The History of Energy Efficiency

ALLIANCE TO SAVE ENERGY

*Using less. **Doing more.***

Alliance Commission on National Energy Efficiency Policy

JANUARY 2013

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INTRODUCTION

For the purposes of this report, energy productivity will be defined as "measuring the output and quality of goods and services generated with a given set of inputs. . . . Energy productivity is the inverse of the energy intensity of GDP, measured as a ratio of energy inputs to GDP."[1]

To properly project and channel the future of energy productivity in the United States, we must first look back at over forty years of the history of energy use in the nation. We also need to examine the role played by energy efficiency policies, including their successes and shortcomings. The energy challenges faced in the 1970s, 1980s, and 1990s provide experiences and lessons likely to apply in coming decades. The history of energy efficiency in the U.S. provides a vital reference and guide to any future national energy-efficiency strategy.

The Alliance to Save Energy's Commission on National Energy Efficiency Policy (ACNEEP) established a goal of doubling U.S. energy productivity by 2030 relative to 2011. The Commission seeks to identify policies and actions that will double the amount of economic output derived per unit of energy used in the U.S. economy. Economic outputs include both the quantity and quality of production and economic activity. A more energy productive economy should be a more economically productive economy that delivers a higher quantity and quality of goods and services while enhancing incomes, employment, and quality of life for Americans. Improving energy productivity can be thought of as getting greater bang for each energy buck spent.

Over the years, federal and many state and local governments have adopted a broad array of public policies aimed at increasing energy efficiency and productivity. The rationales and policy instruments have varied by time and place, with some common themes, including using government policy to reduce energy costs and cost volatility, avoid or defer investments in higher-cost energy supply options, enhance energy security and reliability, shrink the environment footprint of energy production and delivery, and stem the flow of energy-related expenditures out of a region's economy.

By necessity, federal policies for energy efficiency have tended to focus on product standards and fiscal tools, which affect the efficiency profile of products and investments that enter the market. For example, federal policies include appliance efficiency standards, vehicle efficiency standards, and tax incentives for private firms to make an investment in a more efficient product. By contrast, state efficiency policies have tended to focus on things more directly in their jurisdiction: energy efficiency provisions in building codes; land-use planning tools and support for public transit to slow growth in vehicle trips and vehicle miles travelled; state tax incentives; and programs operated by electric and natural gas distribution utilities to enhance consumer adoption of efficiency measures.

Time and again the business case for energy efficiency is supported through real economic savings. Without the numerous energy efficiency improvements made since 1973, the U.S. would require about 50% more energy to deliver our current GDP.[2] The adoption of more efficient products and services is responsible for 60% to 75% of the increase in energy productivity since 1970.[3]

While every region in the country has shown leadership in some area of energy efficiency, California, the Northeast and Mid-Atlantic regions,[4] parts of the country with some of nation's highest energy prices, have made some of the greatest progress in improving energy efficiency .. Despite significant past progress, great potential remains to improve the energy-efficiency policies and programs in every state, which can help drive further large increase in U.S. energy productivity. Recognizing the differences in the structure and features of different regional economies and climate zones across the U.S., these opportunities for adoption of policies to support greater energy efficiency investments and actions are strong in states with high energy use per unit of economic product, per square foot of floor space, per capita, or other measures of energy intensity.

Before delving into the history of U.S. energy efficiency policy, it is relevant to look at how the Alliance has contributed to doing more while using less energy over the last thirty-five years. In 1978, the Alliance launched its first national TV public service advertising campaign with Gregory Peck promoting energy conservation by declaring "Don't Blow it America." Jumping to the 1980s, the Alliance initiated new research programs promoting energy efficiency in private markets through innovative methods, designed the first methodology to evaluate energy efficiency as a resource for public utilities, and helped nonprofit organizations across the country finance efficiency improvements through pooled performance contracting.

1 *Farrell, Remes, and Charles, "Fueling Sustainable Development," 8.*
2 *Alliance to Save Energy, "American Energy Initiative."*
3 *Mims, Bell, and Doig, "Assessing the Electric Productivity Gap," 7.*
4 *Hendricks, Campbell, and Goodale, "Efficiency Works," 25.*

The 1990s was another productive decade for the Alliance with the launching of its corporate partnership Associate program, its international program, and the Building Codes Assistance Project (BCAP). At the same time, the Alliance contributed to energy-efficiency provisions in the National Affordable Housing Act of 1990 and the Energy Policy Act of 1992 and helped secure a $45 million increase in funding for federal energy-efficiency programs in 1998. Since the beginning of the 2000s, the Alliance has advocated for energy efficiency at the federal, state, and local level. Among important recent milestones are:

- helping negotiate rules to increase the efficiency of clothes washers 35% by 2007;
- instituting the Power Save campus program to introduce energy efficiency concepts in California universities;
- ensuring strong energy-efficiency provisions in the federal Energy Policy Act (EPAct) of 2005;
- launching the Drive Smarter Challenge consumer campaign, designed to encourage fuel efficient driving;
- helping create the Clean and Efficiency Energy Program (CEEP), an initiative with public power partners that promotes energy efficiency investments by public power utilities; and
- establishing the Alliance's Commission on National Energy Efficiency Policy.[5]

HISTORICAL ENERGY PRODUCTIVITY TRENDS IN THE US

Over the past forty years, the United States made significant gains in energy productivity. U.S. economic output expanded more than three times since 1970 while demand for energy grew only 50%.[6] The gains markedly accelerated after the oil shocks of 1973 and 1979 brought focus on America's energy demand and vulnerability to energy supply disruptions. The oil shocks prompted a variety of policies at the state, national, regional, and local levels and actions by governments, companies, and nonprofit organizations.

According to the Rocky Mountain Institute, "if energy productivity had remained constant since 1970 [when about 68 quadrillion Btu (Q or quad) were consumed], the U.S. would have consumed 207.3 quadrillion Btu in 2007, when it actually only consumed 101.6 quads."[7] Economists have estimated that the adoption of more efficient products and services is responsible for 60-75% of the increase in energy productivity since 1970.[8] A recent study by the American Council for an Energy-Efficient Economy (ACEEE) also concludes "that energy efficiency has 'fueled' about 106 quads, or roughly three-fourths of the new growth for energy-related services since 1970." [9] In 1970, U.S. energy productivity was $63 billion of gross domestic product (GDP) per Q of energy.[10] In 2011 energy productivity reached $135 billion of GDP per Q of energy.[11]

On a per capita basis, U.S. energy productivity and efficiency gains have muted the growth in energy use that might be expected as Americans have become more prosperous. Despite the growth in average home size, more and bigger vehicles driven more miles, and the rapid growth in all kinds of energy-consuming devices, from air conditioners to computers to air travel, energy used per American has actually decreased over the last several decades. In 1970 Americans consumed the energy equivalent of about 2,700 gallons of gasoline per person for all uses of energy. That rate of consumption extrapolated to our current economy would have come to the equivalent of about 5,400 gallons per person. Instead, 2010 consumption was the equivalent of 2,500 gallons per person.[12]

Energy efficiency measures, investments, and behaviors are, however, not the only factors contributing to the increase in energy productivity over the last few decades. Other factors driving this improvement include changes in the nation's economic structure toward greater activity in less energy intensive industries, outsourcing of some heavy industries, general forces that drive technological advances that have improved energy productivity as a byproduct, demographic changes such as population migration to warmer regions with less winter heating needs, and volatile energy prices.[13]

These economic changes have affected the buildings, transportation, and industrial sectors.

5 *Alliance to Save Energy, "Our History."*
6 *Laitner et al., "Long-Term Energy Efficiency Potential," 3.*
7 *Mims, Bell, and Doig, "Assessing the Electric Productivity Gap," 7.*
8 *Ibid.*
9 *Laitner et al., "Long-Term Energy Efficiency Potential," 4.*
10 *Calculations based on U.S. Energy Information Administration (EIA), "Annual Energy Review 2011."*
11 *Calculations based on EIA, "Annual Energy Outlook 2012."*
12 *Ibid.*
13 *Allcott and Greenstone, "Energy Efficiency Gap?", 6.*

BUILDINGS

Today, residential and commercial buildings account for about 41% of total U.S. energy consumption.[14] Building-sector energy consumption grew by 48% between 1980 and 2009.[15] Although energy use in buildings has increased since 1970, it has done so at a rate slower than the growth of GDP.[16] In residential buildings, a large portion of this increased energy use is due to the growing use of home electronics as well as the increase in total floor space in buildings and average square footage per home as well as demand for other energy services. However, the development and adoption of appliance efficiency standards as well as utility and government sponsored demand-side management (DSM)[17] programs has helped alleviate the impact.[18] For instance, energy consumption per unit of floor space has declined by 11% for residential and 21% for commercial buildings since 1980.[19] While the numbers are not adjusted for structural changes, many studies point to energy efficiency playing a role in this reduction. [20]

TRANSPORTATION

Overall, energy use in the U.S. transportation sector has risen with only brief periods of decline during economic recessions. In the decade following the adoption of Corporate Average Fuel Economy (CAFE) standards in 1975, no policies at either the state, local, or national level encouraged, much less required, fuel economy improvements, and as a consequence, efficiency stagnated. A large portion of the fuel efficiency gains since the 1980s have also been offset by the increase in vehicle size and performance.[21] At the same time, vehicle miles traveled (VMT) have increased consistently almost every year since the statistics were collected. [22] Between 1991 and 2004 alone, VMT grew by 38.4%.[23]The increase in VMT can partially be attributed to zoning laws in the U.S. that encourage spread-out development and land-use patterns. This in turn has led to greater reliance on motor vehicles and in some areas has reduced the viability of public transit, bicycle, and pedestrian alternatives. Data from the Federal Highway Administration shows, however, that in recent years, VMT has started to level off. The recent economic downturn and increased fuel prices along with new demographic trends, the growing popularity of urban living, and balanced transportation systems may explain this change in VMT trends.

INDUSTRIAL

From 1985 to 2003, industrial sector GDP increased by more than 60%, while industrial energy use rose only 12%.[24] Structural changes have had a significant effect on this sector's energy use because the fraction of the economy derived from manufacturing, especially energy-intensive manufacturing (such as iron and steel, cement, aluminum, and paper products), has decreased significantly. A substantial portion of the economy is now focused on services and information technologies, as well as lighter industries, many of which did not exist in the 1970s.[25] Some of the energy-use decrease is also due in part to the outsourcing of the production of more energy-intensive products, such as steel and iron.[26] However, the manufacturing and broader industrial sectors have become more energy productive as more energy- and material-efficient processes and systems have been implemented.[27] For instance, the American iron and steel industry has undergone significant restructuring with a lower proportion of production from more energy-intense plants making steel from iron ore and coke and a greater proportion processing scrap steel via electric-arc furnaces. Improved processes, more efficient motors and other equipment, better energy management practices, and the application of information technologies to industrial process controls have increased manufacturing energy productivity.

Federal policies have made modest contributions to promoting increased industrial efficiency with much of the activity being limited to research and development (R&D). Voluntary, non-incentivized programs at the Environmental Protection Agency (EPA) and the Department of Energy (DOE) have supplemented R&D, including technical assistance, such as DOE-supported

14 *EIA, "Annual Energy Review 2010," page.*
15 *Ibid.*
16 *National Research Council, "Real Prospects for Energy Efficiency," 43.*
17 *According to EIA, demand side management is "a utility action that reduces or curtails end-use equipment or processes and is often used in order to reduce customer load during peak demand and/or in times of supply constraint."*
18 *National Research Council, "Real Prospects for Energy Efficiency," 4.*
19 *Granade et al., "Unlocking Energy Efficiency Potential in U.S. Economy,"viii.*
20 *Ibid.*
21 *National Research Council ,"Real Prospects for Energy Efficiency," 129.*
22 *Puentes and Tomie, "The Road…Less Traveled," 7.*
23 *Ibid.*
24 *National Research Council. "Real Prospects for Energy Efficiency," 189.*
25 *Ibid.*
26 *Ibid.*
27 *Yergin, The Quest, 616.*

University based Industrial Assessment Centers. Activity has also occurred at the state level, through information programs run by state energy offices. Further, some states' utility energy efficiency programs have included industrial efficiency components. Additionally, electricity supply-side programs to encourage nonutility generation passed by Congress in 1978 helped create new combined heat and power (CHP) production. These types of industrial programs, however, have generally not been first priority compared to other sectors.

At the end of August 2012, industrial efficiency, primarily CHP, received a boost through the signing of an Executive Order 13624 by President Obama. The executive order has the overarching goal of accelerating investment in industrial energy efficiency and aims to do so through the following mechanisms:

- Convene stakeholders to identify, encourage and develop investment models and best practices for CHP and industrial efficiency;
- Provide technical assistance and public information on benefits; and
- Use existing federal authorities to support investment. [28]

The executive order also directs various agencies and departments to "encourage efforts to achieve a national goal of deploying 40 gigawatts of new, cost effective industrial CHP in the U.S. by the end of 2020."[29] According to the White House, this goal would "save energy users $10 billion per year" and "result in $40-$80 billion in new capital investment in manufacturing and other facilities."[30] In the next decade, manufacturers could save upward of $100 billion in energy costs due to increases in industrial efficiency. [31]

FEDERAL POLICIES THAT IMPACT ENERGY EFFICIENCY: 1975 - PRESENT

The 1973 oil embargo and ensuing energy crisis proved to be a game changer in the U.S. It exposed the U.S.to global vulnerability because of unstable energy supplies and, combined with other factors, ushered in a period of high inflation. During this time prices of energy and various material commodities rose greatly, which triggered fears that an era of resource scarcity with economic, political, and security stresses had begun. It was also recognized that the extraction, processing, transport, and use of energy was a major source of pollution, waste, and land disruption Further, the growing environmental movement led to the passage of environmental laws and the establishment of the Environmental Protection Agency (EPA). . This combination of events provided a prime opportunity for the consideration of a national energy policy, including energy efficiency.

Several of the early important policy initiatives were born during the years of the Nixon, Ford, and Carter Administrations. These early policies tended to focus on educational efforts, financial incentives, and national energy efficiency standards.[32] President Gerald Ford signed the first law on the issue, the Energy Policy and Conservation Act (EPCA) of 1975. Among other provisions, it authorized the Federal Energy Administration (FEA) to develop energy conservation contingency plans, established vehicle fuel economy standards, and authorized the creation of efficiency standards for major household appliances.[33] A year later, in 1976, the Energy Conservation and Production Act (ECPA) was signed into law. This act went one step further by including incentives for conservation and renewable energy, providing loan guarantees for energy conservation in public and commercial buildings, and authorizing a weatherization program for low-income homes.[34] Both the EPCA of 1975 and the ECPA of 1976 followed Ford's strong vision to make the U.S. an energy independent nation by 1985 with energy efficiency being a central component of this plan.

While the next national energy-efficiency policy did not come into effect until the following year, President Jimmy Carter issued the first executive order regarding energy efficiency and presented Congress with a National Energy Plan in 1977. Carter's National Energy Plan identified energy efficiency as a cornerstone because of the observation that "conservation is the quickest, cheapest, most practical source of energy."[35] The executive order, Energy Policy and Conservation E.O. 12003, promoted exceeding minimum requirements for average fuel economy standards and required federal agencies to develop energy conservation plans.

The start of Carter's presidency in 1977 also marked another important milestone for energy policy with the formation of the Department of Energy (DOE). Established in response to the energy crisis and the need for unified energy planning, the DOE consolidated the Federal Energy Administration, the Energy Research and Development Administration, the Federal Power Commission, and other government programs into one cabinet-level department to provide the framework for a comprehensive national energy plan.[36]

28 *White House, Office of the Press Secretary, "Executive Order -- Accelerating Investment in Industrial Energy Efficiency."*
29 *Ibid.*
30 *White House, Office of the Press Secretary, "President Obama Signs Executive Order Promoting Industrial Energy Efficiency."*
31 *Ibid.*
32 *National Research Council "Real Prospects for Energy Efficiency," 264.*
33 *Anders, "The Federal Energy Administration," 5; Energy Policy and Conservation Act, S. 622, 94th Cong. (1975-1976).*
34 *Anders, "The Federal Energy Administration" 5.*
35 *Peters and Woolley, "Jimmy Carter: National Energy Program Fact Sheet on the President's Program."*
36 *U.S. Department of Energy (DOE), "History of the U.S. Department of Energy."*

In addition, Congress approved the National Energy Act (NEA) in 1978, which included the National Energy Conservation Policy Act (NECPA), the Public Utility Regulatory Policies Act (PURPA), and the Power Plant and Industrial Fuel Use Act (PIFUA). Several of the statutes enacted under NEA, including PIFUA and PURPA, focused on primary fuel sources for power plant electricity generation and the development of renewable energy facilities, respectively. NECPA established the Residential Conservation Service program, which required states to prepare and submit implementation plans to the DOE and "utilities to offer onsite home energy audits to residential customers at a maximum cost of $15."[37] The Residential Conservation Service was designed to improve energy efficiency of the residential sector, but by 1986, according to the General Accounting Office (now called the Government Accountability Office); only about 6% of eligible U.S. households had participated.[38] Cumulative energy savings from the program were also uncertain due to difficulties in measuring results. Acting as the core authority for most federal energy management goals and requirements, NECPA is regularly updated and amended.[39]

NECPA also directed the DOE to establish energy efficiency standards for specified household appliances and products.[40] However, the DOE did not immediately implement the appliance standards under NECPA. The Carter Administration did not finalize its proposed efficiency standards before leaving office, and the Reagan Administration did not support appliance efficiency standards, leaving the DOE with little incentive to prioritize the law. Instead, beginning in 1975, a number of states took initiatives to implement appliance efficiency standards across the country. The issue was not considered nationally again until the National Appliance Energy Conservation Act (NAECA) of 1987. This act established the first national home appliance efficiency standards by amending NECPA.

Energy prices stabilized in the 1980s, in part as a result of the reduced gasoline demand caused by fuel economy standards passed in 1975. Unfortunately, as a consequence, national interest in energy policy declined as well. It was not until the early 1990s that another comprehensive energy policy was enacted by Congress. However, small steps such as the National Appliance Energy Conservation Amendment of 1988 made some additional progress. Five years later, the Energy Policy Act of 1992 (EPAct 1992) was signed into law, containing many significant energy efficiency provisions. It addressed "building energy codes, equipment energy-efficiency standards, appliance energy-efficiency labels, grants for regional lighting and building centers to be established in each of the ten regions served by the DOE, federal energy management, electric and gas utility regulatory reform, least-cost planning for federal electric utilities, and energy-efficiency R&D."[41] Five years after the enactment of the law, the Alliance to Save Energy and ACEEE ran a joint analysis determining that many of the law's provisions were voluntary and largely disregarded.[42] However, the equipment efficiency standards were mandatory and, thus, were effective. Additionally, minor progress occurred in n 1999 and 2000 when President Clinton issued two executive orders pertaining to energy efficiency that set more aggressive energy-use reductions for federal buildings and urged the government to lead by example.[43]

The next significant piece of broad energy legislation was the Energy Policy Act of 2005 (EPAct 2005). As the first major energy law in over a decade, it included several energy efficiency provisions, most notably several appliance standards, new tax incentives, and federal energy management enhancements. According to ACEEE estimates, EPAct 2005 reduced energy use in 2010 by about 0.66 Q which represents about 0.7% of total energy use in 2010.[44] Savings are projected to increase to 2.41 Q in 2020, or about 2.3% of total projected energy use.[45]

Two years later the Energy Independence and Security Act (EISA) of 2007 was passed. This act came as a response to high energy prices and growing global climate change concerns. Emphasizing energy efficiency as a top priority, EISA's provisions included raising corporate average fuel-economy standards, new and strengthened appliance and equipment efficiency standards, new light bulb efficiency standards, authorization of industrial efficiency programs, and several other initiatives. ACEEE projects that EISA will, "save American consumers and businesses more than $400 billion in avoided energy costs by 2030 and reduce energy consumption 7% by 2030."[46] President Bush also issued an executive order in 2007, Strengthening Federal Environmental, Energy and Transportation Management (E.O. 13423), which aimed to consolidate President Clinton's previous executive orders by requiring even more aggressive building energy savings goals for federal agencies. The federal agency energy savings goals were later enacted in EISA.

37 *General Accounting Office, "Federal Home Energy Audit," 2.*

38 *Ibid.*

39 *U.S. Department of Energy, "National Energy Conservation Policy Act."*

40 *National Energy Policy Conservation Act, H.R.5037, 95th Cong. (1977-1978).*

41 *Energy Policy Act of 1992, H.R.776 (May 16, 2005); American Council for an Energy-Efficient Economy (ACEEE), "Energy Policy Act of 1992."*

42 *ACEEE, "Energy Policy Act of 1992."*

43 *Exec. Order No.13,123, Fed. Reg. 64 (June 8, 1999); Exec. Order No. 13,149, Fed. Reg. 65 (April 26, 2000).*

44 *Gold and Nadel, "Assessing the Harvest: Implementation of the Energy Efficiency Provision in the Energy Policy Act of 2005," vi.*

45 *Ibid.*

46 *Alliance to Save Energy, "Policy Summary: H.R. 6."*

The American Recovery and Reinvestment Act (ARRA) of 2009 was the most recent major federal law that was enacted featuring energy efficiency. This law's purpose was to stimulate the economy in the face of the Recession, hence the law's nickname, the Stimulus Act. ARRA provided the single largest investment in energy efficiency in U.S. history, allocating more than $25 billion for core energy efficiency.[47] These core efficiency programs include an appliance rebate program, energy efficiency and conservation block grant program, state energy programs, weatherization assistance program, federal high performance green buildings, tax incentives, and Smart Grid grants. During the same year, President Obama issued an executive order, Federal Leadership in Environmental, Energy, and Economic Performance (E.O. 13514), which expands on President Bush's goals by including water efficiency and a net-zero energy buildings objectives for federal agencies.

FEDERAL ENERGY EFFICIENCY POLICIES BY TOPIC AREA

While national energy policies and executive orders provide the big picture, there are many individual programs and standards that have had impact even in times when energy efficiency was less prominent in federal policy making. The following section will provide a brief overview of these various areas and their effects throughout the history of U.S. energy-efficiency policy.

FEDERAL APPLIANCE STANDARDS (1980-PRESENT)

The first appliance standards were established at the state level, starting with California in 1974, with New York, Florida, and Massachusetts soon following suit. Federal standards were first proposed in 1978 under NECPA, which gave the DOE the authority to set mandatory standards for thirteen household appliances.[48] However, it was not until 1987 with the enactment of the National Appliance Energy Conservation Act (NAECA) that efficiency standards became mandatory at the national level.[49] Manufacturers agreed to these standards to preempt a patchwork of state standards. Existing appliance standards have reduced U.S. energy consumption by an estimated 3.6% or 3.6 Q per year, which is greater than the total annual energy consumption of Louisiana.[50]

Perhaps the most well-known success story for appliance efficiency standards is that of the refrigerator since the mid-1970s. Various iterations of refrigerator standards have helped lower the energy use of a new refrigerator from about 1,800 kWh per year in 1972 to less than 500 kWh per year today.[51] As standards became effective, innovation and competition continued to drive down the cost of refrigerators. At the same time, the size of the average refrigerator has continued to get bigger and its functionality has continued to get better. The newest refrigerator standard was approved by DOE in 2011 and will go into effect in 2014. This will save up to another 25% for various product classes.[52]

CORPORATE AVERAGE FUEL ECONOMY STANDARDS (1975-PRESENT)

Congress passed the first national corporate average fuel economy (CAFE) standards in 1975. This law required the "doubling of passenger vehicle efficiency to 27.5 miles per gallon (mpg) within ten years."[53] At the same time, the National Highway Traffic Safety Administration (NHTSA) was also able to set standards for light-duty trucks. By phasing in CAFE standards, vehicle efficiency increased steadily throughout the 1980s. Between 1975 and 1985, the fleet's fuel economy approximately doubled from 13.5 mpg to 27.5 mpg for passenger vehicles and 11.6 mpg to 19.5 for light trucks; thereby meeting the requirements of the 1975 law.[54]

However, after this first decade of innovation, CAFE standards were left basically unchanged for almost two decades until 2007. In 2002, the National Academy of Sciences estimated that Americans were saving almost 2.8 million barrels of gasoline per day due to the vehicle efficiency standards previously enacted, yet these savings could have been much higher.[55] In 2007, EISA raised CAFE standards by 40% or up to 35 mpg by 2020 for cars, SUVs, and pickups. The Obama Administration accelerated this process in 2009 by "requiring a fleet-wide average of 35.5 mpg by 2016."[56] In July 2011, the Administration also announced a proposed 54.5 mpg efficiency standard, to be achieved for cars and light-duty trucks by model year 2025.[57] The Administration finalized the fuel efficiency standards in August 2012.[58]

47 *Alliance to Save Energy, "Policy Summary: The American Recovery."*
48 *Gillingham, Newell, and Palmer, "Retrospective Examination," 7.*
49 *Ibid., 8.*
50 *Gold et al., "Appliance and Equipment Efficiency Standards," 5.*
51 *Appliance Standards Awareness Project, "Refrigerators and Freezers."*
52 *Ibid.*
53 *"History of Fuel Economy: One Decade of Innovation, Two Decades of Inaction."*
54 *Pew Environment Group, "History of Fuel Economy," 1.*
55 *National Research Council, Effectiveness and Impact, 3.*
56 *Pew Environment Group, "History of Fuel Economy," 3.*
57 *White House, "President Obama Announces."*
58 *White House, "Obama Administration Finalizes."*

The mpg ratings used in the CAFE standards are based on particular laboratory test protocols. To correct for the variance between test protocol results and actual performance on the road, the Environmental Protection Agency (EPA) developed adjusted standards, finding that actual light duty vehicle (LDV) mpg is on average 20% less than the figure derived from using the CAFE test protocol.[59] With LDVs typically operating for 15 or more years, it will take time for more efficient vehicles to displace older less efficient ones on the nation's roads.[60] Further, fuel prices and the state of the economy will also affect the rate of vehicle turnover.

RESIDENTIAL AND COMMERCIAL BUILDING CODES (1976-PRESENT)

Buildings consume almost 40% of the nation's primary energy, making building energy codes a critical tool for cutting U.S. energy consumption. Interest in building energy efficiency predates the oil crises; residential efficiency standards were first established in the 1950s by the Housing and Home Finance Agency, a predecessor of the U.S. Department of Housing and Urban Development (HUD), in response to mortgage defaults on federally insured loans on homes with high utility bills. Commercial efficiency standards were established by American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) as a response to the New York blackout of 1970.

In 1975, ASHRAE published Standard 90.1, Energy Conservation in New Building Design, with technical support from the Illuminating Engineering Society of North America.[61] Since no national standard existed at the time, this was the first time many architects and engineers were alerted to the energy consequences of their design. It also provided building operators with energy-efficiency tools for their buildings. [62] Standard 90.1, which is regularly updated, has been widely adopted as a benchmark for building efficiency. EPAct 1992 required all states to adopt building energy codes for commercial and high-rise multifamily residential buildings that at least met 90.1.[63]

The first federal legislation to call for national building energy codes passed in 1976, yet the building industry strongly opposed this policy—in part based on its detailed structure of requiring fixed energy ratios per square foot of building, and the resultant requirement that all buildings be modeled using computers. It was ultimately altered to voluntary guidelines and design tools.[64]

In 1994, a second initiative, the International Code Council (ICC), was established as a "nonprofit entity to develop a single set of comprehensive and coordinated national model construction codes." [65] Four years later, the International Energy Conservation Code (IECC) was introduced by the ICC, and the IECC is revised every three years.

Currently, the efforts on building energy codes are largely driven by state and local level codes. The IECC and ASHRAE 90.1 serve as the technical baseline standard for most of states and jurisdictions to regulate the design and construction of new buildings. [66] While the IECC address all residential and commercial buildings, ASHRAE 90.1 covers mainly commercial buildings.[67] With each update of the IECC and ASHRAE standards, DOE provides determinations on the codes' impacts and, at times, uses the latest version of the standards as the base code with which each state must comply. No enforcement mechanism is in place, however, states must demonstrate compliance, ask for an extension, or justify reasoning for not complying within two years of the final determinations.[68] Ten states have recently adopted building codes that exceed IEEC 2009 or ASHRAE 90.1-2007 for residential and commercial building construction. Maryland and Illinois have gone beyond this to adopt IECC 2012 for residential buildings.[69] Both these standards have therefore been key in improving the energy efficiency of the building sector over time. For instance, since 1979 Floridians have saved more than "39 billion kWh of electricity, which is enough to power about 3 million new Florida homes for a year," and accrued cost savings of almost $4.7 billion due to the state's residential energy code.[70]

The most recent catalyst for the widespread adoption of building energy codes across states was the American Recovery and Reinvestment Act (ARRA) of 2009, which technically required states to adopt codes (2009 IECC and ASHRAE 90.1 -2007) prior to receiving stimulus funding through State Energy Program (SEP). [71] Under ARRA, states are also required to achieve 90% compliance with codes (2009 IECC and ASHRAE 90.1-2007) by 2017. [72]

59 *Miller, "New CAFE Standards Deliver."*
60 *Green and Schafer, "Reducing Greenhouse Gas Emissions," ii.*
61 *Jarnagin, "Energy Profile."*
62 *Ibid.*
63 *Jarnagin, "Energy Profile."*
64 *Clinton, Geller, and Hirst, ""Review of Government."*
65 *International Code Council, "About ICC."*
66 *U.S. Department of Energy, Energy Efficiency & Renewable Energy, "Building Energy Codes,"5.*
67 *Ibid.*
68 *Foster et al., "The 2012 State Energy Efficiency Scorecard,"49.*
69 *Ibid, vi.*
70 *Fairey, "Florida's Residential Energy Code," 2.*
71 *Foster et al., "The 2012 State Energy Efficiency Scorecard,"50.*
72 *Ibid.*

Beyond building energy code programs, there are also private-sector building-rating and certification systems. These include the Home Energy Rating Systems (HERS), ENERGY STAR, and Leadership in Energy and Environmental Design (LEED). The HERS rating system determines a home's annual energy costs and gives the home an index between 0 and 100, the higher the score, the more efficient.[73] ENERGY STAR certification does not provide a direct rating system but "ENERGY STAR homes are typically 15% more energy efficient than average minimum energy codes."[74] The LEED certification programs assigns point values to energy efficiency elements and provide four certification levels in total. Each of these programs has had and continues to have an impact in orienting the construction and design sector toward more energy efficient buildings. A number of localities have encouraged use of these rating and certification systems. Further, a few localities, such as Austin, Texas and New York City have started to mandate energy use benchmarking and disclosure for certain buildings.

ELECTRIC DEMAND SIDE MANAGEMENT PROGRAMS AND PUBLIC BENEFITS CHARGES (1978-PRESENT)

Between 1975 and 1978, EPCA, ECPA, and NECPA laid the groundwork for utility demand-side management (DSM) programs by setting the base for utility conservation and load management.[75] As part of its requirements, NECPA specifically mandated that utilities offer on-site energy audits to residential customers, thereby acknowledging that saving energy could be cheaper than producing it.[76] The drive for utility DSM programs was also furthered by Public Utility Regulatory Policies Act (PURPA) 1978, which "required state public utility commissions to bring energy conservation considerations into their rate making practices."[77] Most of the early programs in the 1970s focused on providing information on the cost effectiveness of energy efficiency. However, these programs did not lead most consumers to make energy-saving choices.[78]

Starting in the 1980s, rebate programs became popular and least-cost or integrated-resource planning was developed, in which demand-side management is included as an energy resource option. The first institutionalized efforts in least-cost planning were led by states including California and Wisconsin in 1975 and the Pacific Northwest in 1980.[79] A number of states also implemented public benefits funds from a surcharge on utility bills to fund DSM measures, including energy-efficiency programs. In 1993, DSM peaked with almost $2 billion of spending on such programs and then declined in the late 1990s as state-level efforts drove restructuring and deregulating electric utility markets. [80] In recent years funding has picked up again for utility energy-efficiency programs, and in 2011 U.S. ratepayer-funded electric-efficiency budgets totaled over $6.8 billion, a 25% increase from 2010.[81] The funding, however, is not evenly distributed across all states and the top ten states in 2011 accounted for 74% of electric efficiency budgets in the United States.[82]

More recently, many states have adopted energy efficiency resource standards (EERS), which set a required level of savings that utilities help their customers achieve. Some states also have adopted a requirement for utilities to use all cost-effective energy efficiency before additional energy supply and to use rate structure reforms to encourage utilities to help their customers save energy. Further, some states are altering utility rate structures to provide utilities financial incentives to pursue energy efficiency or at least remove or mute disincentives posed by traditional utility rate structures.

WEATHERIZATION ASSISTANCE PROGRAM (1976 – PRESENT)

Created under ECPA of 1976, the first federal weatherization assistance program was overseen by the Community Services Administration (CSA).[83] It mainly consisted of local grants to help low-income households weatherize their homes as well as small subsidies for energy bills.[84] Over the last three decades, weatherization techniques have progressed, beginning with caulking and weather stripping in the mid-1970s to air conditioner replacements and advanced energy audits in the 1990s.[85] Under ARRA 2009, WAP received $5 billion to weatherize 600,000 homes. This was a step toward President Obama's goal of weatherizing 1 million homes per year.[86] Since 1976, WAP has helped more than 6.2 million families reduce their energy consumption and energy cost burden.[87]

73 *U.S. Department of Energy, Energy Efficiency & Renewable Energy, "Building Energy Codes," 21.*

74 *Ibid.*

75 *Gillingham, Newell, and Palmer, "Retrospective Examination," 15.*

76 *Eto, "Demand-Side Management Programs," 5.*

77 *Gillingham, Newell, and Palmer, "Retrospective Examination," 15.*

78 *Ibid.*

79 *"Least-cost planning differed from traditional planning by treating future load growth as an outcome of a planning process rather than as a fixed input to that process." Eto, "Demand-Side Management Programs," 7; Eto, "Demand-Side Management Programs,"6.*

80 *York et al, "Three Decades and Counting: A Historical Review and Current Assessment of Electric Utility Energy Efficiency Activity in the States," iii.*

81 *Summary of Ratepayer-Funded Electric Efficiency Impacts, Budgets, and Expenditures,"4.*

82 *"Summary of Ratepayer-Funded Electric Efficiency Impacts, Budgets, and Expenditures,"10.*

83 *DOE, "Weatherization Assistance Program."*

84 *Gillingham, Newell, and Palmer, "Retrospective Examination," 50.*

85 *DOE, "Weatherization Assistance Program."*

86 *Ibid.*

87 *National Research Council , "Real Prospects for Energy Efficiency," 272.*

ENERGY STAR PROGRAMS (1990S-PRESENT)

ENERGY STAR was created in 1992 to identify and recognize energy efficient products; later whole buildings and building energy upgrades were added. ENERGY STAR is a voluntary labeling program and is run jointly by the EPA and DOE. Since 2000, ENERGY STAR benefits have more than tripled.[88] In 2011, Americans with the help of ENERGY STAR reduced their utility bills by an estimated $23 billion and prevented 210 million metric tons of GHG emissions, the equivalent to keeping 41 million vehicles off the roads.[89]

FEDERAL ENERGY MANAGEMENT PROGRAM (1973-PRESENT)

The federal government is the nation's largest single energy consumer and several initiatives have been directed toward lowering its energy consumption.[90] The Federal Energy Management Program (FEMP) was established in 1973 as part of the DOE through a mandate to encourage effective energy management in the federal government.[91] Efforts over the last three decades to reduce energy use in federal buildings and facilities have resulted in significant energy and cost savings. Since 1975, the federal government has reduced its energy use by 31%, with "35% less energy used in the facility sector and 28% less in the mobility sector."[92]

STATE ENERGY PROGRAM (1975-PRESENT)

State energy efficiency and renewable energy programs, both for public buildings and the private sector, have also received assistance through the State Energy Program (SEP). First created in the 1970s, SEP was allocated more than $3.1 billion for formula grants under ARRA, which is currently being deployed in various programs across the U.S.[93]. For every dollar of federal investment, the DOE's SEP saves $7.23 from reduced energy bills.[94] In 2003 Oak Ridge National Laboratory led a study that estimated annual cost savings from SEP to be $256 million.[95]

DOE RESEARCH, DEVELOPMENT & DEPLOYMENT

In conjunction with federal and state efficiency programs, the DOE has also spent the past thirty years supporting research, development, and deployment (RD&D) programs. Investment in energy technology RD&D, including renewable energy and energy efficiency, through the DOE has varied over time but "has generally declined in recent years from $10 billion (in 2011 dollars) in 1980 to $3.5 billion in 2011."[96] More than half the support in 2011 was directed toward energy efficiency and renewable energy projects. National labs, such as National Renewable Energy Laboratory and Lawrence Berkeley National Laboratory, can receive portions of their funding from the DOE's Office of Energy Efficiency and Renewable (EERE), and also play a major role in developing new technologies to drive the energy-efficiency market.

In the most recent push to further advanced technologies, the Advanced Research Projects Agency – Energy (ARPA-E) was authorized under the America COMPETES Act in 2007. ARPA-E, however, did not receive funding until 2009 under ARRA, which allocated a budget of $400 million for the agency. ARPA-E is modeled after the Defense Advanced Research Projects Agency (DARPA), which is responsible for several technological innovations including the internet.[97] ARPA-E is intended to fund high-risk projects that industry alone cannot undertake but will tremendously benefit the U.S. with one of its main goals of improving efficiency across the energy spectrum.[98]

ENERGY EFFICIENCY TAX INCENTIVES (1978-PRESENT)

To stimulate adoption of residential and industrial energy-efficiency measures, several tax incentives were created in the 1970s. The Energy Tax Act of 1978 contained a 15% tax credit for residential conservation and renewable energy investment between

88 *Environmental Protection Agency (EPA), "EnergyStar Overview of 2011 Achievements."*
89 *Ibid.*
90 *DOE, "Federal Energy Management Program-About the Program."*
91 *Pacific Northwest National Lab, "Overview."*
92 *Tremper, "Federal Government Energy Use."*
93 *DOE, "History of the State Energy Program."*
94 *DOE, "State Energy Program Goals and Metrics."*
95 *DOE, "Conservation Update: Measuring State Energy Accomplishments."*
96 *Dinan and Webre, "Federal Government Support."*
97 *DOE, "About."*
98 *DOE, "Programs Main Overview."*

1977 and 1985.[99] Conservation measures included weather stripping and insulation among others. [100] The Energy Tax Act also covered a 10% tax credit for certain energy-efficiency measures installed by businesses. According to a study done by ACEEE, the residential and industrial tax credits between 1978 and 1985 had relatively little net impact on driving energy-efficiency improvements. [101]

In the last decade, energy-efficiency tax incentives for private firms and consumers to make investments in more energy-efficient products were included in Energy Policy Act of 2005 and the American Recovery and Reinvestment Act (ARRA) of 2009 as well as other more specific tax policies. Establishing the first major federal energy-efficiency tax incentives in two decades, the Energy Policy Act of 2005 contained several provisions for new energy-efficient home and vehicle tax credits, commercial building deductions, and energy-efficient appliances.[102] ARRA modified and expanded many of the existing federal energy efficiency tax credits.[103] While not all energy efficiency tax incentives have been successful, many have helped spur market transformation toward more energy efficient products particularly for appliances. [104]

ENERGY PRODUCTIVITY COMPARISON

» U.S. STATES

Individual state policies have also contributed significantly to increasing U.S. energy productivity. However, energy-efficiency policies have not developed evenly across all fifty states. The actions of the leading states have clearly outpaced those of lagging states. U.S. states encompass a range of demographics, climate zones, and energy prices, which influence the types of energy-efficiency policies likely to be implemented and find success. Thus, states with effective energy-efficiency measures in place tend to target sectors and employ approaches that are most suitable to their states' economic, political, and social contexts. While it is difficult to determine the individual impact each state has had on increasing U.S. energy productivity, it is important to recognize the states that have had a considerable influence on improving energy efficiency. Doing so not only provides context to the domestic history of energy efficiency but also allows the opportunity to apply lessons learned from exemplary state programs to the national level.

ENERGY EFFICIENCY PROGRESS ACROSS THE NATION

While there are states like California that have continually led the advancement of energy efficiency, the landscape at the state level has changed to a large extent since the 1970s. Some states that were once frontrunners in implementing energy efficiency have dropped in rankings as other states that had initially lagged behind picked up the pace of their energy-efficiency policies. Because it is difficult to draw an across-the-board comparison between all states, one of the primary tools used for ranking energy-efficiency policies at the state level has been ACEEE's annual energy efficiency scorecard.[105] The top ten states in 2012 included: California, New York, Oregon, Vermont, Washington, Rhode Island, Connecticut, Minnesota, Maryland, and Massachusetts (which claimed the number one spot, over California, for the first time in 2011).[106] Among the bottom ten were Mississippi, Wyoming, and North Dakota.

The scorecard demonstrates that states as a whole have pressed ahead with energy-efficiency policies and programs, yet room for improvement constantly emerges. In 2011, electricity energy-efficiency program funding increased to $5.9.billion, up from $4.6 billion in 2010.[107] However, only fourteen states had energy efficiency budgets that were more than 2% of utility revenues.[108] Massachusetts was first at 5.77%, or $453 million, and Vermont fell close behind with 5.64% or $40.7 million.[109] At the same time,

99 *Nadel, "Energy Efficiency Tax Incentives in the Context of Tax Reform," 2.*
100 *Ibid., 2.*
101 *Ibid., 3.*
102 *Gold and Nadel, "Energy Efficiency Tax Incentives," 12.*
103 *Tax Incentives Assistance Project, "Stimulus Package Extends."*
104 *Gold and Nadel, "Energy Efficiency Tax Incentives," 13.*
105 *"Under the scorecard, a state is energy efficient based on two criteria: (1) a policy and regulatory environment that enables efficient use of energy and (2) successful performance in investing in programs that save energy." American Council for an Energy-Efficient Economy, "State Energy Efficiency Scorecard Preview, Part 2: What Makes a State Energy Efficient?"*
106 *Foster et al., "The 2012 State Energy Efficiency Scorecard," v.*
107 *Ibid, 17*
108 *Ibid., 26.*
109 *Ibid.*

roughly twenty-four states have implemented energy efficiency resource standards (EERS), setting long-term energy saving targets and driving the utility sector toward investing in energy-efficiency programs.[110] On building codes, thirty six states have adopted or made significant progress toward implementing the most recent (2009 IEEC and ASHRAE 90.1-2007) building codes, an increase from only twenty nine in 2011 and twenty in 2010.[111]Additionally, according to the U.S. Green Building Council, thirty-four state governments have adopted various "LEED initiatives including legislation, executive orders, resolutions, ordinances, policies, and incentives."[112]

REGIONAL VARIATIONS

While every region in the country has shown leadership in some area of energy efficiency, regional progress as a whole has tended to remain most heavily focused in the Northeast and Mid-Atlantic regions.[113] Yet even within these two regions, progress between states has varied substantially. A 2011 report by the Northeast Energy Efficiency Partnerships (NEEP) analyzed energy-efficiency progress in the Northeast. Even though the report does not rank states, it identified Connecticut, Maryland, Massachusetts, New York, Vermont, Rhode Island, and Washington, D.C., among the leaders in energy-efficiency programs and policies.[114]

The South and Midwest, in contrast, are often viewed as falling and the Southwest has just recently started to climb the ranks to implementing effective efficiency measures. In the 2010 energy efficiency scorecard, Utah, Arizona, New Mexico, and Alaska were the most improved states and for the first time Utah and Arizona ranked among the top twenty states.[115] Progress included "increasing investments in utility energy saving programs, expanding state government initiatives, and adopting better building codes."[116]

STATE LEADERS: REDUCING ENERGY CONSUMPTION

Since the 1970s California has served as a model for energy-efficiency policy at the state level. Not only was California the first state to adopt mandatory appliance efficiency standards, but its electricity and energy consumption per capita have stayed almost constant since the 1970s. Compared to California, U.S. electricity consumption per capita during this time grew by over 40%.[117] California's energy efficiency policies focus on many sectors, include utility rate decoupling,[118] and make energy efficiency a cornerstone of its integrated resource plan. From the beginning, California policies have often targeted the residential sector and thus California's household energy savings between 1976 and 2006 totaled $56 billion.[119]

New York's first energy efficiency efforts also took shape in the late 1970s through federal funding for a state energy conservation program. While funding was minimal, the New York State Energy Office's efforts represented an important first step in obtaining higher energy efficiency savings.[120] Since then, New York's energy-efficiency policies and programs have progressed to its most recent energy use reduction target program titled 15 by 15.[121] The 15 by 15 program aims for a 15% reduction in electricity use by 2015 compared to the projected business-as-usual electricity use for that year.[122] Similar to California, New York also has one of the lowest energy uses per capita.[123] This low energy use per capita over the decades is to some extent due to its effective efficiency policies. But it is also due to high development density and energy efficient urban transportation systems, especially in the New York City region, and the state's economy evolution toward greater reliance on service and information products and reduced presence of heavy manufacturing.[124]

110 *Sciortino et al., "State Energy Efficiency Scorecard," 19.*
111 *Ibid., iv.; Foster et al. , "The 2012 State Energy Efficiency Scorecard,"50.*
112 *U.S. Green Building Council, "Public Policies Adopting or Referencing LEED."*
113 *Hendricks, Campbell, and Goodale, "Efficiency Works," 25.*
114 *Northeast Energy-Efficiency Partnerships, "A Regional Roundup," 4.*
115 *Molina et al., "State Energy Efficiency Scorecard," iii.*
116 *Ibid.*
117 *Kandel, Sheridan, and McCauliffe, "Per Capita Electricity Consumption."*
118 *Decoupling and related utility rate design approaches seek to remove the traditional link between utility energy sales and their revenues and profit, sometimes referred to as throughput bias, so that utilities would be financially indifferent to reducing volumes sold due to energy efficiency programs.*
119 *Roland-Holst, "Efficiency, Innovation, and Job Creation," 4.*
120 *National Research Council, Effectiveness and Impact, 285.*
121 *EPA, "New York: Energy Efficiency Portfolio Standards."*
122 *American Council for an Energy-Efficient Economy, "New York."*
123 *U.S. Energy Information Administration, "Rankings: Total Energy Consumed per Capita, 2010 (million Btu)."*
124 *National Research Council, Effectiveness and Impact, 285.*

Finally, the current state leader in energy efficiency is Massachusetts.[125] Being the first state to unseat California in the number one ranking on ACEEE's Scorecard, Massachusetts has taken some aggressive steps to implement energy-efficiency policies, including the 2008 Green Communities Act. The Green Communities Act establishes energy efficiency as the state's first priority resource and "is expected to lead to an investment of $2.2 billion in energy efficiency and demand-resources between 2010 and 2012."[126] In the past twenty years, energy-efficiency programs have delivered 90,000 GWh in energy savings in Massachusetts and, as a result, the state now meets about 10% of its electricity needs through energy efficiency. [127]

Progress has been made in every state to implement energy-efficiency policies. Despite steady progress, there is still large potential to improve the energy-efficiency policies and programs at the state level, which will help drive an increase in U.S. energy productivity. Recognizing the differences in the structure and features of regional economies and climate zones., the opportunities for adoption of policies to support greater energy efficiency investments/actions seem particularly strong in states with relatively high energy use per unit of economic product, or per square foot of floor space, or per capita, or other such relevant measures of energy intensity and productivity.

LOCAL ENERGY EFFICIENCY POLICIES AND PROGRAMS

Local energy efficiency policies can be implemented at the level of the municipality, metropolitan region, or county. Due to the many responsibilities local governments have, they can implement energy-savings measures using several mechanisms such as land use and zoning, community planning, property taxes, and building requirements.[128] While it is difficult to measure the impact of local energy-efficiency policies at the national level, case studies provided later in this report will show specific energy savings due to exemplary local efficiency programs. Local-level policies and programs are important because they can address specific barriers to energy efficiency in a community as well as drive energy savings beyond those achieved through federal and state programs.

Recently, innovative mechanisms have emerged at the local level to spur energy savings in buildings, one of these being city benchmarking and disclosure policies.[129] A prime example is New York City's Greener, Greater Buildings Plan, which uses four pieces of legislation to increase the energy efficiency of large New York City buildings.[130] Local Law 84, the benchmarking law, requires owners of large buildings to annually log and disclose data on energy and water consumption.[131] About 2,370 buildings have already been benchmarked since 2011.[132]

Local policies such as benchmarking and disclosure could be implemented at the federal level to create substantial energy savings in buildings across U.S. cities. A recent study by the Institute for Market Transformation predicted that a national building energy-rating and disclosure policy would create more than "23,000 net new jobs in 2015" due to "increased demand for energy efficiency services and technologies, and from the reinvestment of energy cost savings by consumers and businesses into the economy."[133] Such policies also support the industry that has grown around the green building sector in recent years. With the application of building-rating and certification programs such as LEED and HERS, a growing number of contractors offering energy audits, energy-efficiency upgrades, and related services, and the technological advancement of energy management systems, the business of making buildings more energy efficient will become ever more relevant in a competitive construction market.

INTERNATIONAL COMPARISONS

While the U.S. has consistently improved energy productivity, it is relevant to recognize other countries that are pushing ahead with implementing aggressive energy efficiency targets. Doing so provides further context to domestic energy productivity and allows a top level comparison on an international scale. Currently, Germany and Japan's energy targets make them the clear leaders in driving energy productivity. Japan has one of the lowest rates of energy consumption per GDP in the world and is the only country in the world to implement all twenty-five International Energy Agency (IEA) energy-efficiency policy recommendations.[134] Germany is working to reduce its energy intensity by 50% by 2050.

125 *Sciortino et al., "State Energy Efficiency Scorecard," v.*

126 *Ibid., 29*

127 *Massachusetts Department of Energy Resources, "Energy Efficiency in Massachusetts."*

128 *ACEEE, "Energy Efficiency Policies for Local Governments."*

129 *"Benchmarking is the process where building owners and operators use a tool, such as the EPA's Portfolio Manager, to not only measure their building's energy and water use, but also to track it over time in order to account for efficiency upgrades in future scores." Sobin and Steele, "Glossary of Commercial Building Terms."*

130 *Sobin and Steele, "New York City: Energy-Efficient Building Policy."*

131 *Ibid.*

132 *Ibid.*

133 *Burr et al., "Job Creation and Energy Cost Savings," 3.*

134 *Pasquier and Saussay, "Progress Implementing," 76.*

While China lags behind in energy productivity, its historically low levels increased between 1980 and 2000 with its GDP growing much faster than energy consumption, largely as a result of policy. Its goal is to reduce energy usage by 20%, which could help it gain ground in energy productivity.[135] Canada, whose primary energy and electricity consumption per unit of GDP is the highest among IEA countries, also struggles with energy efficiency.[136] Countries across the board seem to struggle with implementation and enforcement.

Overall, energy policies do not tend to transcend countries' borders, although the level of activity has increased in the past few years. Even within various sectors such as buildings or industry, little international information exchange occurs regarding data and model policies. International collaboration of best practices and lessons learned could advance efficiency policies.

ECONOMY- WIDE ENERGY TARGETS BY COUNTRY

BRAZIL: A national energy-efficiency action plan in Brazil seeks to reduce electricity consumption 10% by 2030.[137] In October 2011, the Ministry of Mines and Energy approved a National Plan for Energy Efficiency, Premises and Basic Guidelines, which outline actions to achieve energy-savings targets.[138] Brazil's Ministry estimates an investment of more than $350 billion in expanding the country's national energy output between 2008 and 2017.[139]

CANADA: In 2008, individual Canadian "provinces committed to a 20% increase in energy efficiency by 2020 through improved building codes, product regulation, green building policies, audits, and retrofit assistance."[140]

CHINA: China's twelfth five-year plan (2011-2015) sets a 16% energy intensity reduction target for 2015 and a 40% reduction in carbon dioxide by 2020 from 2005 levels.[141] Provinces also have individual energy efficiency goals.

DENMARK: Denmark set a goal of achieving fossil-fuel independence by 2050.[142] It will also decrease gross energy consumption 4% (from the 2006 level) by 2020 and hopes to become one of the three most energy efficient countries in the world by 2020, based on energy intensity.[143]

FRANCE: France is following the European Union (EU) directive to achieve a 9% reduction in consumption from 2008-2016. It is also trying to achieve a 20% reduction in energy consumption by 2020.[144] The government also aims to reduce energy intensity by 2% annually by 2015, and 2.5% annually by 2030, with a specific focus on the transportation and building sectors.[145]

GERMANY: Germany has a National Energy Efficiency Action Plan (2008-2016) and energy intensity targets with goals of "9% energy-efficiency improvement between 2007 and 2016," as well as a "20% reduction in primary energy use per unit of GDP by 2020 and a 50% reduction by 2050."[146] Germany measures target energy efficiency across sectors, with the most savings expected from the residential sector.

INDIA: India's Energy Conservation Act was enacted in 2002 and created the Bureau of Energy Efficiency to implement provisions under the act. India has a target of a 5% reduction in energy consumption by 2015.[147]

JAPAN: Japan set a goal of reducing energy intensity by 30% by 2030 with 2003 as the base year.[148] It will focus on increasing energy efficiency through a new energy supply demand structure and has also pledged to reduce its oil dependence.[149] Japan pioneered the concept of management systems standards to produce continual improvement in energy performance in the 1970s, requiring companies to designate energy managers and report their performance to the government annually. This concept has recently been globalized as the voluntary standard ISO 50001, with strong research and pilot program support from the DOE.

135 *Levine, Zhou, and Price, "Energy Efficiency in China," 5.*
136 *Pasquier and Saussay, "Progress Implementing," 52.*
137 *ABB Group, "Brazil: Energy Efficiency Report," 2.*
138 *REEEP, "Policy DB Details: Brazil (2012)."*
139 *"The Energy Matrix."*
140 *International Energy Agency, "Executive Summary and Key Recommendations," 12.*
141 *ABB Group, "China Energy Efficiency Report," 1; Morgan, "China Meets Five-Year."*
142 *Pasquier and Saussay, "Progress Implementing," 57.*
143 *Ibid.*
144 *European Commission, "Energy Efficiency Action Plan for France," 5.*
145 *Pasquier and Saussay, "Progress Implementing," 61.*
146 *Ibid., 63; Wade et al., "National Energy Efficiency," 15.*
147 *ABB Group, "India Energy Efficiency Report," 1.*
148 *Asia Pacific Energy Research Center, "Energy Efficiency Policies of APEC Economies," 1.*
149 *Ibid.*

MEXICO: Mexico set a target of 2% energy savings by 2012 and 18% savings by 2030.[150] It plans to reduce its electrical power consumption by 43,416 GWh by 2012. Mexico also has a national energy strategy to generate 35% of total power capacity from clean technologies by 2024 with an interim goal of 7.6% from renewables by 2012.[151]

SWEDEN: Sweden's national energy efficiency plan follows the EU directive to achieve a 9% reduction in energy consumption (or 41 TWh of end-use energy savings) by 2016 (using 2001-2005 as a baseline).[152] "A long-term target of 20% energy efficiency improvement by 2020, expressed as an inter-sectoral target of 20% lower energy intensity between 2008 and 2020." "Indicative targets for reduced energy use in 2010 and 2016 have also been adopted outlining that final energy use will decrease by 6.5% by 2010 and 9% by 2016."[153]

UNITED KINGDOM: "The UK's plan outlines a 9% energy savings target for 2016, but indicates that it expects savings from key policies and measures to be equivalent to 18% by 2016."[154]

UNITED STATES: "The United States has a goal of reducing energy intensity of the GDP 25% by 2030, relative to 2005."[155] This Commission suggests doubling energy productivity by 2030 from the 2011 baseline.

CONCLUSION

The United States has made significant gains in energy productivity in the years since the 1973 energy crisis. While the salience of energy and energy efficiency in national policy has waxed and waned over time, a strong architecture of policy tools has developed at federal, state, and local levels. Building codes, vehicle fuel economy standards, and appliance and equipment efficiency standards have delivered considerable energy savings in the past and continue to promise more in the future. States have implemented electric and natural gas utility energy efficiency programs that now garner annual multibillion dollar investments. Additionally, states and localities have pioneered new approaches, including in land-use and transportation planning, utility incentives, building benchmarking, and other areas. The role of ENERGY STAR, technical assistance and outreach, and other voluntary programs has also been considerable for raising consumer awareness and advancing the bar for manufacturers, designers and builders, and other stakeholders.

Though policy has played a significant role in advancing national energy productivity, energy prices, advances in technology, the climate for capital investment, industrial structure, demography and migration patterns, consumer tastes and preferences, and other factors also contribute.

There is still much we can do to improve our energy efficiency and productivity. According to a McKinsey study, the U.S. could cost-effectively reduce energy consumption by 23% from the business as usual case (BAU) by 2020 through an array of energy efficiency measures, saving about 9.1 Q of end use energy and yielding approximately $1.2 trillion in gross energy savings.[156] Others posit even greater opportunities. The potential and opportunities exist across all sectors of the economy, as do the benefits of energy cost savings, improved business productivity, more energy security and reliability, and reduced adverse environmental impact. Economic and employment benefits will accrue as energy savings are recycled in the economy; businesses use their energy inputs more effectively; opportunities grow for energy efficiency products and services; energy reliability and security is reinforced; and damage to public health and the environment is abated.

However, to stimulate this magnitude of energy productivity gain—including the ACNEEP goal of doubling today's energy productivity by 2030—barriers such as high upfront costs and return-on-investment hurdles, split incentives, organizational and institutional impediments, and knowledge and information gaps must be overcome. This will require modifying the energy policy tool box, reinforcing and enhancing some of our current tools while heeding lessons and best practices as well as fashioning new tools. The accompanying ACNEEP sector papers and systems integration report illuminate some policy-relevant options.

150 *Author, "Mexico Energy Efficiency Report," 1.*
151 *Asia Pacific Energy Research Center, "G-20 Clean Energy."*
152 *ABB Group, "Sweden Energy Efficiency Report," 1.*
153 *Wade et al., "National Energy Efficiency," 37.*
154 *Wade et al., "National Energy Efficiency,"40.*
155 *Asia Pacific Energy Research Center. "Compendium of energy Efficiency Policies of APEC Economies," 215.*
156 *Granade, et al. , "Unlocking Energy Efficiency in the U.S. Economy," 1.*

CASE STUDIES AND BEST PRACTICES

Programs for energy efficiency vary greatly among states, countries, industries and utilities, and cities across the globe. The following section highlights successful programs and policy instruments that could be piloted with similar success in the U.S. or simply be employed at a greater scale within the U.S. These case studies will demonstrate particularly effective elements of local, state, national, and industrial programs currently in practice to promote or accelerate energy efficiency. The following examples represent a diverse group of unique energy codes and standards, government policies, citywide plans and initiatives, national organizations, private business solutions, statewide public programs, financial incentives, or combined public and private partnerships to reduce wasteful energy consumption. Analyzing the successes experienced by healthcare facilities, aluminum manufacturers, states like California and Texas, countries like Germany and Japan, and cities like Stockholm it becomes evident that readily increasing energy productivity is not only possible in every energy-intensive economic sector throughout the world, but that it is also imperative for businesses, governments, towns, states, utilities, countries, and industries.

LOCAL

AUSTIN'S ENERGY CONSERVATION AUDIT AND DISCLOSURE (ECAD) ORDINANCE

Austin, Texas, is among the select few cities in the United States to pioneer energy disclosure laws. This includes crafting a citywide ordinance believed to advance efficiency in commercial and residential buildings and encourage retrofits.

BACKGROUND

The legislature passed the Energy Conservation Audit and Disclosure (ECAD) ordinance in 2008 as a response to the City's 2007 Climate Protection Plan.[157] It is enforced and implemented by the municipal electric utility, Austin Energy, and ECAD applies to both commercial and residential buildings yet it has different requirements for each.[158]

RESIDENTIAL

Single-family homes that are ten years old or older by June 2009 must be audited before a transaction, and the audit report must be disclosed to the potential home buyer "at least three days before the end of the option period, during which a potential buyer can cancel his or her contract to purchase the home."[159] Multifamily homes of five units or more that are ten years old or older require an energy audit and results must be posted in buildings starting in June 2011.[160] A major difference from single-family homes is that upgrades are required for those multifamily buildings whose energy use per square foot exceeds the average energy use in all of Austin's multifamily buildings by 150% or more.[161]

COMMERCIAL

According to the original ordinance, all commercial buildings constructed ten or more years before June 2009 were to be rated and disclosed by June 2011, but the amendment passed in April 2011 gave building managers more leeway to complete the task.[162] Commercial buildings must also receive an annual energy rating if they are ten years old or older.[163] This requirement is gradually phased in over time according to a building's size.

PROGRAM RESULTS

In the programs first year, 4,682 homes were audited, which could have potential annual savings of 7,788,000 kWh per year and $723,650 per year.[164] This is the equivalent to powering 650 homes.[165] The city's goal was to have 25% of homes sold receive retrofits in the first year yet only 10% participated.[166] In response to the lessons learned in the first year, the Austin City Council amended the ordinance and "chose to stagger reporting deadlines for commercial properties, clarify the point of sale disclosure requirement," and address condominium requirements.[167]

157 *Sobin and Steele, "Austin, Texas: Building Efficiency Policy."*
158 *"Case Study — Austin Energy Conservation Audit and Disclosure (ECAD) Ordinance"*
159 *"Council approves amendments to energy audit/rating ordinance"*
160 *"Case Study — Austin Energy Conservation Audit and Disclosure (ECAD) Ordinance,"1.*
161 *ACEEE, "Austin Energy Conservation."*
162 *Sobin and Steele, "Austin, Texas: Building Efficiency Policy."*
163 *ACEEE,"Austin Energy Conservation."*
164 *Austin Energy, "Energy Conservation Audit," 4.*
165 *Ibid., 4.*
166 *Ibid., 6.*
167 *ACEEE, "Austin Energy Conservation."*

CHARLOTTESVILLE LOCAL ENERGY ALLIANCE PROGRAM (LEAP)

Charlottesville's LEAP is a community based nonprofit that serves as a one-stop shop for energy-efficiency retrofits and aims to streamline the home energy assessment to retrofit the process.[168] Under this broad umbrella, LEAP includes various programs focused on increasing energy efficiency while improving home comfort and simultaneously saving homeowners money on their energy bills.

BACKGROUND

Established in 2009, LEAP's initial funding was from a $500,000 competitive grant awarded to the City of Charlottesville and County of Albemarle from the Southeast Energy Efficiency Alliance (SEEA).[169] It is also a sub grantee to SEEA in the Department of Energy's Better Buildings Neighborhood program.[170] Recently LEAP has expanded from Charlottesville and Albemarle County to Northern Virginia, including Arlington.

As a one-stop shop, LEAP first provides a home assessment using ENERGY STAR's Home Performance Program. Based on the home assessment, LEAP makes recommendations to the homeowner about which energy efficiency upgrades will be most cost effective. Finally, LEAP provides financing options and helps to coordinate LEAP certified contractors to perform the work.

FINANCING OPTIONS

Various financing options are offered under LEAP, depending on location. In Northern Virginia, LEAP offers a cash rebate and low interest loans through credit unions in order to finance efficiency projects. Central Virginia residents are able to obtain a more extensive list of cash rebates due to the program's longer existence in the area. Another unique financing option offered in Central Virginia through the University of Virginia (UVA) credit union is Power Saver loans. The Power Saver loan program is a two-year pilot program which offers low-cost financing for energy-efficient home improvements, sometimes even reaching a 0% interest rate.[171]

ADDITIONAL ENERGY EFFICIENCY PROGRAMS

The Local Energy Alliance Program also offers the following additional programs:

- Home Performance with ENERGY STAR, through which homeowners can receive a Home Performance with ENERGY STAR Certificate and enjoy 20% (or more) energy savings;[172]
- Home Energy Score, which allows a homeowner to compare her or his home's energy consumption to that of other homes, similar to a vehicle's mile-per-gallon rating;[173]
- Commercial Program, which includes benchmarking services, an energy treasure hunt and presentation, and an energy assessment; and
- Better Business Challenge, in which 106 Charlottesville businesses "compete over one year to increase their efficiency and sustainability as well as earn recognition for their sustainability efforts by looking at six key areas of their daily operations."[174]

LEAP RESULTS

According to LEAP's Annual Report, in 2011 LEAP achieved these goals:

- served 310 local homeowners;
- generated and applied $3.4 million in private investment;
- saved $200,000 (cumulative yearly cost savings);
- saved 1,390,892 kWh, equivalent to removing 93 homes from the grid; and
- created seventeen jobs.[175]

168 *Local Energy Alliance Program, "About LEAP."*
169 *Ibid.*
170 *Ibid.*
171 *LEAP, "Loans for Central VA."*
172 *"Home Performance with ENERGY STAR."*
173 *LEAP, "Home Energy Score."*
174 *LEAP, "Better Business Challenge."*
175 *LEAP, "Annual Report 2011."*

STATE

EFFICIENCY VERMONT

Vermont is home to the nation's first ratepayer-funded energy efficiency utility, Efficiency VT, which provides services and programs for energy-efficiency initiatives statewide.[176] These include direct financial incentives for consumers and business owners, technical assistance for efficiency projects, construction and renovation frameworks, and advice for efficiency upgrades.

BACKGROUND

The Vermont legislature created the Energy Efficiency Utility Service in 1999, and began providing services to Vermonters in 2000.[177] The service is operated by a private, nonprofit organization, VT Energy Investment Corporation, which was appointed by the Vermont Public Service Board. The District Department of the Environment in Washington, D.C., recently selected VT Energy Investment Corporation to create and operate its Sustainable Energy Utility (SEU).

PROGRAM GOALS

Efficiency VT strives to reduce costs of energy for consumers, strengthen the local economy, and protect the environment by reducing energy consumption of homes and businesses. Efficiency VT releases annual plans that set target for energy and monetary savings for the coming year. The goal for savings from 2009-2011 was 359,700 MWh with a total resources benefits of $313 million.[178]

PROGRAM RESULTS

From 2009 to 2011, the savings totaled 304,000 MWh and $314.9 million.[179] From 2011 investments in efficiency alone, $68.8 million was saved in energy, production, and new products costs, which accounts for about 1.91% of Vermont's overall annual electric energy savings requirements.[180]

FUNCTIONS

The program applies an energy-efficiency charge to ratepayers' electric bills, which is used to fund Efficiency VT's statewide services. The Vermont Public Service Board mandates guidelines and budgets for the program as well as annual plans and progress reports. The board also collaborates with over 250 retailers to promote the sale of energy-efficient products.[181] In 2011, products sold directly as a result of Efficiency VT initiatives totaled $15.8 million in sales.[182] Efficiency VT employs demand-side services and initiatives, including the following programs.

- Geographic Targeting concentrates energy efficiency programs in regions or locales that demand especially high levels of electricity or areas at or near electrical grid capacity during peak hours. This helps relieve the strained transmission and distribution systems.[183]
- Property Assessed Clean Energy collects a special assessment payment along with property tax payments to finance efficiency improvements. A town can decide to partner with the program to allow consumers' access to its Administration Services with no fee for the town.[184]
- Smart Gird will replace analog meters with digital, real-time energy meters so that homeowners and property owners can better manage energy use. Federal grants totaling $69 million will be matched by Vermont utility investments of an additional $69 million to replace 85% of the state's meters.[185] Smart Grid is also a pilot program to understand how advanced energy technologies like smart meters affect low-income ratepayers. Smart Grid is expected to save 4-12% of the household electricity use, according to a report released by ACEEE.[186]

176 *Efficiency Vermont, "How Efficiency Vermont Works."*
177 *Ibid.*
178 *Vermont Energy Investment Corporation, "Efficiency Vermont Annual Report 2011," 2.*
179 *Efficient Vermont, "2011 Savings Claim," 2.*
180 *Ibid.*
181 *Ibid, 5.*
182 *Ibid.*
183 *Efficiency Vermont, "Geographic Targeting."*
184 *Efficiency Vermont, "PACE."*
185 *Merriam, "Getting Smart About Energy and the Economy."*
186 *Ibid.*

- Vermont Town Energy Data is an online renewable and energy efficiency services mapping tool that highlights service providers, such as HVAC contractors, in a town or municipality. The tool also displays the town's historical energy usage.[187]
- Green Mountain Power Energy Efficiency Fund is a proposal for Vermont to invest $8 million in energy efficiency and renewables by the end of 2012.[188] This investment is estimated to generate $25 million in benefits for Vermonters.[189]
- Energy Savings Account was created by the Vermont Public Service Board as a way to self-administer energy efficiency. Any Vermont business that pays an energy efficiency charge through its electric bills in "excess of $5,000 per year, or average $5,000 per year for three years, is eligible to use a percentage of the charge to fund energy-efficiency projects within its facilities."[190]

CALIFORNIA'S LONG-TERM ENERGY EFFICIENCY STRATEGIC PLAN

Since the 1970s, California's electricity consumption per capita, as well as its energy consumption per capita, has remained relatively constant. The state has been a trailblazer for energy-efficiency policy, and California's first building and appliance efficiency standards were adopted in 1977 under Title 24. In 1982, efficiency advocates and utilities led an effort to disaggregate utilities' financial incentives from consumption and link them to investment in energy efficiency, which has become known as decoupling.[191]

California's latest endeavor, adopted in 2008 by the California Public Utilities Commission, produced the Long-term Energy Efficiency Strategic Plan that sets ambitious and enduring energy targets for the state ,which will be achieved through market mechanisms, standards and codes, and utility programs. This is the state's first plan solely addressing energy efficiency and builds from past provisions for efficiency within the Energy Action Plans of 2003 and 2005.

PROGRAM GOALS

From years 2010 to 2012, the state has allocated $3.1 billion to be funneled into energy efficiency and conservation programs, $718 million has been mandated for low-income-sector efficiency programs, and over $2 billion for retrofits of existing structures.

Savings goals from the investment are:

- reach zero net energy in the residential sector by 2020 and in the commercial sector by 2030 for all new construction;
- achieve 40% energy savings by 2020 for existing homes and for existing commercial structures, 50% savings are expected by 2030;[192]
- 60-80% reduction in lighting energy consumption.[193]

Another goal of the Plan is to spread energy savings to low-income communities. According to the Plan, "all eligible low-income residents of California will be targeted to participate in low-income energy efficiency programs by 2020."[194]

PROGRAM RESULTS

By 2013, it is estimated that if the current standards remain intact, Californians will have saved $23 billion since the Plan's implementation in 2008. Between 2012 and 2020, from regulated, investor-owned utilities (IOU), the Plan is expected to save Californians about 4,500 MW, or about nine major power plants, and over 16,000 GWh of electricity.

187 *Efficiency Vermont, "Vermont Town Energy Data."*
188 *Efficiency Vermont, "Green Mountain Power Energy Efficiency Fund."*
189 *Ibid.*
190 *Efficiency Vermont, "Energy Savings Account (ESA) Program."*
191 *California Public Utilities Commission, "CA: Energy Efficiency Strategic Plan," 2.*
192 *California Public Utilities Commission, "CA: Energy Efficiency Strategic Plan"; 7; California Public Utilities Commission, "California Long Term Energy Efficiency Strategic Plan," 34.*
193 *Baker, 9.*
194 *California Public Utilities Commission, "California Long Term Energy Efficiency Strategic Plan," 6.*

PROGRAM FUNCTIONS

The Plan provides access to programs that promote or provide customer incentives, education and information, technical assistance, codes and standards, and emerging technologies. Investor-owned utilities operate efficiency programs with the California Public Utilities Commission's guidance and approval. The Plan manages the following efficiency tasks under programs listed in table 2:

- building benchmarking
- energy ratings
- cost-effective energy efficiency improvements
- financing options
- outreach and education
- workforce training
- benchmarking of commercial buildings
- heating ventilation and air conditioning (HVAC) quality maintenance and quality installation

Table 2. Programs and budgets for efficiency projects managed by IOUs under the Plan in California

Program	Budget	Program	Budget
Residential	$718 M	Emerging Technologies	$68 M
Commercial	$863 M	Codes & Standards	$30 M
Industrial	$405 M	Integrated DSM	$11 M
Agricultural	$128 M	Workforce Education & Training	$102 M
New Construction	$ 137 M	Marketing Education & Outreach	$ 80 M
HVAC	$128 M	Lighting Market Transformation	$1.5 M

ENERGY UPGRADE CALIFORNIA

Energy Upgrade California is an example of a successful program within the Plan that uses $111 million in funds from the American Recovery and Reinvestment Act (ARRA) to conduct home retrofits through consumer incentives and tax credits of up to $8,000 per household. As of August 2011, 749 retrofits had been completed using this funding.[195] The program also provides households that are income-eligible with free energy-efficient appliances, services, and energy education materials.[196]

Retrofits also create domestic jobs since an overwhelming majority of efficiency construction materials are produced in the U.S., such as 99% of duct sheet metal, 98% of vinyl, and 96% of foam insulation.[197]

INTERNATIONAL

STOCKHOLM, SWEDEN – THE FIRST GREEN EUROPEAN CAPITAL

The EU Commission awarded Stockholm the first European Green Capital award in 2010. Stockholm's efforts to promote energy efficiency and sustainability include an integrated administrative system that guarantees environmental concerns are considered in budgets, operational planning, reporting, and monitoring; an ongoing effort to reduce CO_2 emissions that has resulted in 25% reduction since 1990; as well as continuing efforts to reduce emissions with the objective of being fossil fuel-free by 2050. The city has also set an interim goal of reducing greenhouse gas emissions 3 tons per person by 2015.[198]

BACKGROUND

The Green European Capital award was created in 2008 to recognize local efforts to improve the environment, economy, and quality of life, and as a way for cities to inspire each other to develop more sustainably through sharing best practices. The award is given to cities that consistently "achieve high environmental standards, are committed to ongoing and ambitious goals for further environmental improvement and sustainable development, and can act as role models to inspire other cities and promote best practices to all European cities."[199] The award recognizes green cities based on ten indicators including air quality, sustainable land use, waste management, and water consumption.[200]

195 *Efficiency First California, "Energy Upgrade California," 2.*
196 *Energy Upgrade California, "Income Qualified Assistance Programs."*
197 *Energy Upgrade California, "About Energy Upgrade California."*
198 *Environment Administration, City of Stockholm, "The City of Stockholm's Climate Initiatives," 2.*
199 *European Green Capitol, "About the Award."*
200 *European Green Capitol, "About the Award."*

HAMMARBY SJÖSTAD PROJECT

"In Sweden, the average annual rate of energy use in some regular new developments is 200 kWh per square meter."[201] However, the Hammarby Sjöstad neighborhood set a goal of reducing energy use to 100 Kwh per square meter. The project also has other efficiency targets including "water reduction and reuse, emissions reduction, reduction of hazardous construction materials, and the use of renewable energy sources."[202]

- The Stockholm environment program established six environmental goals for 2008-2011.[203]
- "Environmentally efficient transport
- Safe building free of dangerous substances
- Sustainable energy use
- Sustainable land and water use
- Waste treatment with minimal environmental impacts
- Healthy indoor environment."[204]

Stockholm promotes energy efficient buildings through the Stockholm Energy Centre. The Centre serves an internal energy advisory service for the city and helps determine which energy-efficiency enhancements are most cost-effective. Projects include home energy efficiency improvements and LED lighting upgrades. The city is implementing plans to increase the energy efficiency of the city's social housing from the 1960s, including improvements to insulation. The program includes a model for implementing large-scale energy-efficiency enhancement in the city's property holdings, which would have contractors who make the investments responsible for the operation, maintenance, and follow-up of projects. Stockholm is also installing LED lighting to help reduce energy consumption by 25%. Projections suggest that these and other changes will help achieve annual energy savings of 238,000,000 kWh, 30,000 tons of CO_2 and €28 million.[205]

The city of Stockholm also signed a Climate Pact under which companies commit to reduce energy use by 10% between 2008 and 2010. More than sixty companies have signed between 2007 and 2009.[206]

GERMANY

BACKGROUND

Though many countries formulate policies based on the assumption that greater energy consumption fosters economic growth, Germany began decoupling the two in the 1970s as a reaction to the 1973 oil embargo that sent energy prices surging.[207] For example in 1979, West Germany's energy consumption cost the country an astounding $8 billion more than the previous year due to an OPEC oil price increase.[208]

In 2008, Germany started implementation of its National Energy Efficiency Action Plan, which establishes a framework for Germany to meet its goal of doubling energy productivity by 2020 from 1990 figures.

THE MODEL FACTORY FOR ENERGY EFFICIENCY

The Model Factory (MF), a joint venture by German business, academia, and McKinsey & Company's Global Operations Practice, which opened in 2009, combines business ideas with government regulations to achieve greater energy productivity within industry.

The first MF began as a part of the Technical University of Munich, which focused on increasing energy productivity and reducing costs to businesses while reducing GHG emissions. Each MF works to streamline manufacturing by simulating a real work environment and providing experiential learning to factory employees and management while measuring the overall equipment effectiveness. The factory has helped to identify potential savings by highlighting losses from operations practices, such as continuing to power machines during standby periods and recognizing the need for better insulation. From Germany, MFs have successfully spread to Italy, Morocco, the U.S., and seven other locations throughout the world.[209]

201 *Energy Sector Management Assistance Program, "Good Practices in City Energy Efficiency," 187.*
202 *Ibid.*
203 *Ibid., 186.*
204 *Ibid.184.,*
205 *Environment Administration, City of Stockholm, "The City of Stockholm's Climate Initiatives," 16.*
206 *Ibid., 24.*
207 *Pasquier, "Progress Implementing the IEA 25 Energy Efficiency Policy Recommendations,"63.*
208 *Siegert, "West Germany's Energy," 2.*
209 *McKinsey & Company, "McKinsey Model Factories."*

The MF creates an industrial setting in which to gauge energy losses and room for increased energy productivity. As of 2009, 70 companies and 1,000 participants had worked with Germany's MF. German industry could save $10 billion by 2020 by taking advantage of available energy-saving technologies. Savings could be as much as 30% of production costs.[210]

GERMANY'S FUTURE HOUSE CAMPAIGN

An even larger consumer of Germany's energy than its intensive industrial sector is the buildings sector, which consumes about 40% of final energy. The German Energy Agency (*Dena*) has begun a national campaign demonstrating the savings potential of energy efficiency by providing measures to issue grants, regulate energy use, and create market mechanisms to increase efficiency.

A successful market mechanism has been the Future House Campaign that originates from the Energy Savings Act of 2007. Energy performance certificates that display the energy usage and characteristics of a structure must be made available during the buying, leasing, or renting process and must also be displayed publicly. This incentivizes better energy performance for structures and encourages building upgrading machinery as well as retrofitting the building envelope to increase efficiency.[211]

JAPAN

BACKGROUND

As most of the world recoiled after the fuel shortage shocks caused by the 1973 oil embargo, so, too, did Japan. Energy efficiency and conservation became energy security goals of the Japanese government. While Japan's first energy saving policy was implemented in 1947; its energy policy became much more sophisticated after the energy crises of the 1970s.[212]

After the 1979 energy crisis, the Japanese government implemented its first energy policy, the Energy Conservation Act or the Law Concerning the Rational Use of Energy. This act serves to save energy and reduce carbon dioxide emissions within four sectors: buildings, industry, transportation, and machinery and equipment.[213] Remarkably, from 1973-2007, Japan's large industrial sector has had little or no increase in energy consumption.[214] As is shown in Figure 1, Japan has the highest energy productivity in the world at three times the global average.[215]

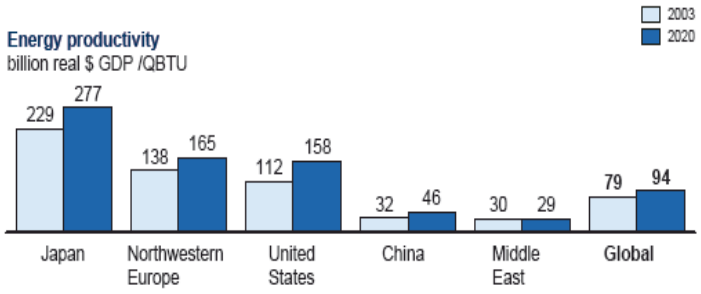

Figure 1. McKinsey and Company Curbing Global Energy Demand

JAPAN'S ENERGY CONSERVATION CENTER

Created through a provision of the Energy Conservation Act of 1979, the Energy Conservation Center of Japan (ECCJ) serves as a resource link between government and industry and private businesses in order to provide assistance and consultation on energy efficiency and conservation techniques, technologies, and programs.

The ECCJ addresses three overlapping interests of the Japanese government with regard to increasing energy productivity: 1) economic growth, 2) environmental protection, and 3) energy security.[216]

The Japanese government and civil society are also informed on data produced and disseminated by the ECCJ.[217] This form of comprehensive design for the organization helps to create new cultural norms that emphasize energy efficiency and conservation, ultimately leading to higher energy productivity.

210 *McKinsey & Company, "Model Factory Munich 2011."*
211 *Zukunft-haus, "Energy Performance Certificates for Buildings."*
212 *Energy Conservation Center, Japan, "We Support Your Energy Conservation Activities."*
213 *Ibid., 2*
214 *Shiel, Jeffer, and Dyar, "Energy Conservation Measures in Japan," 13.*
215 *Bressand et al., "Curbing Global Energy," 21.*
216 *Tanaka, "PROMECC," 7.*
217 *Energy Conservation Center, Japan, Energy Efficiency Policy Development*

A myriad of energy-related issues within the transportation, residential, commercial, and industrial sectors are addressed by the EECJ, such as energy auditing, energy conservation training and education, national dissemination of information, and international cooperation.[218] There are also two federal tax incentives offered for efficiency upgrades, a deduction for corporate tax or income tax up to 7% of acquisition costs or a special depreciation incentive up to 30% of acquisition costs.[219]

TOP RUNNER PROGRAM

One of ECCJ's most successful programs has been the Top Runner Program. For example, from 1995 to 2005, air conditioners monitored under the program increased efficiency by nearly 40%.[220] Electricity consumption of refrigerators per year per liter decreased from 1995 to 2010 by over 80%.[221] Top Runner establishes machinery and equipment standards for energy efficiency. There are generally three main methods to set energy standards:

- minimum standard value system or the minimum energy performance standard;
- average standard value system; and
- maximum standard value system.

If a product does not meet the minimum standard established it can be suspended from the market. The average standard determines that the average of a manufacturer's products will exceed the minimum, meaning a product can be well above and below the average as long as all products meet the average target.

The Top Runner Program employs the maximum standard method, which sets the highest value for the most energy-efficient products available. A manufacturer may still distribute products not meeting the maximum or exceeding it as long as the average meets the maximum goal. Of thirteen major product categories monitored by Top Runner, all have achieved greater efficiency than projected by initial improvement expectations. The U.S. currently uses the minimum energy performance standard approach but not the average or maximum.[222]

UTILITY

CONNECTICUT ENERGY EFFICIENCY RESOURCE STANDARDS AND ENERGY EFFICIENCY FUND

In the original version of Connecticut's Renewable Portfolio Standard (RPS) "a minimum of 7% of state's electricity was required to come from Class I renewable resources."[223] Energy efficiency and combined heat and power (CHP) were, however, not included in the RPS until 2005 under the establishment of a new Class III requirement.[224] Electricity suppliers had to meet 1% by using energy efficiency and CHP, and the target increased 1% annually for a total of 4% by 2010.[225]

The Connecticut Energy Efficiency Fund (CEEF) was established to help "homeowners and renters, small and large businesses, and state and local governments reduce energy use."[226] All Connecticut Light & Power and United Illuminating utility customers contribute to CEEF through the Combined Public Benefits Charge on their electric bill.[227] Customers of Connecticut Natural Gas, Southern Connecticut Gas Company, and Yankee Gas Services Company contribute through a conservation charge on gas bills.[228]

218 *Energy Conservation Center, Japan, "Organization of ECCJ."*
219 *Energy Conservation Center, Japan, Energy Efficiency Policy Development 12.*
220 *Ibid.*
221 *Ibid.*
222 *Ministry of Economy, Trade and Industry Agency for Natural Resources and Energy, Japan, "Top Runner Program," 6.*
223 *Renewable Energy and Energy Efficiency Partnership, Alliance to Save Energy, and American Council on Renewable Energy, "Compendium of Best Practices," 21.*
224 *Ibid.*
225 *Ibid.*
226 *Ibid.*
227 *CT Zero Energy Challenge, "Connecticut Energy Efficiency Fund Sponsors."*
228 *Ibid.*

CT ENERGY EFFICIENCY RESOURCE STANDARD

BACKGROUND

Connecticut's RPS was expanded to incorporate an energy efficiency and CHP requirement, with targets increasing 1% annually, and CEEF administers programs that help homeowners, businesses, and state and local governments reduce their energy use. The Fund "offers residents everything from incentives to replace energy-wasting appliances with newer, more efficient models to rebates on energy-saving lighting products and air conditioners."[229] The fund's mission is threefold.

1. "Advance the efficient use of energy.
2. Reduce air pollution and negative environmental impacts.
3. Promote economic development and energy security."[230]

PROGRAMS

- The Smart Living Center educates consumers about the benefits of energy efficiency through various mechanisms such as hosting seminar and providing guided facility tours.[231]
- By installing energy efficient electric central air conditioning and electric heat pump systems, homeowners can receive heating and cooling incentives.[232].
- Eesmarts provides lessons and workshops that teach students from prekindergarten to ninth grade about energy efficiency and renewable energy. [233]
- Energy Conscious Blueprint helps reduce capital and operating costs for new construction for businesses.[234]
- Express services give commercial customers a way to save money through rebates offered for heating/cooling equipment.[235]
- Process Reengineering for Increased Manufacturing Efficiency (PRIME) is for "commercial and industrial customers with an average monthly peak demand of 350 kWh to 1500 kWh."[236] The PRIME Audit begins with a facility walk-through assessment at no cost. It also provides businesses with training in "lean manufacturing techniques to streamline product flow, eliminate or reduce waste, improve production efficiency, minimize environmental impact, and reduce energy consumption."[237]

SAVINGS

Since 1998, Connecticut's energy-efficiency programs have delivered critical peak demand reductions and energy savings. In 2011, the Fund's "program activities resulted in 3.2 billion KWh lifetime savings, equivalent to providing electricity to more than 384,000 homes for one year, reducing energy costs by $646 million, and avoiding the emissions of 2.4 million tons of carbon dioxide."[238] According to Connecticut Light and Power, each dollar invested in electric efficiency provides electric system benefits greater than $3 for the state.[239]

229 *"Connecticut Energy Efficiency Fund."*
230 *"Connecticut Energy Efficiency Fund," About CEEF.*
231 *United Illuminating Company, "Smart Living Center."*
232 *"Connecticut Energy Efficiency Fund," Energy Programs.*
233 *Ibid.*
234 *Ibid, For Your Business.*
235 *Ibid, For Your Business.*
236 *Ibid, For Your Business*
237 *CT Zero Energy Challenge, "Connecticut Energy Efficiency Fund Sponsors."*
238 *Connecticut Light and Power, "Helping Connecticut Save Energy."*
239 *Ibid.*

INDUSTRY

KINDRED HEALTHCARE, INC.

Headquartered in Louisville, Kentucky, Kindred Healthcare has nationwide subsidiaries, and its Louisville location partnered with the Kentucky Pollution Prevention Center (KPPC) in June 2009.[240] For Kindred Healthcare, KPPC's goal is to decrease energy usage by 2.5% annually for ten years.

Kindred Healthcare implemented a number of cost-saving and energy-saving measures in its Louisville location in June 2011, including the following:

- audited energy usage of employee workstations and reduced electricity demand.
- established a facility energy policy and management plan.
- replaced inefficient lighting with efficient CFL bulbs
- organized and reported energy-usage data through the ENERGY STAR Portfolio Manager.
- installed cool roofs that reflect more solar heat energy.
- replaced exit signs with efficient LED signs.
- programed lighting to turn off at 9:00 p.m.
- installed submeters in order to track peak load times.

ESTIMATED SAVINGS

Since the measures have been implemented, a cost-benefit analysis was conducted to calculate approximate savings, which are estimated to be $101,000 per year and up to 7,390 MBtu. The cost of investment in these programs ranges from $0 to $157,000 and is expected to have a payback period up to 3.7 years.

DENSO MANUFACTURING

Located in Athens, Tennessee, DENSO Manufacturing produces and ships automotive components and parts to automakers globally.[241] The Athens plant joined the Tennessee Pollution Prevention Partnership in 2005, which reformed the plant's approach to energy usage. At the Athens location, there are seven large cooling towers that support its HVAC chiller units. During the winter, the cooling towers are unnecessary, but were run year-round in the past.

The plant revised its energy management strategy, and now only two cooling towers are needed to support HVAC chiller units. Three towers are now decommissioned during the winter, and two are left in stand-by mode, which only requires powering those towers for 1.5 hours per day. Annually, the shift in energy management has saved:

- $70,000 in utility costs;
- $10,000 in chemical costs;
- 1.6 million KWh of electricity; and,
- 300 tons of carbon dioxide.[242]

240 *Kentucky Pollution Prevention Center, "Kindred Healthcare, Inc. Case Study."*

241 *Tennessee Department of Environment & Conservation, "Tennessee Pollution Prevention Partnership Success Story"*

242 *Assembly Magazine, "Saving Energy: Saving Money"; DENSO, "CSR Report 2007,"61.*

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FIGURES AND TABLES

LIST OF ABBREVIATIONS

ACEEE – American Council for an Energy-Efficient Economy

ARPA-E – Advanced Research Projects Agency - Energy

ARRA – American Recovery and Reinvestment Act

ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers

BCAP – Building Codes Assistance Project

Btu – British thermal unit

CAFE - Corporate Average Fuel Economy

CEEF – Connecticut Energy Efficiency Fund

CEEP – Clean and Efficiency Energy Program

CHP – Combined Heat and Power

CSA - Community Services Administration

DARPA – Defense Advanced Research Projects Agency

DOE – Department of Energy

DSM – Demand –Side Management

ECAD - Energy Conservation Audit and Disclosure

ECCJ - Energy Conservation Center of Japan

ECPA – Energy Conservation and Production Act

EERE – Office of Energy Efficiency and Renewable

EERS – Energy Efficiency Resource Standards

EISA – Energy Independence and Security Act

EPA – Environmental Protection Agency

EPAct – Energy Policy Act

EPCA – Energy Policy and Conservation Act

EU – European Union

FEA – Federal Energy Administration

FEMP - Federal Energy Management Program

GDP – Gross Domestic Product

GHG – Greenhouse Gas

GWh – gigawatt-hour

HERS – Home Energy Rating Systems

HUD – Department of Housing and Urban Development

ICC – International Code Council

IEA – International Energy Agency

IECC – International Energy Conservation Code

KPPC – Kentucky Pollution Prevention Center

kWh – kilowatt-hours

LDV – Light Duty Vehicle

LEAP – Local Energy Alliance Program

LEED - Leadership in Energy and Environmental

MF – Model Factory

NAECA – National Appliance Energy Conservation Act

NEA – National Energy Act

NECPA – National Energy Conservation Policy Act

PIFUA – Power Plant and Industrial Fuel Use Act

PRIME – Process Reengineering for Increased Manufacturing Efficiency

PURPA – Public Utility Regulatory Policies Act

Q – Quad; quadrillion Btu

R&D – Research and Development

RD&D – Research, Development and Deployment

RPS – Renewable Portfolio Standard

SEEA – Southeast Energy Efficiency Alliance

SEP – State Energy Program

SEU – Sustainable Energy Utility

VMT – Vehicle Miles Traveled

WAP – Weatherization Assistance Program

APPENDIX A - U.S. FEDERAL PUBLIC POLICIES ON ENERGY EFFICIENCY

The chart below highlights key components of major federal energy efficiency policies enacted between 1975 and 2009.

Year	Statute	Residential	Commercial	Industrial	Transport	Electric	Federal/State Government
1975	Energy Policy and Conservation Act			§340 Industrial Equipment Efficiency	§321 CAFE for cars and light trucks		§381 Federal Conservation Programs
1976	Energy Conservation and Production Act	Low-income home weatherization; appliance efficiency standards					EPCA §361 State Energy Programs
1978	National Energy Act (NECPA, PURPA, PIFUA)*	Energy efficiency tax credits	Energy efficiency tax credits	PIFUA		PURPA §210, PIFUA	NECPA; EPCA §381, 382 Federal efficiency standards
1992	Energy Policy Act of 1992	Model energy efficiency building codes; appliance standards	Commercial office equipment efficiency standards	§131 industrial efficiency grants		Utility energy efficiency grants	§157 Federal energy training, audits, procurement; Federal Energy Efficiency Fund
2005	Energy Policy Act of 2005	§135 Appliance standards, §124 efficiency appliance rebates	Efficiency standards for commercial equipment		Fuel efficiency studies	Net-metering, Interconnect standards, PURPA relief	§101 Energy saving measures in Federal buildings
2007	Energy Independence and Security Act of 2007	Light bulb and consumer appliance standards	Institutional Grants and Loan; Zero-energy Commercial Buildings	EPCA §371 Industrial Waste Energy Recovery	§101, new CAFE Standards;	Title XIII, Smart Grid policy	§141 Federal fleet requirements; §431,521 high performance Federal buildings; §541 EECBG*
2009	American Recovery and Reinvestment Act (Stimulus Bill)	Weatherization funding for low-income homes			Electric vehicle and battery funding	Smart grid funding; transmission study funding	State Energy Office Funding; EECBG Funding

Note: NECPA - National Energy Conservation Policy; PURPA – Public Utility Regulatory Policies Act; PIFUA – Power Plant and Industrial Fuel Use Act; EECBG – Energy Efficiency and Conservation Block Grant Program

APPENDIX B - PUBLIC POLICIES FOR ENERGY EFFICIENCY IN THE U.S.

Policy	Description
Energy Policy and Conservation Act of 1975	EPCA was enacted for the purpose of serving the nation's energy demands and promoting conservation methods when feasible. It mandated vehicle fuel economy standards, established an energy-conservation program for major household appliances, created energy conservation programs, directed the creation of strategic petroleum reserves, and extended oil price controls to 1979.
Energy Conservation and Production Act of 1976	ECPA created incentives for conservation and renewables, funded weatherization for low Income homes, and established a program to establish energy conservation standards for new buildings. ECPA specifically required development and implementation of performance standards for all new residential and commercial buildings.
National Energy Act (National Energy Conservation Policy Act, Public Utility Regulatory Policies Act, Power Plant and Industrial Fuel Use Act) of 1978	NEA was a legislative response by U.S. Congress to the energy crisis of 1973, and it included NECPA, PURPA, and PIFUA. NEA established energy efficiency programs, tax incentives, tax disincentives, energy conservation programs, alternative fuel programs, and regulatory and market-based initiatives. NECPA serves as the underlying authority for federal energy management goals and requirements and is regularly updated.
Energy Policy Act of 1992	EPAct of 1992 set goals, created mandates, and amended utility laws to improve energy efficiency in the U.S. Major energy-efficiency provisions of the Act included building energy-efficiency standards, equipment energy-efficiency standards, including motor standards, residential energy-efficiency ratings, regional lighting and building centers, federal energy management, electric and gas utility regulatory reform, least-cost planning for federal electric utilities, and energy efficiency R&D, among others.
Energy Policy Act of 2005	The Energy Policy Act of 2005 included several important energy-efficiency provisions to help Americans save money and energy while reducing pollution including residential and federal appliance standards, funding for fuel efficiency studies, net-metering, and energy saving measures in Federal buildings.
The Energy Independence and Security Act of 2007 (EISA)	The President signed into law the most sweeping energy efficiency legislation ever enacted on December 19, 2007. EISA is projected to save American consumers and businesses more than $400 billion through 2030, and will reduce energy consumption by 7% and greenhouse gas emissions by 9% from the forecast for 2030, according to the American Council for an Energy Efficient Economy. EISA set standards for light bulbs and other consumer appliances, set new corporate average fuel economy standards, funding for high performance federal buildings and many other efficiency provisions.
The American Recovery and Reinvestment Act of 2009 (ARRA)	Signed into law by President Barack Obama on February 17, 2009, ARRA, or "the stimulus package," is the single greatest federal investment in the American economy in United States' history. The stimulus includes more than $25 billion dollars for core energy efficiency and billions more which can be directly or indirectly applied to energy efficiency projects. These projects included weatherization for low-income homes, smart grid, electric vehicles and batteries, and State Energy Office funding.

Sources: THOMAS –Library of Congress, http://thomas.loc.gov/home/thomas.php; Alliance to Save Energy, http://ase.org/resources/energy-legislation; The Encyclopedia of the Earth, http://www.eoearth.org/article/Energy_Policy_and_Conservation_Act_of_1975,_United_States; DOE, Office of Renewable Energy and Energy Efficiency, http://www1.eere.energy.gov/femp/regulations/necpa.html; American Council for an Energy Efficient Economy, http://www.aceee.org/topics/energy-policy-act-1992.

APPENDIX C - EXECUTIVE ORDERS DRIVE ENERGY EFFICIENCY [243] [244] [245] [246] [247]

Year	Title	Description
1977	Energy Policy and Conservation (E.O. 12,003)	Signed by President Carter, the Energy Policy and Conservation E.O. 12,003 promotes that the minimum statutory requirement for fleet average fuel economy is exceeded for 1978-1980, and that executive agencies may not acquire a passenger automobile unless such automobile meets or exceeds the average fuel economy standard for that model. Also requires federal agencies to work together to develop the ten-year plan for energy conservation with respect to Government buildings which set specific energy savings goals.[1]
1999	Greening the Government Through Efficient Energy Management (E.O. 13,123)	Signed by President Clinton, and later updated and consolidated into E.O. 13,423. Set goals to reduce energy use by the Federal government including: reducing GHG emissions attributed to facility energy use by 30% by 2010 compared to 1990, reduce energy consumption per square foot of facilities by 30% by 2005 and 25% by 2010, and reduce petroleum use within agencies' facilities.[2]
2000	Greening the government Through Federal Fleet and Transportation Efficiency (E.O. 13,149)	Signed by President Clinton the purpose of this order is for the Federal government to show leadership in the reduction of petroleum consumption through improvements in fleet fuel efficiency and alternative fuel vehicles (AFVs). The main goal for this E.O. is that each agency operating 20 or more vehicles must reduce the fleet's annual petroleum consumption by at least 20% by 2005 compared to 1999 through various measures specified in the order.[3]
2007	Strengthening Federal Environmental, Energy, and Transportation Management (E.O. 13,423)	Signed by President Bush, the ordinance sets goals to make government agencies more sustainable including: a 3% a year or 30% by 2015 reduction in energy intensity compared to an FY 2003 baseline, reduce GHG emissions attributed to energy use by 30% by 2012, 95% of electronics purchased must meet Electronic Product Environmental Assessment Tool standards and ENERGY STAR features must be enabled on 100% of computers and monitors, buildings must be constructed or renovated to comply with the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings. The order consolidated many previous executive orders, included E.O. 13123 and E.O. 13149 above.[4]
2009	Federal Leadership in Environmental, Energy, and Economic Performance (E.O. 13,514)	Signed by President Obama, it expanded E.O. 13423 to require federal agencies to set a 2020 greenhouse gas emissions reduction target within 90 days of the order issuance by increasing efficiency and meeting various sustainability targets including: a 30% reduction in vehicle fleet petroleum use by 2020, a 26% improvement in water efficiency by 2020, Implementation of the 2030 net-zero-energy building requirement and ensure that all construction and renovation meets cost-effective strategies to reduce energy consumption.[5]

243 *Peters and Woolley, "Executive Order 12,003."*
244 *Exec. Order No.13,123, Fed. Reg. 64 (June 8, 1999).*
245 *Exec. Order No. 13,149, Fed. Reg. 65 (April 26, 2000).*
246 *Exec. Order No. 13,423 Fed. Reg. 72 (January 26, 2007).*
247 *Obama "Federal Leadership in Environmental, Energy, and Economic Performance"*

APPENDIX D – U.S. ENERGY EFFICIENCY TARGETS COMPARED TO OTHER COUNTRIES' TARGETS

As the table below demonstrates, there are many types of energy targets. While the Commission recognizes that varying economic structures, levels of industrialization, and national goals influence countries' decisions to pursue different energy targets, this section of the report will use energy productivity to set a baseline for countries' achievements to date as well as illustrate projected future accomplishments.

Table 1. Economy-Wide Targets

Country/Region	Economy Wide Targets			Sectoral Targets
	Indicator*	Target*	Timeframe	
Brazil	Reduced consumption / final electricity savings	10% reduction in electricity consumption; 109 TWh electricity savings	2030	Industry, transportation, and buildings
Canada	Energy efficiency	20% increase in energy efficiency	2020	Building
China	Energy intensity	16%	2011-2015	Industrial
	Energy use	3.5% reduction per unit of GDP		
Denmark				
	Final energy demand	1.5% absolute per annum	2008-	
	Gross energy demand	2% absolute reduction	2006-2011	
	Gross energy demand	4% absolute reduction	2006-2020	
	Annual energy savings	100% increase	2010	
	Annual energy savings	50% increase	2013	Utilities
	Annual energy savings	75% increase	2017-2020	
	Energy use - New construction	Require less energy than passive homes	2015	Building
France	Final Energy intensity	2% per annum	2005-2015	
	Final Energy intensity	2.5% per annum	2015-2030	Building, construction focus; transportation
	Final energy savings	12 Mtoe	2016	
	Energy use – buildings	Low consumption	2012	
		Net positive	2020	Building

Country/Region	Economy Wide Targets			Sectoral Targets
	Indicator*	Target*	Timeframe	
Germany	Energy Intensity (primary energy use per unit of GDP)	20%	2008 (base)-2020	Energy, buildings, transportation
	Energy Intensity (primary energy use per unit of GDP)	50%	2008 (base)-2050	
	Energy productivity	2.1% per annum	2050 (terms of primary energy consumption)	
	Energy productivity	Double	1990 (base) - 2020	
India	Energy consumption	5%	2015	
	Energy savings	25,000 MW	2012	
Japan	Energy Intensity (total primary energy supply/ GDP)	30%	2003(base) by 2030	Transportation, new supply demand structure
Mexico	Electoral power consumption	43,416 GWh	2006-2012	
Sweden	Energy intensity	20%	2008(base)- 2020	
	Emissions target	130 g CO2/km for passenger vehicles	2015	Transportation
United Kingdom (UK)*	Final energy consumption	18%	2016	
United States	Commission Suggestion: Energy productivity	Double energy productivity (GDP/ primary energy consumption)	2030	
	Energy intensity	25% reduction in energy intensity of GDP (relative to 2005)	2030	

** While the data here do not use a single indicator to compare countries, different measures of countries' targets are helpful for an overview of efforts to help reduce energy demand and increase energy productivity.*

APPENDIX D - INTERNATIONAL ENERGY PRODUCTIVITY

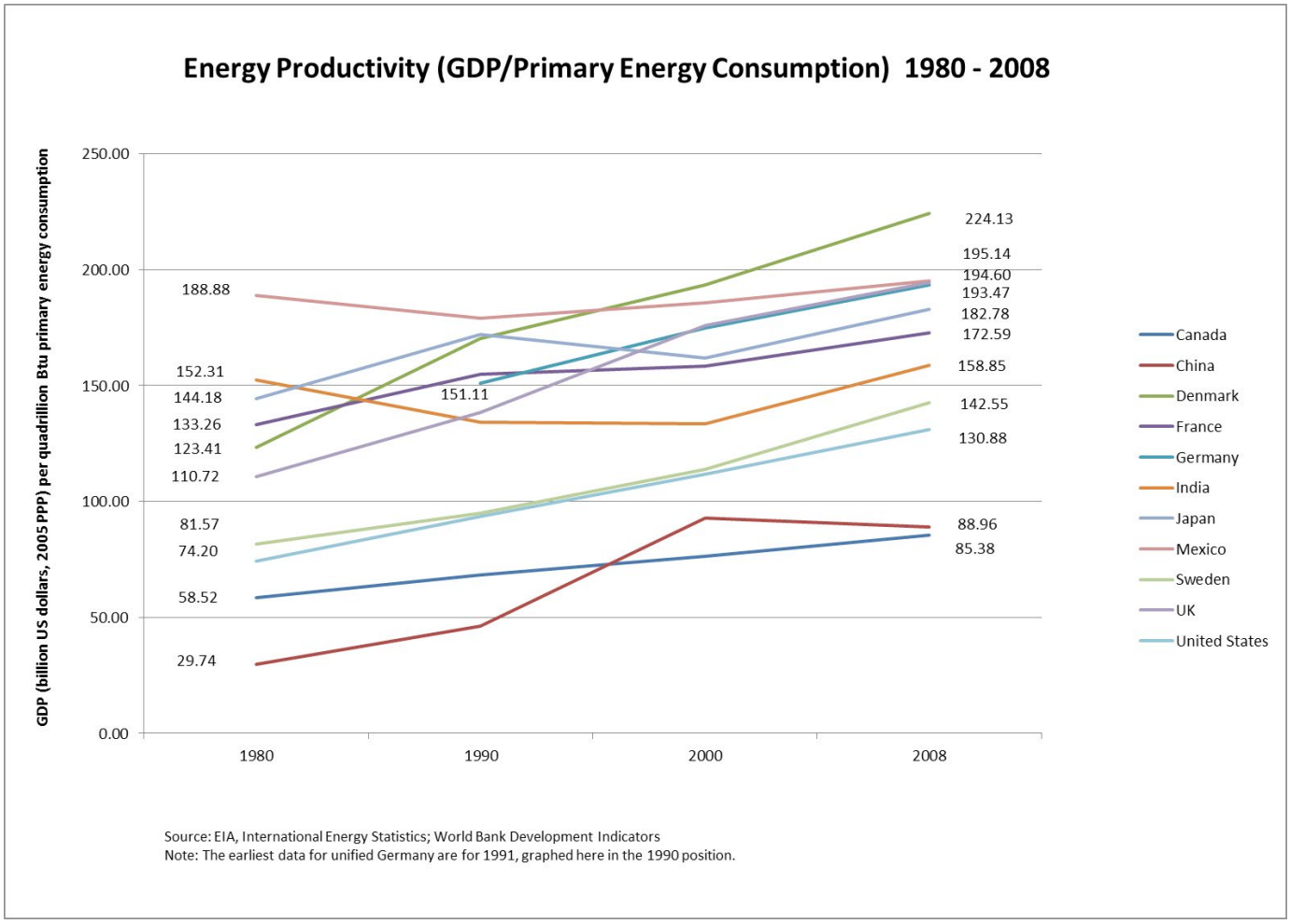

Figure 2. Shows the energy productivity (GDP/Primary Energy Consumption) from 1980 – 2008. Denmark and Germany have consistently shown high energy productivity levels over time. France, India, and Japan's experiences with energy productivity appear to be more turbulent, each experiencing periods of increasing and decreasing productivity, with more consistent upward trends emerging around 2000. Canada and China appear to lag behind other countries in achieving high levels of energy productivity, but they too have experienced upward trends.

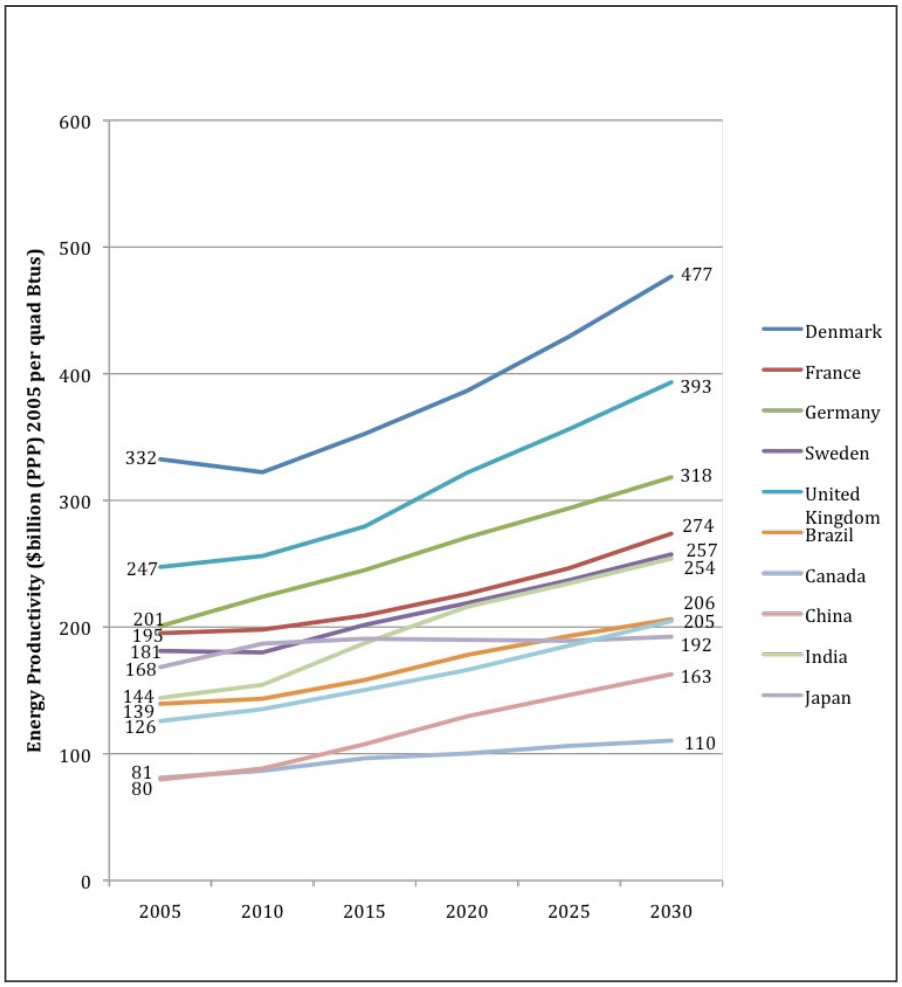

Figure 3. The figure above depicts the projected energy productivity levels of various countries between 2005 and 2030. It was created using World Bank and U.S. Department of Agriculture GDP projections from 2012-2030. Projections of energy use were taken from the 2011 EIA Annual Energy Outlook. While these are merely projections based on various economic assumptions, the figure demonstrates that based on current projections Denmark and Sweden will likely continue to lead the pack in highest energy productivity. However, if the U.S. reaches the Commission's projected goal of doubling energy productivity by 2030 from 2011 levels, meaning the U.S. would be at $270 (billion dollars per quad BTU), it would be competitive with other highly energy productive nations around the world.

The Alliance to Save Energy promotes energy efficiency worldwide to achieve a healthier economy, a cleaner environment, and greater energy security. Founded in 1977, the Alliance to Save Energy is a non-profit coalition of business, government, environmental, and consumer leaders.

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