symbolic action.

1. Improved Efficiency in Existing Residential and Commercial Buildings

Energy-efficiency standards are established for new residential and commercial buildings. A major challenge—and an opportunity for reducing energy consumption—is in renovation and upgrades for already existing structures.

Energy-efficiency standards for buildings are primarily a matter of state law, though 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 building codes and to determine within two years whether it should adopt the 1992 Model Energy Code published by the Council of American Building Officials.¹⁵² The Act contains a comparable provision for energy-efficiency provisions in commercial building codes.¹⁵³ The Model Energy Code and its commercial counterpart, the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Code, are revised periodically. Whenever either code is revised, the Act requires states to consider or adopt updated provisions that DOE determines “would improve energy efficiency” in residential or commercial buildings.¹⁵⁴ This legislation has been only modestly successful. In practice, 26 states have the most recent and energy-efficient residential codes and 25 have the most recent and energy-efficient commercial codes.¹⁵⁵ To bolster state performance, the Energy Policy Act of 2005 authorizes DOE to provide \$25 million annually to states to improve existing energy-efficiency codes and to improve compliance with such codes.¹⁵⁶

These standards will be especially necessary in the coming years because of the amount of new housing needed to respond to population growth. U.S. population is expected to grow from 300 million at present to 378 million by 2025, and this increase is likely to require construction of a substantial number of new residential and commercial buildings with an attendant need for additional energy.¹⁵⁷

These codes do not, however, apply to existing residential and commercial buildings. As a consequence, broadly speaking, newer buildings tend to be more energy efficient than older buildings, and often substantially more efficient. Sixty percent of existing residences are not well insulated, for example, and 70% or more of commercial buildings lack roof or wall insulation.¹⁵⁸ Retrofitting and upgrading existing structures and their heating, ventilation, and air conditioning systems offers a considerable opportunity to improve energy efficiency. This is especially true because

existing residential and commercial buildings will be around for a long time. “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.”¹⁵⁹ Beyond that, existing residential and commercial buildings are responsible for almost 40% of the nation’s annual energy consumption (38.41 out of 99.68 quads in 2004, according to Figure 2).

A strong economic case can be made for retrofitting or upgrading a great many existing buildings, although savings and costs will vary depending on the building and the proposed change. Essentially, the initial cost of the retrofit or upgrade project is offset, over some period of time, by the dollar value of the energy saved. The less efficient and more energy consuming something is, the shorter the payback period. A common range is five to 10 years,¹⁶⁰ though many payback periods are less than a year or two. New and more efficient technologies will likely be cheaper and more efficient over time, as both producers and users of these technologies learn how they work and how they can be made to work better.¹⁶¹

But the economic case is often not good enough. The building industry is fragmented among hundreds of thousands of independent contractors, builders, architects, remodeling firms, and service and repair providers.¹⁶² “On the production side, buildings are the largest handmade objects in the economy.”¹⁶³ For residences alone, there are some 70 million owner-occupied housing units as well as an additional 30 million that are rented or leased by their owners to someone else.¹⁶⁴ There are, in addition, some 4.6 million commercial buildings.¹⁶⁵ This fragmentation creates numerous obstacles. For instance, many projects do not occur because the person who would be spending the money (e.g., owner), is not the person who would recoup the benefit (e.g., tenant). Barriers to greater energy efficiency also include up-front costs, limited understanding by consumers and contractors, and lack of consumer demand.¹⁶⁶ Thus, the builder or contractor may not be familiar with what the customer requests, or the customer may not be knowledgeable about cost-effective upgrades or retrofits that the builder or contractor could provide.

A variety of mechanisms can be used to help overcome these obstacles. These mechanisms include tax incentives and weatherization programs. States and the federal government have some such programs. Still, it appears that considerable opportunities for energy efficiency remain.

159. *Id.* at 11.

160. JENNIFER THORNE, *RESIDENTIAL RETROFITS: DIRECTIONS IN MARKET TRANSFORMATION* 3-4 (2003), available at <http://aceee.org/pubs/a038full.pdf?CFID=496507&CFTOKEN=27353623>.

161. John A. Laitner & Alan H. Sanstad, *Learning-by-Doing on Both the Demand and the Supply Sides: Implications for Electric Utility Investments in a Heuristic Model*, 2 INT’L J. ENERGY TECH. & POL’Y 142 (2004).

162. THORNE, *supra* note 160, at 2-3.

163. CLIMATE-FRIENDLY BUILT ENVIRONMENT, *supra* note 78, at 17-18.

164. THORNE, *supra* note 160, at 1. A somewhat similar division occurs in private commercial structures; 40% are rented or leased. CLIMATE-FRIENDLY BUILT ENVIRONMENT, *supra* note 78, at 17.

165. REPRESENTATIVES OF THE COMMERCIAL BLDG. INDUS., *HIGH-PERFORMANCE COMMERCIAL BUILDINGS: A TECHNOLOGY ROADMAP* 6 (2000), available at http://www.eere.energy.gov/buildings/info/documents/pdfs/roadmap_lowres.pdf.

166. *Id.* at 4-5.

151. U.S. DOE, *Strengthen National Energy Security*, <http://www.fuel.economy.gov/feg/oildep.shtml> (last visited July 21, 2006).

152. 42 U.S.C. §§6832(15), 6833(a).

153. *Id.* §§6832(16), 6833(b).

154. *Id.* §6833(a)(5), (b)(2).

155. CLIMATE-FRIENDLY BUILT ENVIRONMENT, *supra* note 78, at 46-47.

156. 42 U.S.C. §6833(e).

157. CLIMATE-FRIENDLY BUILT ENVIRONMENT, *supra* note 78, at 3.

158. *Id.* at 14.

Two common forms of tax incentives are credits and deductions.¹⁶⁷ A tax credit reduces the tax that would otherwise be paid. A \$1,000 tax credit reduces a tax bill by that amount. A deduction, by contrast, reduces the amount of income subject to a tax. If a person is subject to a 28% income tax rate, a \$1,000 deduction reduces her tax bill by \$280. On balance, then, credits are more financially attractive to taxpayers.

For energy efficiency, carefully crafted tax incentives validate the technology or activity for which the credit is provided because the government has, in effect, endorsed it. Carefully crafted tax incentives are also “sized” to provide enough motivation to be effective.¹⁶⁸ Tax incentives reduce the initial capital cost of upgrade and retrofit projects. That encourages homeowners and others to undertake such projects, encourages manufacturers to mass market energy-efficient technologies, and introduces these technologies to remodeling firms and independent contractors. By fostering the diffusion of new technologies, tax incentives can also reduce their price.¹⁶⁹ Tax incentives for energy efficiency may be more appropriate and effective for upgrades and retrofits than for new structures because of the size of the existing housing stock and because of their potential to encourage innovation.¹⁷⁰

Oregon appears to have the oldest and most well-established state energy-efficiency tax credit.¹⁷¹ The credit applies to renewable energy as well as energy efficiency, but has been administered with considerable attention to efficiency.¹⁷² A residential tax credit is available for certain new highly efficient refrigerator freezers (\$50-\$70), clothes washers (\$115-\$1,180), and dishwashers (\$50).¹⁷³ Between 1998 and 2001 alone, the credit was claimed for 66,000 appliances. Overwhelming majorities of those surveyed said the program influenced their buying decision and that they would use it again.¹⁷⁴ Business tax credits are available, among other things, for retrofit projects that will result in a 10% energy-efficiency improvement and lighting retrofit projects that are 25% more efficient.¹⁷⁵ Between 1981 and 2001, 3,655 energy-related projects took advantage of the

business tax credit program.¹⁷⁶ The Oregon program has reduced demand for electricity by 530 million kilowatt hours (kWh) and demand for natural gas by 580 million Btus.¹⁷⁷ A handful of other states have similar tax incentives.¹⁷⁸

In the Energy Policy Act of 2005, Congress provided another set of tax incentives for energy efficiency in existing buildings.¹⁷⁹ Homeowners who make certain efficiency improvements at their residence before the end of 2007 can receive a credit of up to \$500.¹⁸⁰ Energy-efficient commercial building expenditures that are put in service before the end of 2007 may qualify for a deduction of \$1.80 per square foot.¹⁸¹

Weatherization programs for low-income persons are another means of providing incentives for energy-efficiency upgrades and retrofits. DOE’s Weatherization Assistance Program has weatherized more than five million homes since 1976. About 105,000 homes were weatherized in 2002, but 28 million households are eligible.¹⁸² While the weatherization program began with a focus on insulation and caulking, it now includes a range of energy-efficiency services, including improved heating and cooling systems and more efficient appliances.¹⁸³ For each dollar spent on this program, the economic and non-economic benefits are estimated at \$3.71.¹⁸⁴ The program reduced energy demand by 0.061 million Btus in 2002.¹⁸⁵ States also have a variety of weatherization programs.¹⁸⁶

Many states and utilities are now employing a targeted “neighborhood blitz” approach to energy efficiency in low-income neighborhoods.¹⁸⁷ These programs provide kits containing such items as low-flow shower heads, setback thermostats, and water heater wraps to residents in low-income neighborhoods. These kits, which cost between \$17 and \$180 each, are distributed free of charge. The economic and energy saving benefits are considerable; for some pro-

167. Other incentives include exclusions of an activity from gross income and taxing the activity at a lower or preferential rate. Roberta F. Mann, *Subsidies, Tax Policy, and Technological Innovation*, in *GLOBAL CLIMATE CHANGE AND U.S. LAW* (Michael Gerrard ed., forthcoming 2007).

168. ELIZABETH BROWN ET AL., *TAX CREDITS FOR ENERGY EFFICIENCY AND GREEN BUILDINGS: OPPORTUNITIES FOR STATE ACTION* vii (2002), available at <http://www.aceee.org/pubs/e021full.pdf>.

169. 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>.

170. David G. Duff, *Tax Policy and Global Warming*, 51 *CANADIAN TAX J.* 2063, 2101 (2003).

171. OR. REV. STAT. §469.185-.225; PRINDLE ET AL., *supra* note 169, at 32.

172. OR. ADMIN. R. §§330-070-0010 to 330-070-0097 (1996), available at <http://www.oregon.gov/ENERGY/CONS/RES/tax/docs/oar-retc06.pdf>.

173. Oregon DOE, *Residential Energy Tax Credits*, <http://www.oregon.gov/ENERGY/CONS/RES/tax/appliances.shtml#App> (last visited July 21, 2006) (dollar values for each category of appliance are available through links on right side of web page for each qualifying category).

174. PRINDLE ET AL., *supra* note 169, at 34.

175. Oregon DOE, *Business Energy Tax Credits*, <http://www.oregon.gov/ENERGY/CONS/BUS/BETC.shtml> (last visited July 21, 2006). The credit applies to 35% of eligible project costs. *Id.*

176. PRINDLE ET AL., *supra* note 169, at 34.

177. *Id.* at 32. Based on Oregon’s experience, a state with average population size and a comparable program could expect to reduce demand for electricity by 863 million kWhs and demand for natural gas by 945 million Btus. *Id.*

178. BROWN ET AL., *supra* note 168, at v-vi (explaining Arizona, Hawaii, Idaho, Maryland, Massachusetts, New Jersey, and New York programs).

179. For an overview of these incentives and their potential impact, see STEVEN NADEL, *THE FEDERAL ENERGY POLICY ACT OF 2005 AND ITS IMPLICATIONS FOR ENERGY EFFICIENCY PROGRAM EFFORTS* (2005), available at <http://aceee.org/pubs/e053.pdf?CFID=421765&CFTOKEN=69178468>.

180. Energy Policy Act of 2005, §1333 (codified at 16 U.S.C. §25C).

181. *Id.* §1331; 16 U.S.C. §179D.

182. CLIMATE-FRIENDLY BUILT ENVIRONMENT, *supra* note 78, at 50-51.

183. U.S. DOE, *Weatherization Assistance Program: Steady Advances in Weatherization Technologies*, http://www.eere.energy.gov/weatherization/wx_technologies.html (last visited July 21, 2006).

184. U.S. DOE, *Weatherization Assistance Program: Non-Energy Benefits of Weatherization*, http://www.eere.energy.gov/weatherization/ne_benefits.html (last visited July 24, 2006).

185. CLIMATE-FRIENDLY BUILT ENVIRONMENT, *supra* note 78, at 50-51.

186. U.S. DOE, *Weatherization Assistance Program: Weatherization Activities in the States*, http://www.eere.energy.gov/weatherization/state_activities.html (last visited July 24, 2006).

187. SOUTHWEST ENERGY EFFICIENCY PROJECT, *LOW COST/NO COST ENERGY EFFICIENCY MEASURES: NEIGHBORHOOD BLITZ, DIRECT INSTALL AND CONSERVATION KIT PROGRAMS* (n.d.), available at http://www.epa.gov/cleanrgy/pdf/ee_lowcost.pdf.

grams, the savings to a household in the first year alone exceed the cost of the kit.¹⁸⁸

2. Transportation

Energy efficiency in transportation, of course, depends in significant part on CAFE standards. But CAFE standards, which are a form of efficiency standards, are not the only way to reduce energy consumption. A great many conservation options are available for transportation. They are premised in the reality that existing zoning, housing, and tax laws, as well as direct and indirect subsidies for roads and highways, have significantly reduced the transportation options available to Americans. As a result, it is difficult or impossible for many Americans to walk, bicycle, or take transit to get to work, and it is equally challenging for their children to walk or bicycle to school.¹⁸⁹ A similar story can be told about the movement of goods. Laws that repeal or modify these laws, or in other ways correct their effects, would provide people with more options, not less. In this respect, laws that foster greater energy conservation are also laws that enhance rather than restrict personal freedom. Two examples of energy conservation and efficiency are expansion of rail freight and transit-oriented development.¹⁹⁰ Both occur in the context of high and fluctuating fuel prices and growing highway congestion. The non-energy benefits of both, however, are so great that energy savings are not given great attention. A third option, an increased transportation fuels tax, would likely also bring significant benefits but raise more obvious political concerns.

□ *Expansion of Rail Freight.* Moving freight by rail has energy efficiency and environmental advantages over moving freight by truck or tractor trailer. A single train can move the same amount of freight as 280 to 500 trucks. The overall fuel efficiency of railroads is three times greater than that for trucks. The fuel efficiency of trains increased from 235 mpg to 410 mpg for a ton of freight between 1980 and 2004. These energy efficiencies translate into reduced air pollution and greenhouse gas emissions.¹⁹¹ Reducing truck traffic on highways eases congestion and reduces demand for new or expanded highways. Railroads are also becoming more competitive. Rail freight rates have been steadily declining since the early 1980s, making the industry more competitive.¹⁹² Unlike their competitors (trucks and barges), however, railroads own and maintain their own tracks and rights-of-way; trucks and barges operate on public rights-of-way that are supported and maintained by taxes.

At the same time, their primary competition—the trucking industry—is flexible in ways that railroads cannot be. Trucks are overwhelmingly the dominant mode of freight

transport mode, representing 78% of the tonnage of domestic freight that is transported. By contrast, rail moves just 16%.¹⁹³ Every company, manufacturer, farmer, and mine is connected to a road or highway that is accessible by a truck, but this is not true of rail. While road and highway systems have expanded over the past century, the number of miles of railroad track declined; rail track mileage is one-half of what it was in 1920.¹⁹⁴ Even if a company is located on a rail spur, moreover, it has not always been possible to get a load of cargo by rail from that spur to a particular destination within the required time. For these and other reasons, a fruit producer in southern Pennsylvania may routinely use tractor trailers to ship applesauce to the West Coast.

An alternative for this and other shippers is intermodal transportation. By this approach, a tractor trailer transports goods a relatively short distance from the producing site to a rail line. The trailer is then loaded onto a flatbed rail car and transported a much longer distance to a rail terminal near the market destination. The trailer is then moved off the rail car, and another tractor takes the trailer to its destination. After goods are initially loaded into the trailer, the goods inside are not touched until the trailer is unloaded at its final destination; the trailer is simply the container in which the goods are moved. Something similar happens with shipping containers used in trans-oceanic trade. They are often moved directly from a cargo ship onto a flat rail car, and then transported across country to a rail terminal near their destination. They are then transported by flat bed tractor trailer to their destination.

Most of the rail freight market is based on long-distance transportation of commodities like coal, wheat, soybeans, and chemicals. Intermodal transport takes advantage of rail's market strengths in moving goods for long distances while benefiting from the flexibility of trucks. Indeed, the fastest growing share of the rail market is based on intermodal transport, which has tripled since the early 1980s. The most heavily used corridor for intermodal transport is between California and Illinois, connecting the U.S. heartland to markets in Asia.¹⁹⁵ Intermodal transportation enhances market competition and gives shippers transportation choices that they may not otherwise have.

The Intermodal Surface Transportation Efficiency Act (ISTEA),¹⁹⁶ as amended and extended by the Transportation Equity Act for the 21st Century (TEA 21),¹⁹⁷ enhanced the competitiveness of rail freight in several ways. Most obviously, the use of “intermodal” in the first statute’s name emphasized the importance of this approach to transportation.¹⁹⁸ The term “intermodal” indicates “the beginning of a

188. *Id.* at 4.

189. F. Kaid Benfield & Michael Repogle, *Transportation, in STUMBLING TOWARD SUSTAINABILITY*, *supra* note 6, at 647.

190. They are examples of conservation because they involve the use of less energy. They are also examples of efficiency because they involve using less energy per commuter trip or cargo shipment.

191. ASS'N OF AMERICAN R.R.S., OVERVIEW OF U.S. FREIGHT RAILROADS 7 (2006), available at <http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Overview.pdf>.

192. FEDERAL R.R. ADMIN., U.S. DEP'T OF TRANSP., FREIGHT RAILROADS BACKGROUND (n.d.), available at <http://www.fra.dot.gov/downloads/policy/freight5a.pdf>.

193. AMERICAN ASS'N OF STATE HIGHWAY AND TRANSP. OFFICIALS, TRANSPORTATION: INVEST IN AMERICA, FREIGHT-RAIL BOTTOM LINE REPORT 2 (2002), available at <http://freight.transportation.org/doc/FreightRailReport.pdf> [hereinafter FREIGHT-RAIL BOTTOM LINE REPORT].

194. *Id.* at 2.

195. *Id.* Rising gas prices are pushing trucking costs up faster than rail costs because trucks are less fuel efficient. As a consequence, more shippers are moving freight by rail. Peter Krouse, *Rising Energy Costs Fuel Surge in Rail Shipping, Profit*, PATRIOT-NEWS (Harrisburg, Pa.), July 9, 2006, at C1.

196. Pub. L. No. 102-240, 105 Stat. 1914 (1991) (codified in 10 separate titles but predominantly Titles 23 and 49).

197. Pub. L. No. 105-178, 112 Stat. 107 (1998).

198. STEVEN R. KALE, INTERMODAL AND MULTIMODAL FREIGHT POLICY, PLANNING, AND PROGRAMMING AT STATE DEPARTMENTS OF

new direction: a greater emphasis on all modes of travel, not just highways, and an emphasis on environmental and economic efficiency.”¹⁹⁹ TEA 21 requires freight and passenger transportation planning to be conducted by state and metropolitan agencies to “minimize transportation-related fuel consumption and air pollution.”²⁰⁰ The Act also requires that freight shippers and transporters be given notice and an opportunity to comment on proposed transportation plans.

A major obstacle to expanded rail freight service, however, results from its growing success in recent decades. Railroads are approaching the limits of current rail capacity.²⁰¹ The American Association of State Highway and Transportation Officials issued a report in 2002 stating that an aggressive public-private investment strategy is needed to help rail freight increase its existing 16% market share to 17% by 2020. Such a strategy—involving only a 1% increase in rail freight’s market share—could “shift 600 million tons of freight and 25 billion truck [vehicle miles traveled] off the highway system, save shippers \$239 billion, save highway users \$397 billion, and reduce highway costs by \$17 billion.”²⁰² These investments would, among other things, allow more trains to travel on a single line through global positioning system tracking, upgrade rail lines and bridges, and provide for safer crossing routes. The nation’s major railroads are now spending approximately \$2 billion per year for improvements, not including repair and maintenance, but close to \$5 billion per year is needed, state officials said. While the railroads themselves would need to meet most of that through revenue and borrowing, the rest would need to come from a variety of public and private sources.²⁰³

Two examples illustrate how rail freight can be fostered across the United States and what opportunities are available. These are the Alameda Corridor project in southern California and Virginia’s intermodal transportation planning activities.

The Alameda Corridor is a useful example of the public-private partnerships that will be needed to maintain and expand rail freight transportation. The corridor is a “rail cargo expressway” that connects two ports, Long Beach and Los Angeles, to transcontinental rail lines 20 miles away. About one-third of all U.S. waterborne container cargo goes through these two ports.²⁰⁴ Before this corridor was constructed, three major railroads employed four different routes to move cargo from these ports, crossing streets at 200 locations and creating traffic congestion, pollution, and safety risks. Projected growth in container cargo volume at these ports was considerable, raising serious questions about the continued ability of these rail lines to move that

traffic. The key piece of this \$2.4 billion project is a 10-mile-long subsurface trench that eliminated the 200 street crossings and reduced rail transit times from more than two hours to 45 minutes.²⁰⁵ The Alameda Corridor required coordination among eight cities, acquisition of rights-of-way, compliance with environmental requirements, and financing from a variety of public and private sources. About a decade and a half elapsed between initial planning and project completion.²⁰⁶ The project appears to be succeeding in its goal of facilitating an increase in rail freight; 17,000 trains used the corridor in 2005, compared to 14,000 in the corridor’s first year of operation. This, in turn, has reduced congestion as well as air and noise pollution.²⁰⁷

A Virginia planning process exploring the potential for moving freight from trucks to rail illustrates the opportunities that are available and the seriousness with which these opportunities are being evaluated. A focal point for this planning process, which is partly an outgrowth of ISTEA and TEA-21, is the Interstate 81 (I-81) corridor. I-81 runs from New York to Tennessee for a distance of 824 miles, 323 of which are in Virginia.²⁰⁸ It has become a major truck transport route; one in every three vehicles on the highway is a truck.²⁰⁹

A 2003 study prepared for the Virginia Department of Rail and Public Transportation identified two approaches to diverting truck traffic from I-81—an approach for the entire length of the highway, and a Virginia-based approach. In both cases, capital investments would need to be made to improve and expand rail service. These investments would include additional tracks, signaling systems that allow for faster and more frequent trains, and the construction of terminals for transferring loads between rail and truck.²¹⁰ Along the length of the corridor, the report said, an initial investment of \$2.6 to \$2.8 billion could divert roughly 700,000 truck loads annually from I-81 within three to five years, and a 10 to 12 year investment of \$7.3 to \$7.9 billion could divert 2.8 to 3.0 million truck loads annually. In Virginia alone, an investment of \$500 million would produce annual diversions of about 500,000 truck loads over five to seven years. These projected diversion levels, the study said, are reasonable because they are consistent with experience elsewhere.²¹¹

In May 2006, Virginia enacted legislation requiring the Virginia Department of Transportation (a separate agency from the Department of Rail and Public Transportation) to prepare a plan “to divert the maximum amount feasible of the long-haul, through-truck freight traffic to intermodal rail

TRANSPORTATION IN THE DECADE SINCE ISTEA 2 (2002), available at http://www.ltrc.lsu.edu/TRB_82/TRB2003-002118.pdf.

199. Benfield & Replogle, *supra* note 189, at 654.

200. 23 U.S.C. §134(a).

201. FED. HIGHWAY ADMIN., U.S. DEP’T OF TRANSP., THE FREIGHT STORY: A NATIONAL PERSPECTIVE ON ENHANCING FREIGHT TRANSPORTATION 14 (2002), available at http://ops.fhwa.dot.gov/freight/freight_analysis/freight_story/freight.pdf. In the mid-Atlantic region alone, \$6 billion will be needed to meet capacity demands over the next 20 years. *Id.*

202. FREIGHT-RAIL BOTTOM LINE REPORT, *supra* note 193, at 3, 5.

203. *Id.* at 4.

204. AJAY AGARWAL ET AL., THE ALAMEDA CORRIDOR: A WHITE PAPER 3 (2004), available at <http://www.mettrans.org/pdfs/AlamedaCorridorWhitePaper.pdf>.

205. *Id.* at 17-18; Alameda Corridor Transportation Authority, Alameda Corridor—Fact Sheet, http://www.acta.org/projects_completed_alameda_factsheet.htm (last visited July 24, 2006).

206. AGARWAL ET AL., *supra* note 204.

207. Press Release, Alameda Corridor Transp. Auth., Alameda Corridor Posts Strong Performance Gains in 2005 (Feb. 17, 2006), available at <http://www.acta.org/Releases/February%202005%20Bd%20release.pdf>.

208. Wikipedia, Interstate 81 (2006), http://en.wikipedia.org/wiki/Interstate_81 (last visited July 24, 2006).

209. KAREN RAE & GEORGE CONNER, REEBIE ASSOCS., THE NORTH-EAST-SOUTHEAST-MIDWEST CORRIDOR MARKETING STUDY: EXAMINING THE POTENTIAL TO DIVERT HIGHWAY TRAFFIC FROM INTERSTATE 81 TO RAIL INTERMODAL MOVEMENT, Executive Summary (2003).

210. *Id.* at 7.

211. *Id.* at 8-9.

in the Interstate Route 81 Corridor.” The plan is to include a detailed analysis of the operating characteristics of this system as well as an evaluation of costs, return on investment, and alternative financing methods.²¹²

□ *Transit-Oriented Development.* A side effect of personal car travel is traffic congestion, and congestion in urban areas has grown considerably in the past two decades. According to the Texas Transportation Institute, the annual delay per peak traveler grew from 16 to 47 hours between 1982 and 2003, and the number of metropolitan areas with more than 20 hours of delay per peak traveler grew from 5 to 51. Delays grew from 0.7 billion to 3.7 billion hours over this 20-year period, wasted fuel increased from 0.4 to 3.7 billion gallons, and costs (in 2003 dollars) climbed from \$12.5 billion to \$63 billion.²¹³

As a consequence, public transportation has become more attractive. Uncongested or free-flowing travel in urban areas is less than one-half of what it was in 1982.²¹⁴ Public transport saved 1,096 million hours in travel delays in 2003, compared to 269 million hours in 1992. Similarly, public transport saved \$18.2 billion in congestion costs in 2003, compared to \$4.6 billion in 1982.²¹⁵ Additional road capacity, which for many is the most straightforward solution, has been unavailing. Only 4 of 85 urban areas have had road capacity that stayed relatively even with demand growth; in 53 other areas, traffic growth has exceeded growth in road capacity by more than 30%.²¹⁶

Transit-oriented development (TOD) is one of many responses to growing congestion. TOD is designed to use public transportation rather than a personal car, to reduce road congestion, and to create a pedestrian-friendly environment in the area around public transportation facilities.²¹⁷ Increased ridership means greater income for public transportation agencies. TOD can also be a way to achieve significant economic development in less developed or even deteriorating neighborhoods around transit stops. While definitions vary somewhat, TOD has five major characteristics:

First, a TOD has sufficient density to encourage the use of public transit. Second, a TOD locates residences, jobs, and retail destinations close to public transit facilities. Third, a TOD consists of mixed uses, with retail and employment locations within walking distance of residential areas. Fourth, the TOD is built on a grid transportation network, which is not divided into the arterial-collector-local road classification system found in most suburban areas. Finally, most TODs contain urban design guidelines and design features to encourage a more pedestrian orientation, which theoretically encourages its residences to eschew the automobile in favor of more communal forms of transportation.²¹⁸

212. 2006 VA. ACTS CH. 934, available at <http://leg1.state.va.us/cgi-bin/legp504.exe?061+ful+CHAP0934+pdf>.

213. DAVID SCHRANK & TIM LOMAX, THE 2005 URBAN MOBILITY REPORT 1 (2005).

214. *Id.* at 2-3.

215. *Id.*

216. *Id.* at 6.

217. ROBERT H. FEILICH, FROM SPRAWL TO SMART GROWTH: SUCCESSFUL LEGAL, PLANNING, AND ENVIRONMENTAL SYSTEMS 269 (1999).

218. *Id.* at 268-69. See also TRANSP. RESEARCH BD., TRANSIT-ORIENTED DEVELOPMENT IN THE UNITED STATES: EXPERIENCES, CHALLENGES, AND PROSPECTS S-1 (2004) (describing the most

The United States now has more than 100 TOD projects, mostly around various types of rail stations.²¹⁹ Public transportation is more economically feasible in higher density areas. The more people who live or work in a particular area, and the closer they are to a public transportation facility, the more likely they are to use public transportation.²²⁰ Mixed-used zoning, which allows businesses to be located next to housing, and a pedestrian-friendly environment can make these areas even more attractive as places to live. More than 100 “joint development projects” also exist. These are based on U.S. transit-agency properties located near transit stations. This land is developed in a TOD fashion in public-private partnerships that put the public transit agencies in the role of government economic development agencies.²²¹

TOD tends to be more successful “when it starts with a vision, cultivated from broad-based public input, and proceeds to strategic station-area planning backed by appropriate zoning as well as policy incentives and regulations.”²²² TOD usually requires special zoning requirements, particularly to enable higher densities and mixed-use zoning around public transit facilities. Traditional zoning, by contrast, divides a municipality into districts in which uses are the same. Thus, there are districts that are strictly residential, districts that are strictly commercial, and so forth.²²³ Traditional zoning ordinances also contain density restrictions on the number of residences, businesses, and other structures. Overlay zones are the primary means used to modify existing zoning for TOD. An overlay zone is laid over an existing zone and modifies restrictions that exist within that zone, increasing permissible densities and uses in a manner that is consistent with the original vision.²²⁴ To encourage the use of TODs, Massachusetts has published a model ordinance for a TOD overlay district.²²⁵

Perhaps the most successful example of a TOD outside a central business district in the United States is the Rosslyn-Ballston corridor in Arlington County, Virginia, which is developed along five stations in Washington, D.C.’s Metrorail system.²²⁶ The area around these five stations has been transformed since the 1970s, when the Metrorail was constructed. It now has office towers and major hotels, a great variety of retailers and service providers (including restaurants, specialty retailers, beauty/barber shops, and banks), and 18,000 housing units.²²⁷ Generally, higher-den-

common attributes of TOD as “compact, mixed-use development near transit facilities and high-quality walking environments”). Various local definitions of TOD are collected in *id.* at 6.

219. *Id.* at S-1.

220. See, e.g., CONGRESSIONAL BUDGET OFFICE, THE PAST AND FUTURE OF U.S. PASSENGER RAIL SERVICE 27-28 (2003), available at <http://www.cbo.gov/ftpdocs/45xx/doc4571/09-26-PassengerRail.pdf>.

221. TRANSP. RESEARCH BD., *supra* note 218, at 18-35. These properties were purchased for public transportation but, as it turns out, are not needed for that purpose.

222. *Id.* at 81.

223. This approach is often referred to as Euclidian zoning, after the zoning ordinance whose constitutionality was upheld in *Euclid v. Amber Realty Co.*, 272 U.S. 365 (1926).

224. TRANSP. RESEARCH BD., *supra* note 218, at S-2, 63-64.

225. STATE OF MASS., TRANSIT-ORIENTED DEVELOPMENT OVERLAY DISTRICT: MODEL BYLAW, available at http://www.mass.gov/envir/smart_growth_toolkit/bylaws/TOD-Bylaw.pdf.

226. TRANSP. RESEARCH BD., *supra* note 218, at 61.

227. *Id.* at 61-62, 241-42.

sity commercial areas are located closer to the Metrorail stations, and medium-density uses are in the next ring, and lower-density uses, including lower-density housing, are farther away. The zoning districts, taken together, are more in the form of a bull's eye than a series of boxes.

TOD success stories come from all around the country, including Boston, Chicago, Colorado, Dallas, Miami-Dade County, New Jersey, Portland, San Francisco Bay, and Southern California.²²⁸ The available evidence indicates that TOD is actually achieving its primary goal—moving people from cars to public transit. People who live in TOD areas are five to six times more likely to use public transportation than others who live in the same region.²²⁹ The success stories indicate that economic development motivates many TOD projects, and that government economic development assistance of various kinds is employed for TOD.²³⁰ Finally, though, the fact that there are only 200 or so TODs or TOD-like projects indicates that opportunities for expansion of TOD are abundant.²³¹

□ *Taxation of Transportation Fuels.* Fuel taxes are among the most widely advocated but most widely criticized means of achieving greater energy efficiency in transportation. Even before one gets to the merits of any proposal involving fuel taxation, there is a threshold question of political acceptability. “Americans are reflexively opposed both to tax programs and to gasoline price increases,” and a gasoline tax “combines both.”²³² This may be particularly true at a time of high gasoline prices. Still, the option is worth serious consideration in any discussion of what choices exist to stabilize energy use from transportation fuels, and it is helpful to understand the strengths and weaknesses of taxation as a tool for achieving energy efficiency. Because high fuel prices imitate to some degree what might be expected from a fuel tax increase, it is also useful to see what studies indicate about the effects of an increased fuel tax.

To begin with, there are already taxes on gasoline, and these taxes contribute to some degree to energy efficiency by increasing its overall price. The federal excise tax for gasoline is 18.4 cents per gallon, and states charge an average of an additional 21 cents per gallon. With local taxes included, the average gasoline tax is 41 cents per gallon.²³³ These taxes are included in the price paid at the pump.²³⁴ Highways receive most of the federal money (15.44 cents),

while public transportation (2.86 cents) and the Leaking Underground Storage Tank Trust Fund Account (0.1 cents) receive the rest. In Fiscal Year 2001, the federal tax brought in \$20.6 billion, of which more than \$17 billion was allocated for highways.²³⁵

Fuel taxes are supposed to encourage efficiency by increasing the price of fuel. Some increase in efficiency occurs, but it is more modest than what may be expected. Two primary sources of data are available: recent experience with fuel price increases, and studies that have been conducted on this issue.

To be sure, higher fuel prices at the pump, even without an increased gasoline tax, are driving greater energy intensity and motivating many individuals and businesses to trade in less fuel-efficient vehicles for more fuel-efficient vehicles.²³⁶ Higher fuel prices are also contributing to greater interest in rail freight and transit-oriented development. But higher prices challenge a long-standing trend of Americans driving more each year. Vehicle miles traveled by passenger cars increased from 587 million to 1,661 million between 1960 and 2003.²³⁷ Higher gasoline prices in the summer of 2005 slowed the increase in number of miles driven to one-half the usual rate.²³⁸ That the rate of driving still increased is due, to some degree, to consumers who respond by spending more of their money on fuel and less on other things.²³⁹ This is particularly true when they lack affordable or available alternatives. Among households, those with low incomes or who live in rural areas are most affected.²⁴⁰ The long-term effect of higher fuel prices is also difficult to gauge, in part because it depends on the growth and duration of higher prices, but higher prices unquestionably exert downward pressure on use of transportation fuels.

A number of studies indicate that fuel tax increases will likely lead to greater efficiency. European experience with various types of fuel and energy taxes supports that conclusion.²⁴¹ Other studies suggest that a 10% increase in fuel prices often leads to a 1% to 2% reduction in miles driven in the short run and a 6% reduction in fuel consumption in the long run.²⁴² The reduction in fuel consumption occurs not

228. A chapter on each is contained in *id.*

229. *Id.* at 139.

230. *Id.* at 11 (describing community economic development as a secondary objective of TOD).

231. Neighborhood resistance and lack of government leadership may be reasons TOD has not made greater progress. Douglas R. Porter, *Transit-Focused Development: A Progress Report*, 64 J. AM. PLANNING ASS'N 475, 485 (1998).

232. Robert R. Nordhaus & Kyle W. Danish, *Assessing the Options for Designing a Mandatory U.S. Greenhouse Gas Reduction Program*, 32 B.C. ENVTL. AFF. L. REV. 97, 148 (2005). The paper also appears, in substantially the same form, as ROBERT R. NORDHAUS & KYLE W. DANISH, *DESIGNING A MANDATORY GREENHOUSE GAS REDUCTION PROGRAM FOR THE U.S.* (2003), available at <http://www.pewclimate.org/docUploads/USGas%2Epdf>.

233. FUEL ECONOMY STANDARDS VERSUS A GASOLINE TAX, *supra* note 102, at 1.

234. 26 U.S.C. §4081; U.S. DOE, Energy Info. Admin., *A Primer on Gasoline Prices*, http://www.eia.doe.gov/bookshelf/brochures/gasoline/pricesprimer/eia1_2005primerM.html (last visited July 24, 2006).

235. PAMELA J. JACKSON, CONGRESSIONAL RESEARCH SERV., *THE FEDERAL EXCISE TAX ON GASOLINE AND THE HIGHWAY TRUST FUND: A SHORT HISTORY* CRS-9 (2006), <http://cnie.org/NLE/CRSreports/06May/RL30304.pdf>.

236. See, e.g., Jonathan Welsh, *The Post-SUV Family Car*, WALL ST. J. (July 14, 2006), at W1.

237. U.S. DOT, Bureau of Transp. Statistics, *Table I-32: U.S. Vehicle--Miles*, http://www.bts.gov/publications/national_transportation_statistics/2004/html/table_01_32.html (last visited July 24, 2006). Vehicle miles traveled by tractor trailers increased from 29 million in 1960 to 138 million in 2003. *Id.*

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

239. ANNUAL ENERGY OUTLOOK 2006, *supra* note 7, at 34.

240. MARK COOPER, CONSUMER FEDERATION OF AMERICA, *THE IMPACT OF RISING PRICES ON HOUSEHOLD GASOLINE EXPENDITURES* (2005), available at http://www.consumerfed.org/pdfs/CFA_REPORT_The_Impact_of_Rising_Prices_on_Household%20Gasoline_Expenditures.pdf.

241. Duff, *supra* note 170, at 2088-93.

242. TODD LITMAN, VICTORIA TRANSPORT POLICY INST., *APPROPRIATE RESPONSE TO RISING FUEL PRICES 3* (2005), available at <http://www.vtpi.org/fuelprice.pdf>.

only because people drive less, but also because they shift to more fuel-efficient vehicles.²⁴³

A 2003 Congressional Budget Office (CBO) study on reducing gasoline consumption by 10% illustrates this point in greater detail, even though it was completed before the recent run-up in fuel prices. In a nutshell, the CBO concluded that a gas tax is preferable to tightened CAFE standards as a way to achieve that reduction. The CBO calculated that a 31.3 mpg CAFE standard for cars and a 24.5 mpg standard for light trucks would meet the 10% reduction, and that a 46-cents-per-gallon tax increase would also meet that reduction. The gas tax, the CBO said, would be more effective than new CAFE standards over the short term because it would affect all vehicles right away; CAFE standards would apply only to new vehicles and would not take full effect until all existing vehicles had been replaced (about 14 years).²⁴⁴ Without an increased gas tax, moreover, more stringent CAFE standards would also lead some vehicle owners to drive more, offsetting some of CAFE's benefits.²⁴⁵

Interestingly, benefits appear to significantly outweigh costs for both options. A higher gas tax would save 90.5 million gallons over its first 14 years but impose additional costs (mostly to consumers) of \$21 billion.²⁴⁶ At \$2 per gallon, the benefit-to-cost ratio for consumers is 9 to 1, and at higher gasoline prices the ratio is even greater.²⁴⁷ CAFE standards (with a model that allows manufacturers to engage in trading to meet the standards) would save 63.6 billion gallons of gasoline and cost \$28.9 billion (again, mostly to consumers in the form of increased costs for new vehicles).²⁴⁸ At \$2 per gallon, benefits to consumers exceed costs by 4 to 1, and the benefit-to-cost ratio is even greater with higher prices. Non-economic benefits for both options include reducing carbon dioxide emissions and dependence on foreign oil.²⁴⁹

A great many choices exist for establishing and structuring a gasoline tax. These choices clarify a set of important differences between an increased tax, on one hand, and market-driven price increases on the other. These options include the amount of the tax and whether to start with a relatively small tax and steadily increase it to a higher tax in the medium to long term.²⁵⁰ Another set of choices is whether

and how to provide some kind of refund or exemption for low-income or rural individuals, or to certain businesses. Another question is how to use the additional money that is collected. One approach would refund the proceeds to individuals with more efficient vehicles, individuals who drive less, or both. This approach has a double efficiency benefit—a higher fuel tax for all vehicles coupled with a tax refund for those with low fuel consumption.²⁵¹ Unlike market-driven price increases, a higher tax can be structured in various ways to shield low-income or rural people from its impacts. Unlike higher fuel prices, moreover, tax proceeds can be redistributed in the form of tax incentives, for research on energy efficiency, and for other purposes.

Still another set of choices is whether or how to combine an increased gasoline tax with other legal tools. Taxes for a particular purpose are more effective when used in conjunction with other tools that have the same or similar purposes.²⁵² From an energy conservation perspective, for example, it may be appropriate to consider both a modest increase in fuel taxes *and* more stringent CAFE standards. Similarly, greater attention to increasing rail freight and transit-oriented development, in conjunction with these and other choices, is likely to reduce energy consumption from transportation more than any one of these approaches alone.

3. Electricity

The partial deregulation of the electric utility industry has, to a great degree, changed the landscape on which electric energy efficiency and conservation programs have been run. In the short term, this has had a negative effect on those programs. In the years ahead, a major challenge will be to harness market forces on behalf of greater efficiency and reduced electricity consumption.

The generation, transmission, and distribution of electricity in the United States are, for the most part, accomplished by private industry. When the electric industry began, centralized electric generating stations provided electricity to customers that were reasonably close to the stations themselves. In 1898, Samuel Insull, then president of Chicago Edison, proposed that electric companies be regulated as monopolies because each had discrete service territories. The idea was accepted; state public utility commissions were given authority to set rates and service standards. These commissions remain one of the industry's main sources of regulatory authority.

In this legal framework states achieved considerable energy efficiency through integrated resource planning, demand side management, and similar requirements. These tools—which are still used in a great many states—attempt to reduce demand by requiring utilities to integrate energy efficiency into their planning processes for new power plants, by shifting electricity use from peak or high demand times during the day to nonpeak or low demand times, and by other means.²⁵³

243. IAN W.H. PARRY, DO GASOLINE TAXES AND FUEL ECONOMY STANDARDS INCREASE ECONOMIC EFFICIENCY? 2 (2004), available at http://www.rff.org/rff/About/Fellowships_and_Internships/loader.cfm?url=/commonsspot/security/getfile.cfm&pageid=17085.

244. FUEL ECONOMY STANDARDS VERSUS A GASOLINE TAX, *supra* note 102, at 1-2.

245. *Id.* In its April 6, 2006, final rule increasing the average fuel economy standard for light trucks, for example, the National Highway Traffic Safety Administration estimated that this "rebound effect" would reduce expected savings by 20%. 71 Fed. Reg. at 17632-33.

246. FUEL ECONOMY STANDARDS VERSUS A GASOLINE TAX, *supra* note 102, at v.

247. These ratios are simple proxies for benefits and costs; they do not take into account distributional impacts, effects on producers, or other macroeconomic effects. Still, they indicate that benefits on balance are likely to significantly exceed costs.

248. FUEL ECONOMY STANDARDS VERSUS A GASOLINE TAX, *supra* note 102, at v.

249. *Id.*

250. Another approach, now being tested in Oregon, would tax not gasoline but the number of miles driven; a computer in the pump would access the vehicle's odometer to determine the appropriate tax. Oregon DOT, *Oregon Road User Fee Task Force: Frequently Asked*

Questions, http://www.oregon.gov/ODOT/HWY/OIPP/rufft_faqs.html (last visited July 24, 2006).

251. See Duff, *supra* note 170, at 2092 (describing similar European experience).

252. *Id.*

253. *Lessons From State Experience*, *supra* note 28, at 10966-67.

More recently, two dozen states and the District of Columbia restructured their electricity industries to provide some form of retail access program. Under a typical retail access program, transmission and distribution is still provided by regulated monopolies, but customers are allowed to choose the generator from which they purchase electricity.²⁵⁴ After restructuring, utilities no longer had a monopoly on the provision of electricity to all customers within a particular area; they found themselves in an increasingly competitive environment. As a practical or legal matter, prior energy-efficiency requirements were no longer in effect. As a result, these companies, which now increasingly call themselves electric generation companies or electric distribution companies rather than utilities, dramatically reduced their energy-efficiency expenditures in order to stay competitive. Utility spending on demand side management programs declined from \$1.6 billion in 1993 to \$900 million in 1997.²⁵⁵ For a variety of reasons, but particularly because California's restructuring law contributed to its widely publicized 2000 to 2001 electricity crisis, no state has restructured its electric industry since 2000.²⁵⁶ A continuum now exists across the states from highly regulated vertically integrated monopolies to less regulated market-driven enterprises.²⁵⁷

At the federal level, the Federal Energy Regulatory Commission (FERC) has authority to fix rates for interstate transmission and interstate wholesale sales.²⁵⁸ In 1996, FERC ordered public utilities that operate transmission systems to make those systems available to other utilities on the basis of nondiscriminatory transmission tariffs and charges.²⁵⁹ This order, of course, fosters competition in interstate electricity sales. To improve competition as well as management of the electric power grid, FERC issued an order in 2000 encouraging (but not requiring) the formation of Regional Transmission Organizations (RTOs). The FERC order sets minimum requirements for RTO operation and makes RTOs responsible for transmission tariff administration and design and for interregional coordination. It also requires utilities to participate in an RTO or to explain to FERC why they are not doing so.²⁶⁰

FERC regulates interstate electricity rates for utilities, RTOs, and other regulated entities. These entities file rate proposals with FERC, which approves them if they are "just

and reasonable."²⁶¹ Once these rates are approved, state utility commissions are required to give them binding effect when they determine intrastate rates.²⁶² Thus, while every state has some degree of oversight, state rate-setting authority is limited primarily to intrastate generation and distribution. This structure provides energy-efficiency opportunities in the use of at least two legal tools—public benefit funds and variable rate tariffs.

□ *Public Benefit Funds.* Public benefit fund programs for energy efficiency are an outgrowth of electricity restructuring laws. These programs are also "perhaps the most significant new policy mechanism for implementing energy efficiency in the past decade."²⁶³ Some 18 states are now implementing public benefit funds for energy efficiency.²⁶⁴ Of these states, only Wisconsin and Vermont have not also restructured their electric industry.²⁶⁵ These programs are typically funded through a small public benefit charge to the distribution service part of the electric bill. The charge in these states ranges between 0.03 to 3 mills per kWh (one mill equals one-tenth of one cent).²⁶⁶ The money is collected and administered by different entities in different states; these include a state agency, an independent entity, and the utilities themselves.²⁶⁷ Whatever entity administers the program, the money is spent on a variety of energy-efficiency projects and activities. These include weatherization assistance to low-income households, programs to replace less efficient appliances and equipment with more efficient appliances and equipment, loan programs for residential as well as commercial and industrial electricity customers, consumer education, and research and development.²⁶⁸

These programs appear to be effective in proportion to the amount of money expended; greater energy-efficiency benefits result from greater expenditures.²⁶⁹ Annual energy savings range from 0.1% to 0.8% of total electricity sales, with an average savings of 0.4%.²⁷⁰ Although these savings are relatively small, the savings from any given energy-effi-

261. 16 U.S.C. §824(d).

262. *Entergy Louisiana, Inc. v. Louisiana Public Serv. Comm'n*, 539 U.S. 39, 47 (2003) (citing *Nantahala v. Thornburg*, 476 U.S. 953, 962 (1986)).

263. FIVE YEARS IN, *supra* note 256, at vii.

264. *Id.* at 6. For state-by-state summaries of public benefit programs, see Alliance to Save Energy, *State Energy Efficiency Index: Public Benefit Funds*, <http://www.ase.org/content/article/detail/2604> (last visited July 24, 2006); American Council for an Energy-Efficient Econ., *Summary Table of Public Benefit Programs and Electric Utility Restructuring* (Updated Dec. 2005), <http://www.aceee.org/briefs/mktabl.htm> (last visited July 24, 2006). Public benefit funds are also used for purposes other than energy efficiency, particularly for low-income energy assistance and renewable energy. FIVE YEARS IN, *supra* note 256, at 11.

265. FIVE YEARS IN, *supra* note 256, at 6.

266. *Id.* at iv.

267. *Id.* at 13. Because the fee is attached to the distribution charge, customers cannot avoid it by choosing a different generator to provide their electricity; the generation and distribution charges are separate. See also CARL BLUMSTEIN ET AL., WHO SHOULD ADMINISTER ENERGY-EFFICIENCY PROGRAMS? (2003), available at <http://www.ucei.berkeley.edu/PDF/csemwp115.pdf> (no single administrative structure for energy-efficiency programs in the United States is obviously better than others).

268. See *State Energy Efficiency Index: Public Benefit Funds*, *supra* note 264.

269. FIVE YEARS IN, *supra* note 256, at 27-28.

270. *Id.* at 28.

254. U.S. DOE, ENERGY INFO. ADMIN., STATUS OF ELECTRIC INDUSTRY RESTRUCTURING ACTIVITY AS OF FEBRUARY 2003, at 2 (2003), available at http://www.eia.doe.gov/cneaf/electricity/chg_str/restructure.pdf.

255. DAN YORK & MARTY KUSHLER, STATE SCORECARD ON UTILITY AND PUBLIC BENEFITS ENERGY EFFICIENCY PROGRAMS: AN UPDATE 1 (2002), available at <http://www.aceee.org/pubs/u023full.pdf>.

256. MARTIN KUSHLER ET AL., FIVE YEARS IN: AN EXAMINATION OF THE FIRST HALF-DECADE OF PUBLIC BENEFITS ENERGY EFFICIENCY POLICIES 1 n.4 (2004), <http://aceee.org/pubs/u041.pdf?CFID=66438&CFTOKEN=27313893> [hereinafter FIVE YEARS IN].

257. Edward Vine et al., *Public Policy Analysis of Energy Efficiency and Load Management in Changing Electricity Businesses*, 31 ENERGY POL'Y 405, 408 (2003).

258. 16 U.S.C. §824(a).

259. Promoting Wholesale Competition Through Open Access Nondiscriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmission Utilities, 61 Fed. Reg. 21540, 75 F.E.R.C. 61080 (1996) (Order No. 888). See also *New York v. FERC*, 535 U.S. 1 (2002) (upholding FERC's statutory authority to issue Order No. 888).

260. Regional Transmission Organizations, 65 Fed. Reg. 809 and 65 Fed. Reg. 12088 (2000) (codified at 18 C.F.R. §35.54).

ciency measure will be realized each year for the life of the measure, and individual measures tend to last at least 10 years.²⁷¹ The eight states that report savings in MWs or system demand report an overall savings of 1,059 MWs, which is equivalent to one large base load power plant.²⁷²

These programs also produce a range of other benefits. These include reductions in conventional air pollutants (sulfur dioxide, nitrogen oxides, mercury) and greenhouse gas emissions (carbon dioxide).²⁷³ They also improve the reliability of electricity distribution and transmission systems and reduce the need for new capacity, help businesses to be more competitive, assist disadvantaged customers, and benefit state economies.²⁷⁴ These programs are also cost effective; their benefit-to-cost ratios range from 1.0 (break even) to 4.3 (meaning that the benefits are more than 4 times greater than the cost).²⁷⁵

California's public benefit program is of particular interest because of the energy conservation efforts it made during its electricity supply crisis.²⁷⁶ The 1996 restructuring legislation also imposed a public benefit charge for energy-efficiency programs and requires the state's major investor-owned utilities to administer the fee.²⁷⁷ Between 2000 and 2004, three utilities (Pacific Gas & Electric, San Diego Gas & Electric, and Southern California Edison) spent \$1.4 billion on energy efficiency. In 2004, they spent \$317 million, which is a bit more than 1% of their total revenue.²⁷⁸ Funds were spent on residential and nonresidential programs, new construction, public education and information, and emerging technology, among other things.²⁷⁹ Electricity savings in 2004 were about 1% of overall electricity sales.²⁸⁰ The cost of these programs was about 2.9 cents per kWh (if cross-cutting programs such as public education and information are excluded) compared to the 5.8 cents per kWh cost of base load electric generation and the 16.7 cents per kWh cost of peak time electricity generation in California.²⁸¹ According to one estimate, more than \$2 billion will be spent on energy efficiency at current spending levels over this decade, resulting in \$5.5 billion in electricity savings.²⁸²

Several factors indicate that these programs are not performing at their maximum (or even previous) level of effectiveness. To begin with, overall spending on energy efficiency is lower now than it was a decade ago. Because of

public benefit funds, funding has rebounded to some degree; total spending on ratepayer funded (including demand side management and public benefit funds) electricity efficiency programs in 2003 was \$1.35 billion.²⁸³

In addition, there is considerable variation among states in funding for energy efficiency. The highest public benefit surcharge in a customer's electric bill (Connecticut, 3.0 mills per kWh) is 100 times greater than the lowest surcharge (Illinois, 0.03 mills per kWh). The California and New Jersey surcharges (1.3 mills per kWh) are 10 times higher than the Ohio surcharge (0.13 mills per kWh).²⁸⁴ For all ratepayer funded electricity efficiency programs, the top 10 states in terms of per capita spending are responsible for 39% of all spending, and the top 20 states are responsible for 90% of all spending.²⁸⁵ Yet even in California, which has a long history of electricity efficiency programs, a doubling of the amount spent on public benefit programs would result in *net* savings of \$8.6 billion.²⁸⁶

□ *Variable Rate Tariffs.* The Energy Policy Act of 2005 requires each utility to offer its customers

a time-based rate schedule under which the rate charged by the electric utility varies during different time periods and reflects the variance, if any, in the utility's costs of generating and purchasing electricity at the wholesale level. The time-based rate schedule shall enable the electric consumer to manage energy use and cost through advanced metering and communications technology.²⁸⁷

If individual customers request this rate schedule, utilities are to provide it by January 8, 2007.²⁸⁸ The same statute adds, ambiguously, that each state regulatory authority is to decide whether it is appropriate to implement that requirement.²⁸⁹ While states need not consider efficiency when determining that such a rate is "appropriate," time-based rate schedules appear to have considerable value for energy efficiency.

Demand for electricity varies over the course of the day and year. Demand is greater during the day, when people are awake and working, than it is late at night. Hotter temperatures in the summer increase demand for air conditioning; colder temperatures in the winter push demand for electric heating in some markets. The cost of supplying electricity also varies. Many power plants run on a nearly constant basis, ensuring that the minimum electricity demand—or base load—is always capable of being met. Other plants provide electricity only when there is greater demand—particularly during peak periods. The cost of providing this peak elec-

271. *Id.*

272. *Id.*

273. *Id.* at 28-29.

274. *Id.* at 28-29, 30-31.

275. *Id.* at 29-30.

276. PAUL L. JOSKOW, CALIFORNIA'S ELECTRICITY CRISIS (2001), available at <http://web.mit.edu/ceepr/www/2001-006.pdf> (analyzing crisis and attributing decline in demand during that period to public education, energy conservation, and higher natural gas prices).

277. CAL. PUB. UTIL. CODE §385 (2006).

278. CYNTHIA ROGERS ET AL., CALIFORNIA ENERGY COMM'N, FUNDING AND ENERGY SAVINGS FROM INVESTOR-OWNED ENERGY EFFICIENCY PROGRAMS IN CALIFORNIA FOR PROGRAM YEARS 2000 THROUGH 2004 at 2 (2005), available at http://www.fypower.org/pdf/CEC%20_Trends2000-04.pdf.

279. *Id.* at 3.

280. *Id.* at 6.

281. *Id.* at 9, 11.

282. MICHAEL RUFO & FRED COITO, XENERGY, INC., CALIFORNIA'S SECRET ENERGY SURPLUS: THE POTENTIAL FOR ENERGY EFFICIENCY ES-3 (2002), available at http://www.ef.org/documents/Secret_Surplus.pdf.

283. DAN YORK & MARTY KUSHLER, ACEEE'S 3rd NATIONAL SCORECARD ON UTILITY AND PUBLIC BENEFITS ENERGY EFFICIENCY PROGRAMS: A NATIONAL REVIEW AND UPDATE OF STATE-LEVEL ACTIVITY 1 (2005), available at <http://www.aceee.org/pubs/u054.pdf> [hereinafter 3rd NATIONAL SCORECARD].

284. FIVE YEARS IN, *supra* note 256, at 11.

285. 3rd NATIONAL SCORECARD, *supra* note 283, at ii. The top 10 states in terms of total per capita spending in 2003 were Iowa, Massachusetts, Montana, New Hampshire, New Jersey, Oregon, Rhode Island, Vermont, Washington, and Wisconsin. *Id.* at 5. The bottom 10 states (including the District of Columbia) were Delaware, the District of Columbia, Kansas, Maryland, Missouri, Nebraska, North Carolina, Oklahoma, Virginia, and Wyoming. *Id.* at 7.

286. RUFO & COITO, *supra* note 282, at ES-3.

287. 16 U.S.C. §2621(d)(14)(A).

288. *Id.*

289. *Id.* §2621(d)(14)(F).

tricity is roughly four times more expensive than the cost of base load electricity. The median base load cost across all states for producing base load electricity is \$19.47 per megawatt hour (MWh), compared to \$92.46 per MWh hour for peak load electricity.²⁹⁰

Although costs vary, prices for residential customers generally are in the form of a flat rate per kWh of electricity used. In 2004, the average residential retail rate was 8.9 cents per kWh.²⁹¹ Thus, retail prices for base load electricity exceed costs, and prices for peak load electricity are likely much lower than the actual costs. Properly calibrated peak load charges may encourage energy efficiency.

The possibility of increased efficiency is particularly important for devices that are used during peak load times. Variable rates could encourage accelerated deployment of more efficient technologies and could also speed up the rate at which less efficient systems are retired or replaced. Air conditioners are perhaps the primary example.

Assume, for example, that a consumer replaces an old central air conditioning system that has a seasonal energy-efficiency ratio (SEER)²⁹² of 6.5 with a new air conditioner that meets standards now in effect (SEER of at least 13).²⁹³ This new system will reduce electricity consumption by about one-half. If the original air conditioner consumed 2,305 kWh per year,²⁹⁴ the new model would save 1,153 kWh per year. If a consumer paid a flat-rate tariff of 9 cents per kWh, the new unit would save the consumer \$104 per year.²⁹⁵

Switching to variable pricing would increase the percentage of the bill that is spent on air conditioning. As a consequence, improvements in energy efficiency would save more money under a variable rate. If the variable rate were 16 cents per kWh for high demand periods when the air conditioner was in use, the same upgrade could yield savings of \$184 per year. Central air conditioning systems have an 18.4-year life expectancy and an average installed price for new systems of \$3,032.²⁹⁶ Thus, lifetime savings with a flat tariff would be \$1,914 but could be as high as \$3,386 for a variable rate tariff. Thus, a variable rate would encourage the purchase of state-of-the-art air conditioners and the replacement of less efficient air conditioners.

Some additional calculations provide a sense of what such a rate could achieve. In 2001, some 57.5 million central air conditioning units were in use in U.S. households.²⁹⁷ Na-

tionally, air conditioning accounts for about 5% of U.S. electricity consumption.²⁹⁸ A modest 30% improvement in efficiency for 1% of U.S. central air conditioners would save a small fraction of the total U.S. electricity consumption, but this could offset as much as 20% of the expected 1.1% annual growth in electricity consumption projected for 2004 to 2030.²⁹⁹

How much of that potential could actually be achieved? The short answer is that we don't know. While utilities have implemented variable tariffs for certain customers, U.S. studies of these programs tend to focus on benefits such as load shifting or curtailment, as opposed to long-term energy-efficiency benefits. A 2003 report by the California Energy Commission concluded that customer acceptance of variable rate tariffs would depend on three elements. First, the state would have to design fair rates. Second, customers would need to be educated on how variable rates work and how they can change their electricity use to reduce their bills. Finally, "meters, communications, and billing infrastructure" would need to be in place so customers can assess the impact of the new rate structure on their electricity use.³⁰⁰ Early European experience with variable rate pricing, however, indicates that it can have significant effects on electricity consumption if the system is implemented in a simple and understandable manner.³⁰¹

IV. Is Stabilization Possible?

Considerable evidence exists that stabilization of U.S. energy consumption may be possible in the next several decades. It does not appear that the federal government or anyone else has conducted, within the past several years, an assessment of the policy-based achievable potential for energy efficiency based on a comprehensive set of cost-effective measures. Yet enough evidence exists, from a variety of other sources, to believe that stabilization is possible. At least three lines of evidence are available. These are the availability of other options and tools, the projected savings

290. JAY APT & M. GRANGER BOWMAN, CARNEGIE MELLON ELEC. INDUS. CTR., CRITICAL ELECTRIC POWER ISSUES IN PENNSYLVANIA: TRANSMISSION, DISTRIBUTED GENERATION, AND CONTINUING SERVICES WHEN THE GRID FAILS 18-19, 25 (2005), *available at* http://wpweb2.tepper.cmu.edu/ceic/pdfs_other/Critical_Electric_Power_Issues_in_Pennsylvania.pdf.

291. U.S. DOE, ENERGY INFO. ADMIN., ELECTRIC POWER ANNUAL 2004 at 44 (2005), *available at* <http://tonto.eia.doe.gov/FTPROOT/electricity/034804.pdf>.

292. SEER is defined as the cooling output divided by the power input for a hypothetical average U.S. climate. U.S. DOE, Energy Info. Admin., *Glossary*, http://www.eia.doe.gov/glossary/glossary_s.htm (last visited July 24, 2006).

293. 10 C.F.R. §430.32(c)(2).

294. U.S. DOE, Final Rule on Energy Conservation Standards for Residential Central Air Conditioners and Heat Pumps, 66 Fed. Reg. 7170, 7171 (Jan. 22, 2001).

295. 1,153kWh x \$.09/kWh = \$103.77.

296. 66 Fed. Reg. at 7171.

297. U.S. DOE, ENERGY INFO. ADMIN., 2001 RESIDENTIAL ENERGY CONSUMPTION SURVEY: HOUSING CHARACTERISTICS TABLES, TA-

BLE HC5-8A, APPLIANCES BY URBAN/RURAL LOCATION, MILLION U.S. HOUSEHOLDS at 3 (2001), *available at* http://www.eia.doe.gov/emeu/recs/recs2001/hc_pdf/app/hc5-8a_urbanrural2001.pdf.

298. U.S. DOE, ENERGY INFO. ADMIN., 2001 RESIDENTIAL ENERGY CONSUMPTION SURVEY: HOUSING CHARACTERISTICS TABLES, TABLE CE1-1C, TOTAL ENERGY CONSUMPTION IN U.S. HOUSEHOLDS BY CLIMATE ZONE (2001), *available at* http://www.eia.doe.gov/emeu/recs/recs2001/ce_pdf/enduse/ce1-1c_climate2001.pdf.

299. Variable rate tariffs would, of course, need to be designed with sensitivity toward persons who lack the means to purchase more efficient appliances. For example, it would not be appropriate to encourage people who live in very hot places to shut off their air conditioners (and thereby put their health or even their life at risk) to avoid paying a higher price for the use of a less efficient air conditioner. An alternative approach would have utilities turn off air conditioners and similar appliances for several hours during times of peak demand to customers who give their permission to do so. The customer would not likely even notice the difference, but would pay a lower electric bill because energy use would be reduced. E-mail communication to Prof. Dernbach from Sonny Popowsky, Consumer Advocate, Pennsylvania Office of Consumer Advocate (July 25, 2006).

300. CALIFORNIA ENERGY COMM'N, FEASIBILITY OF IMPLEMENTING DYNAMIC PRICING IN CALIFORNIA 8 (2003), *available at* http://www.energy.ca.gov/reports/2003-10-31_400-03-020F.PDF.

301. EUROPEAN COMMISSION DIRECTORATE-GENERAL FOR ENERGY AND TRANSPORT, ENERGY EFFICIENCY AND LOAD CURVE IMPACTS OF COMMERCIAL DEVELOPMENT IN COMPETITIVE MARKETS; RESULTS FROM THE EFFLOCOM PILOTS 136-37 (2004), *available at* <http://www.elflocom.com/pdf/EFFLOCOM%20report%20no.%207%20Pilot%20Results.pdf>.

from a variety of studies of policy-based potential, and more detailed data on energy intensity. Law and policy, of course, represent only one suite of approaches that can be used to address energy efficiency. According to Steve Specker, president and chief executive officer of the Electric Power Research Institute, there is also an enormous opportunity to “utilize technology, markets, and innovation” on behalf of energy efficiency. “Programmatic approaches” to energy efficiency, while successful, have only “scratched the surface” of what’s possible.³⁰²

A. Other Options and Tools

The energy savings projected from policy-based achievable potential depend on the mix of options and tools that are identified and on the level of effort (including funding) that is projected for these instruments. In addition to the options and tools identified in the previous section, and the evident potential for much more aggressive deployment of those options and tools, dozens of other options and tools exist, many of which offer considerable potential to increase efficiency while producing additional social, economic, environmental, and security benefits.³⁰³ Additional choices exist in every sector, all supported by a variety of possible legal and policy tools.³⁰⁴ These include increased federal research and development funding for energy efficiency, expanded and strengthened appliance efficiency standards as well as accompanying voluntary programs, more energy-efficient state building codes, expanded government procurement of energy-efficient products and equipment, voluntary agreements with specific industry sectors to reduce energy use by a specified percentage by a particular date, expansion of a variety of investment programs for energy efficiency, improved air traffic management programs, pay-at-the-pump automobile insurance, intelligent traffic system controls, and greater use of telecommuting.³⁰⁵

The efficiency of electric power generation, as opposed to improvements in the consumer’s use of electricity, is another example. Electric generation from coal-fired and other central power plants uses no more than 40% of the energy that is produced, and often only one-third.³⁰⁶ In a standard power plant, a turbine recovers some energy in the form of electricity but the heat from fossil fuel combustion is wasted. Combined cycle electric generating technology is more efficient in two respects; it recovers a higher percentage of the electricity (as much as 59%) and recovers heat as well (for a total energy recovery of up to 85%).³⁰⁷ It also results in lower emissions of sulfur dioxide, nitrogen oxides, mercury, and carbon dioxide. Deployment of combined heat and power technologies could reduce U.S. energy demand by at least 4.5 quads by 2020.³⁰⁸ Another set of advanced

coal gasification technologies offer the potential for even greater efficiencies, including the potential to recover marketable chemicals from coal.³⁰⁹ Capital costs and the relatively untried nature of some coal gasification technologies are barriers to their deployment. Regulatory incentives from environmental agencies, cost-recovery guarantees from state utility commissions, and tax incentives are among the available legal tools. Pennsylvania and other states continue to search for the right mix of incentives for the deployment of such advanced technologies.³¹⁰ These technologies would significantly reduce energy consumption in several economic sectors, including the industrial sector.

There does not appear to be a comprehensive catalogue of the available choices or legal tools, not to mention the ways in which these choices and tools could most effectively be combined. Still, the variety of choices and tools described in detail or referenced in this Article suggests that the number is considerable.

B. Studies of Policy-Based Potential

A great many studies indicate a significant potential to reduce energy consumption. These studies vary in the economic sectors they cover, their geographic scope, and their methodology. They also differ in the mix of options and tools on which they are based and, to some degree, in the degree of effort or funding proposed for particular legal tools. Because the studies as a whole involve a larger number of legal tools than any individual study, they suggest that a comprehensive and intensive effort would significantly reduce energy use, and even reduce energy use below current levels.

Perhaps the most comprehensive effort, *Scenarios for a Clean Energy Future*, was published in 2000 by five government laboratories and led by the Oak Ridge National Laboratory and the Lawrence Berkeley National Laboratory.³¹¹ This study used three scenarios to map the range in potential U.S. energy futures. A business-as-usual scenario “assumes a continuation of current energy policies and a steady, but modest pace of technological progress.”³¹² The moderate and advanced scenarios, on the other hand, “are defined by policies that are consistent with increasing levels of public commitment and political resolve to solving the nation’s energy-related challenges.”³¹³ These scenarios are based on a broader suite of policy choices than energy efficiency or conservation alone; they also include renewable energy and carbon trading to reduce greenhouse gas emissions.³¹⁴

The country would consume 20% less energy by 2020 under the advanced scenario than forecast under the business-

302. STEVE SPECKER, EFFICIENCY AND DEMAND RESPONSE (2006), available at <http://mydocs.epri.com/docs/CorporateDocuments/AssessmentBriefs/NARUC.pdf>.

303. See, e.g., PRINDLE ET AL., *supra* note 169 (describing many tools available to states).

304. See, e.g., NAT’L COMM’N ON ENERGY POLICY, *supra* note 9, at 30-40.

305. Price & Levine, *supra* note 6, at 94-97.

306. *Id.* at 13.

307. Wikipedia, *Combined Cycle*, http://en.wikipedia.org/wiki/Combined_cycle (last visited July 24, 2006).

308. See, e.g., PRINDLE ET AL., *supra* note 169, at 13.

309. See U.S. CLIMATE CHANGE TECH. PROGRAM, TECHNOLOGY OPTIONS FOR THE NEAR AND LONG TERM 2.1-4 to 2.1-6 (2005), available at <http://www.climatechange.gov/library/2005/tech-options/tor2005-212.pdf>.

310. See, e.g., Press Release, Commonwealth of Pa., Governor Rendell Launches Initiative to Support Manufacturers, Continue Job Growth; Bold Homegrown Solution (Nov. 28, 2005), <http://www.Ahs.dep.state.pa.us/newsreleases/default.asp?ID=3730&varQueryType=Detail> (last visited July 24, 2006).

311. SCENARIOS FOR A CLEAN ENERGY FUTURE, *supra* note 103.

312. *Id.* at ES.2.

313. *Id.* at ES.1.

314. *Id.* at ES.3.

as-usual scenario, which amounts to a reduction of 23 quads or, in 2000, almost one-fourth of the nation's energy use. Greater use of combined heat and power, the study said, could increase the savings by 2.4 additional quads by 2020.³¹⁵ The most analogous current projection—for the 21-year period between 2004 and 2025—is for an increase of about 27 quads.³¹⁶ Thus, the advanced scenario would nearly stabilize U.S. energy consumption within two decades. The policy choices on which this analysis is based include more stringent appliance standards and building codes, voluntary agreements with industry, increased government research and development, voluntary agreements to improve fuel efficiency in cars, and carbon trading.³¹⁷ While the advanced scenario “will be very difficult to achieve,”³¹⁸ it does indicate that stabilization of energy use is possible.

A more recent but still comprehensive assessment, by the NCEP, synthesized the results of a variety of studies for the commercial, residential, and transportation sectors. The NCEP concluded “that it is possible to cost-effectively reduce the nation's annual energy consumption by at least 16 quads per year in 2025 in these three sectors using known efficiency technologies. Additional energy savings are possible in the industrial sector as well.”³¹⁹ As shown in Figure 3, energy consumption in the commercial, residential, and transportation sectors is projected to increase by almost 22 quads by 2025. Thus, the policy measures represented in those studies would capture slightly more than two-thirds the projected increase in those sectors.

Another report, a “meta-analysis” by the American Council for an Energy-Efficient Economy of 11 recent studies, illustrates the effect of different ways of measuring energy-efficiency potential on the size of the estimates. This meta-analysis also provides a sense of the available opportunities. The median technical potential in the 11 studies for improvement over 10 to 20 years is 33% for electric efficiency and 40% for gas.³²⁰ Because cost-effectiveness is considered in the economic potential, the projections tend to be lower. Thus, in the 11 studies considered in the “meta-analysis,” the median economic potential for electricity is a 20% improvement over 10 to 20 years, and the median for gas is 21.5%.³²¹ The policy-based achievable potential, in turn, is less than the economic potential because the achievable potential is limited by the rate at which new energy saving technology is actually put in place by homes and businesses.³²²

Two other reports focus on buildings alone. In one, Marilyn Brown and others propose a suite of seven policy options that, taken together, could mean that energy consumption in the residential and commercial sectors in 2025 is nearly the same as that in 2004, which would be 11.6 quads below projected levels.³²³ The options that account for the greatest efficiency are upgrades of commercial and residential building codes in 2010 and 2020 as well as compliance with those codes, upgrades of appliance and equipment efficiency standards and application of such standards to new products, and increased federal funding for building energy research and development.³²⁴

The policy options on which this projected reduction is based do not appear to include a major effort to retrofit and upgrade existing commercial and residential buildings, particularly in the building envelope. As a result, it is likely that including this additional approach would reduce energy consumption even farther. Many residences could be made 20% to 30% more energy efficient, saving both money and energy.³²⁵ According to the Oak Ridge report, the United States should achieve “the goal of a cost-competitive net-zero-energy home by 2020” and comparable “climate-friendly designs for large commercial buildings and industrial facilities.”³²⁶

A somewhat similar future is possible for commercial buildings, according to a report in which the building owners played a major role. In 2005, EPA challenged commercial and institutional building owners (but not home owners) to make their buildings 10% more efficient. Under the Energy Star Challenge, as it is called, building owners would “assess energy usage; set efficiency improvement goals of 10 percent or greater, and make cost-effective improvements.”³²⁷ But in 2000, building industry representatives working with DOE concluded that commercial buildings could cost-effectively be made 30% more efficient based on existing technology. Because annual energy expenditures for commercial buildings are \$100 billion, they concluded, annual savings would be \$30 billion, not to mention reduced sulfur dioxide, nitrogen oxide, and carbon dioxide emissions.³²⁸ With new technology, they said, a 50% to 80% reduction would be possible, and eventually commercial buildings should be able to employ solar and other renewable energy to become energy generators, not consumers.³²⁹

Some studies focus on specific issues. In early 2006, for example, the American Council for an Energy-Efficient Economy and the Appliance Standards Awareness Project recommended that states adopt energy-efficiency standards

315. *Id.* at ES.6.

316. *See supra* fig. 3.

317. SCENARIOS FOR A CLEAN ENERGY FUTURE, *supra* note 103, at ES.6. Although carbon trading, of course, is not just an energy-efficiency tool, it is included in this scenario because it can also foster energy efficiency.

318. Price & Levine, *supra* note 6, at 93.

319. NAT'L COMM'N ON ENERGY POLICY, *supra* note 9, at 32.

320. *Id.* at 10. With one exception, the studies being reviewed projected improvements over either a 10-year period or a 20-year period. *Id.* at 3.

321. *Meta-Analysis*, *supra* note 87, at 10.

322. *Id.* at 4. The median improvement in achievable energy efficiency in the “meta-analysis” of 11 studies is 1.2% per year for electricity, or 24% over 10 to 20 years. *Id.* at 10. The achievable potential for gas is 9%, but only three studies looked at gas. *Id.* Because many of the studies analyzed for economic potential or achievable potential, but not both, it is not possible to compare the median figures in the “meta-analysis” for economic and achievable potential. *Id.* at 4.

323. CLIMATE-FRIENDLY BUILT ENVIRONMENT, *supra* note 78, at 59-61.

324. *Id.* at 47, 48, 55-56, & 59. The others are utility-based financial incentive programs, low-income weatherization assistance, ENERGY STAR, and improved energy intensity in federal buildings. *Id.* at 49-54.

325. U.S. DOE et al., *Energy Savers: Homeowners*, <http://www.energy.savers.gov/homeowners.html> (last visited July 24, 2006).

326. CLIMATE-FRIENDLY BUILT ENVIRONMENT, *supra* note 78, at 63.

327. Press Release, U.S. EPA, EPA Issues Energy Star Challenge: Make U.S. Buildings More Energy Efficient (Mar. 14, 2005), available at <http://yosemite.epa.gov/opa/admpress.nsf/b1ab9f485b098972852562e7004dc686/d54f75a8b788a56c85256fc4006f5065!OpenDocument>.

328. HIGH-PERFORMANCE COMMERCIAL BUILDINGS, *supra* note 165, at 6.

329. *Id.*

for 15 products, including DVD players and recorders as well as commercial boilers.³³⁰ If these standards were adopted across the country, the report said, net savings to consumers would be \$54 billion between 2008 and 2030. In addition, electricity demand in 2020 in the commercial and residential sectors would be 2% lower than projected levels for that year, an amount equal to the generating capacity of 40 300-MW power plants.³³¹ This proposal would also reduce carbon emissions by 12 million metric tons by 2020 and reduce emissions of sulfur dioxide, nitrogen oxides, mercury, and particulates.³³²

Finally, a number of studies indicate the potential for greater energy efficiency in particular regions of the United States. One from the Northeast and another from the West are illustrative. A 2005 study, *Economically Achievable Energy Efficiency Potential in New England*,³³³ gives a sense of how significant the policy-based achievable improvements can be. Electricity demand in New England is expected to increase each year until 2013 by 1.2%.³³⁴ “Economically achievable energy efficiency potential,” as defined in this report, is the maximum market penetration of cost-effective energy-efficient measures “that would be adopted through a concerted, sustained campaign involving proven programs and market interventions, and not bound by any budget constraints.”³³⁵ If just 48% of this potential could be captured, the study said, electricity growth in New England over this period would be flat, obviating the need to build 28 new 300-MW power plants. If all of this potential could be captured, electricity demand would decline by about 1.4% annually.³³⁶ These energy improvements, the study noted, cost 67% less than the cost of supplying electricity; benefits are more than three times greater than costs.³³⁷ Several policy measures are proposed to achieve these benefits. These include continued investment in existing energy-efficiency programs, adoption of more stringent energy-efficiency provisions in building codes, more stringent efficiency standards for appliances and other products, and greater taxpayer participation in energy-efficiency programs through public benefit fund charges.³³⁸

In June 2006, an advisory committee to the Western Governors’ Association (WGA) issued a report, *Clean Energy, a Strong Economy, and a Healthy Environment*, that contains detailed recommendations for reducing energy electricity use by 20% below projected levels by 2020.³³⁹ At the state level, these measures include increased effort in de-

mand-side management, more stringent building codes, more stringent appliance efficiency standards, reducing electricity use in public buildings, and tax credits for energy efficiency. At the regional level, these include collaboration on fostering more efficiency in the market and improving the implementation of building codes.³⁴⁰ Aggressive adoption of a suite of “best practice” measures in all 18 of the WGA states, the report said, would reduce projected electricity load growth from 1.9% annually to 0.5% annually.³⁴¹ The report, which grew from substantial stakeholder participation, identified benefits of \$53 billion in savings for consumers and businesses, 48,000 MWs of avoided power plant construction, 1.8 trillion gallons of water savings, and reduced air pollution.³⁴²

C. Energy Intensity Data

State-by-state variations in energy intensity and per capita energy use, as well as other more detailed analyses of energy intensity data, also indicate a significant potential for greater efficiency. A 2003 study by the RAND Corporation found that the United States might be able to reduce its energy intensity by more than 3% annually by adopting the policies employed by those states with the greatest “residual” energy intensity improvements between 1977 and 1999.³⁴³ The study is a statistical analysis, not a policy analysis. The statistical analysis nonetheless gives a sense of the potential significance of state policy in improving energy efficiency.

Substantial differences in energy intensity exist among states. The most energy intensive state used 30 million Btus per dollar of gross state product in 1999, while the least used energy intensive state used 5 million Btus per dollar of gross state product.³⁴⁴ In five states, the average annual energy intensity reduction was more than 3% per year; in four states, the average reduction was less than 1%.³⁴⁵ Residential energy intensity declined in some states (in some cases by more than 1% per year) but increased in others (by as much as 0.50% annually).³⁴⁶ Much of the difference in energy intensity reductions among the states is due to variation in energy prices and differences among state economies, and some of the reduction is due to factors that are consistent across states.³⁴⁷

If the practices of the leading states could be replicated nationally, the RAND study concludes, the nation’s energy intensity could be reduced significantly. A state’s “residual” energy intensity is that part of its overall energy intensity that cannot be explained by the state’s economy and fuel prices, on one hand, and factors that are common to all

330. NADEL ET AL., *supra* note 126. Twelve of these are products for which there are no federal standards. The other three would be more stringent standards on products, including commercial boilers, for which the existing federal standard is considered outdated. *Id.* at iv-v.

331. *Id.* at v.

332. *Id.*

333. OPTIMAL ENERGY, INC., *ECONOMICALLY ACHIEVABLE ENERGY EFFICIENCY POTENTIAL IN NEW ENGLAND* (2005), available at http://www.neep.org/files/Updated_Achievable_Potential_2005.pdf.

334. *Id.* at 3.

335. *Id.* at 4.

336. *Id.* at 5, 7, 12.

337. *Id.* at 9.

338. *Id.* at 6-8.

339. CLEAN AND DIVERSIFIED ENERGY ADVISORY COMM., WESTERN GOVERNORS’ ASSOCIATION, *CLEAN ENERGY, A STRONG ECONOMY AND A HEALTHY ENVIRONMENT* 5 (2006), available at <http://www.westgov.org/wga/initiatives/cdeac/CDEAC06.pdf>.

340. *Id.* at 17-20.

341. *Id.* at 6.

342. *Id.*

343. MARK BERNSTEIN ET AL., RAND CORPORATION, *STATE-LEVEL CHANGES IN ENERGY INTENSITY AND THEIR NATIONAL IMPLICATIONS* 47-48 (2003).

344. *Id.* at 7.

345. *Id.* at 82-83. The states with the greatest reductions are Arizona (-3.07%), Connecticut (-3.18%), Delaware (-3.32%), Massachusetts (-3.53%), and New Hampshire (-3.40%). The states with the least reductions are Iowa (-0.93%), Mississippi (-0.74%), North Dakota (-0.99%), and Wyoming (-0.04%). *Id.*

346. *Id.* at 8.

347. *Id.* at 23-32.

states, on the other.³⁴⁸ The greater the residual reduction in energy intensity, the greater the likelihood that the state achieved reductions due to policies it put in place. Five states had overall residual energy intensity improvements that were significantly greater than what would have been predicted based on economic and price factors.³⁴⁹ This “residual” effect suggests energy intensity could be reduced by more than 3% annually if the experience of the best states could be replicated nationally.³⁵⁰

In addition to energy intensity differences, there are also differences in per capita energy consumption among states. In 2002, the last year for which state-by-state data appears to be available, average per capita energy consumption in the United States was 340.8 million Btus. Among the most populous states, however, there were considerable differences. Per capita energy consumption in California and New York was more than one-third lower than the national average—228.1 and 215.5 million Btus, respectively. Other highly populated states below the national average are Florida (255.3 million Btus) and Pennsylvania (317.7 million Btus). Among populous states, Texas has the highest per capita energy consumption—574.6 million Btus.³⁵¹ Differences in population density, industry composition, and other factors can help to explain many but not all of these differences. Still, these differences provide an indication of how much improvement in energy efficiency may be possible.

Electricity consumption provides an example. In California, which has devoted considerable effort to efficiency and conservation, per capita electricity consumption has been steady since the mid- to late-1970s. Although California and Florida had nearly identical levels of per-capita electricity consumption in 1960, electricity use per capita in Florida is now almost double that in California. California’s policy measures have “demonstrated in practice the ability to stabilize per capita electricity consumption over the last 30 years.”³⁵²

Finally, other opportunities for greater efficiency become evident when the national energy intensity data are analyzed more closely. For example, the energy intensity improve-

ment for *new* equipment alone is about 5%.³⁵³ It follows that the widespread introduction of this equipment, and the replacement of existing equipment, could significantly accelerate improvements in energy intensity. If 80% of new equipment met this energy intensity improvement, and existing equipment is replaced after 30 years, energy consumption from this equipment could be reduced by one-half in 50 years.³⁵⁴ Energy intensity over this period would decline by 3.2% annually, with the most significant reductions coming in later decades as existing equipment is replaced.³⁵⁵

V. Conclusion

Energy consumption needs to be addressed directly, and for a variety of reasons. The traditional arguments for efficiency and conservation, rooted in cost savings and the opportunity to spend money on other things, are being given added force by rising global demand for energy, high energy prices, the growing seriousness of the evidence on climate change, and the threat of terrorism. At the same time, significant economic, security, environmental, and social benefits are available from much greater energy efficiency and reduced consumption. As this Article has shown, energy efficiency and conservation can reduce costs for low-income people, businesses, and others; improve air quality; strengthen business performance; relieve traffic congestion; reduce dependence on foreign energy supplies; and provide more and better choices to Americans. While technological innovation is plainly needed to improve energy efficiency, our laws and institutional arrangements—at the state and federal level—also need to play an important role. New or modified laws, coupled with more aggressive efforts to implement them, can also mitigate the effects of growing energy prices, reduce greenhouse gas emissions, and improve our energy security. The opportunities that are available from much greater efficiency and conservation suggest a goal of stabilizing U.S. energy consumption and then reducing it. As challenging as that goal might be, there is considerable evidence to believe that it is achievable.

Still, energy consumption is an issue with two story lines. One treats increased energy consumption more or less as a given and is skeptical about how much good efficiency and conservation can achieve. The other story line sees reduced energy consumption as about opportunity, not limits. These story lines about energy consumption are accompanied by two story lines about the United States. One is hopeful and the other is not. These two views mirror, almost perfectly, the ambivalent mix of optimism and pessimism about America’s future that teachers see in the classroom. Whatever else the students in this seminar have achieved, they have shown that there is reason to be hopeful.

348. *Id.* at xii.

349. *Id.* at 38. These states are Arizona, Kansas, North Carolina, Oregon, and Washington. *Id.*

350. *Id.* at 48.

351. U.S. DOE, ENERGY INFO. ADMIN., STATE ENERGY CONSUMPTION, PRICE, AND EXPENDITURE ESTIMATES (SEDS), TABLE R2, ENERGY CONSUMPTION BY SOURCE AND TOTAL CONSUMPTION PER CAPITA, RANKED BY STATE (2002), http://www.eia.doe.gov/emeu/states/sep_sum/html/pdf/rank_use_per_cap.pdf. The five states with the least per capita energy consumption are Rhode Island (205.6 million Btus), New York (215.5), California (228.1), Hawaii (235.2), and Massachusetts (243.1). The five states with the highest per capita energy consumption are Alaska (1,149.1 million Btus), Wyoming (883.9), Louisiana (824.2), North Dakota (629.5), and Texas (574.6) *Id.*

Interestingly, Massachusetts is also one of the “top five” list for energy intensity improvement. North Dakota and Wyoming, on the other hand, are two of only four states where there has been no improvement in energy intensity. BERNSTEIN ET AL., *supra* note 343, at 80-81.

352. E-mail communication to Prof. Dernbach from Dan Lashof, senior scientist, Natural Resources Defense Council, Aug. 16, 2006. Dr. Lashof presented this analysis at a public meeting of the Florida Public Utilities Commission on July 17, 2006.

353. Kornelis Blok, *Improving Energy Efficiency by Five Percent and More per Year?*, 8 J. INDUS. ECOLOGY 87, 88 (2005); Arthur H. Rosenfeld, *The Art of Energy Efficiency: Protecting the Environment With Better Technology*, 24 ANN. REV. ENERGY & ENV’T 33, 78-79 (1999).

354. *Id.* at 92-94. Energy use is lower after 50 years if equipment is replaced after 15 years instead of 30, and higher if equipment is used for 60 years. *Id.*

355. *Id.* at 94.