Chapter 10

Conservation and Efficiency

Energy conservation and energy efficiency are sometimes described as the cheapest and cleanest sources of energy. Energy conservation refers to reductions in energy consumption, which can be achieved through greater efficient energy use or simply lower energy consumption. Unlike conservation, which involves some reduction of service, energy efficiency provides energy reductions without sacrifice of service. US EIA, “Glossary.”

Where can gains in conservation and efficiency come from? Consider the ways in which the United States consumes energy. Notice that industrial use is the biggest consumption sector, followed by transportation and then residential and commercial use. More efficient factories might actually be more important than more efficient cars.
In this chapter, you will learn about:

- the difference between and significance of energy conservation and energy efficiency
- the various energy efficient technologies in existence today, particularly in homes and buildings, vehicles, manufacturing, and at the governmental level
- the regulatory responses to energy conservation and energy efficiency
### Chapter 10 – Conservation and Efficiency

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10.1 Energy Use and Role of Conservation

From 1949 to 2011, primary energy consumption in the United States tripled – increasing almost every year. Even in 2009, when U.S. energy use declined because of the economic recession, our energy consumption was still 20% of the world total in 2009. US EIA, “Frequently Asked Questions.” Given the externalities of our energy consumption – including our collective “carbon footprint” – energy conservation and efficiency are important to the United States.

10.1.1 Significance of Conservation and Efficiency

The United States with a population of about 307 million people consumes 94.5 quadrillion Btu, compared to China with 1,330 million people and consumption of 90.3 quads Btu. With less than 5% of the world’s population, our consumption is 4.5 times the world’s average per capita. See National Energy Education Development Project, “Efficiency and Conservation.” Our per capita energy use in 2011 was 312 million British thermal units (Btu), compared to the world’s 71 million Btu per capita in 2009. US EIA, “Frequently Asked Questions.” We use energy for transportation, cooking, heating and cooling, manufacturing, lighting, water-use, and entertainment. Sustaining our lifestyle requires careful management of resources, including reducing our energy. National Energy Education Development Project, “Efficiency and Conservation.”

Here is a chart that shows how we North Americans are off the chart:

Energy is costly and its production and use have negative environmental impacts. National Geographic, “What Can You Do to Conserve Energy?” Most energy consumed in the
United States comes from fossil fuels – petroleum, coal, and natural gas, with crude oil-based petroleum products as the dominant source of energy. Each affects the environment, including emissions, waste, and land or water use impacts. Renewable energy resources currently supply only about 9% of the US total energy consumption. US EIA, “Energy Explained.” Because nonrenewable sources – especially, fossil fuels – supply the vast majority of our energy needs, conservation and efficiency are essential to sustaining those resources.

### 17.1.2 Difference Between Conservation and Efficiency

Conservation means using less, and efficiency means getting as much with less. Turning the lights off when you leave the room and recycling aluminum cans conserves energy. Using “Al Gore” light bulbs is an efficient use of energy. And replacing an incandescent light bulb with a compact fluorescent is an act of energy conservation. US EIA, “Use of Energy in the United States Explained.”

Can you figure out these cartoons?

![Energy Conservation](image1)

![Energy Efficiency](image2)

![Energy Conservation + Energy Efficiency](image3)

Energy Efficiency and Retrofits

Sometimes the difference between conservation and efficiency is a matter of perspective. For example, imagine a sign says, “Take the Stairs Rather Than the Elevator.” Person A thinks, “I’ll use the steps and still get to where I want to go -- and use less energy.” Person A is being “energy efficient.” Person B thinks, “Boy the steps suck, but it’s the right thing to do.” Person B is “conserving energy” because the elevator seems preferable to the steps. See US EIA, “Energy Efficiency: Definition.”

Sacrifice is at the core of conservation; efficiency is simply doing more with less. See Alliance to Save Energy, “Energy Conservation vs. Energy Efficiency”; California Center for Sustainable Energy, “How Does one Define Efficiency?” For this reason, energy efficiency is more popular; sacrifice is not.

### 10.1.3 Promoting Conservation and Efficiency at the Community Level

At the local level, two areas where policy makers have the ability to make a meaningful impact on conservation and efficiency are transportation and land use planning. For instance, local policies that promote the greater use of passenger rail systems, will reduce the emissions associated with individuals commuting to and from work in their automobiles and result in less congested roads for those drivers who do continue to drive on the roads. Daniel A. Farber,
Sustainable Consumption, Energy Policy, and Individual Well, 65 Vand. L. Rev. 1479, 1514 (2012). Some estimates place costs associated with automobile congestion at around $85 billion per year, not including the diminished quality of life and stress associated with congested roads. Id. Second, local building codes, which promote the expanded development of energy efficient buildings are also effective mechanisms for promoting conservation. Presently, municipalities in over forty states and the District of Columbia have in place building energy codes. Energy Efficiency Building Codes.

10.2 Energy Efficient Technologies

So what is our preference – efficiency or conservation? During the Arab Oil embargo, Jimmy Carter urged Americans to turn down their thermostats and wear sweaters. He was voted out of office. Ronald Reagan then said free markets should be unleashed to assure plenty of energy. American Presidency Project, “Ronald Reagan”. He was re-elected, and schools were named after him.

Not surprisingly, Congress has focused on energy efficiency – not energy conservation. The Renewable Energy and Energy Efficiency Technology Competitiveness Act authorizes the Secretary of Energy “to pursue an aggressive national program of research, development, demonstration, and commercial application of renewable energy and energy efficiency technologies in order to ensure a stable and secure future energy supply…” 42 USC § 12001(b). Congress found that it is in both the national security and economic interest of the United States”. 42 USC § 12001(a). Taking this lead, the US Department of Energy (DOE) supports research, development, and deployment projects that increase energy efficiency nationwide in a variety of different sectors, including homes, buildings, vehicles, manufacturing and government. Department of Energy, “Energy Efficiency.”

Energy-efficient buildings, industrial processes, and transportation could reduce the world's projected energy needs in 2050 by one third, and be crucial in controlling global emissions of greenhouse gases. IEA Energy Statistics Manual.

Increased efficiency also saves money, in some settings more than others. In the following chart, what are the most efficient measures – in terms of saving money and reducing CO2 emissions? Which would seem the least-expensive to implement?
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10.2.1 Homes and Buildings

Homes and other buildings use energy for space heating and cooling, for lighting and hot water, and for appliances and electronics. Today’s buildings consume more energy than any other sector in the U.S. economy, including transportation and industry. Department of Energy, “Energy Basics.” The United States spends more than $400 billion each year to power residential and commercial buildings, consuming more than 70% of all electricity used in the United States, about 40% of our nation’s total energy bill, and contributing to almost 40% of the nation’s carbon dioxide emissions. Because of inefficiencies in energy consumption, much of this energy and, consequently, money is wasted – 20% or more, according to the DOE. Department of Energy, “Building Technologies Program.”

We could engage in conservation and simply live in tents, work in the woods, and shop in outdoor markets. But until the apocalypse, we prefer our homes and buildings. Recognizing our preference for efficiency over conservation, DOE has energy-efficiency guides for the private and public sectors. The DOE’s Building Technologies Program (BTP) suggests ways to reduce

Chart: National Geographic
building energy requirements and energy waste by 50% in commercial and residential buildings. Department of Energy, “Building Technologies Program.” As of 2012, the BTP research and development areas include:

- **Active**
  - Better appliances to reduce plug loads
  - Advanced water heaters
  - Improved refrigeration
  - Higher efficiency HVAC and heat pump systems
  - Innovative working fluids for heating and cooling equipment
  - Enhanced energy-efficient, longer-lasting lighting

- **Passive**
  - Efficient window systems for all types of buildings
  - New thermal insulation and building materials
  - Next-generation attic and roof systems
  - Strategies to improve indoor air quality without sacrificing energy efficiency

The idea is the diffusion of low-cost technologies that meet “real” needs, emphasize energy efficiency and minimize negative environmental impacts such as CO2 emissions. In addition, innovative building technologies -- such as high-efficiency replacement motors, variable frequency drives (VFDs), lighting, and controls for heating and cooling equipment -- are on the rise.

Further, numerous state and federal governments encourage investment in energy efficiency by offering incentives like rebates for high-efficiency equipment, financial assistance for conducting energy audits, and other performance-based catalysts. The Database of State Incentives for Renewables and Efficiency (DSIRE), a comprehensive database established by the DOE, provides information about state, federal, local, and utility incentives and policies that support renewable energy and energy efficiency. DSIRE.

**Lighting R&D.** Lighting in the United States consumes about 18% of total electricity generated. Buildings Entry Databook. The commercial sector consumes about half of this – often at peak times when the least-efficient generation methods are used. In addition, commercial lighting generates internal heat that increases the air-conditioning load.

In short, electric lighting is one of the least efficient energy conversion processes in buildings today. Possible improvements include:

**Solid State Lighting** Solid-state lighting (SSL) could reduce U.S. lighting energy usage by nearly one half. The DOE says it’s working to equip buyers to use SSL lighting. Lighting Research and Development. Do you have any LED lights in your home?

**Spectrally Enhanced Lighting** The DOE is also investigating spectrally enhanced lighting (SEL), which uses existing products and technology to reduce energy use. Studies show that the color of lighting can affect energy efficiency of lighting systems. When the spectral properties of ambient lighting are shifted to be more like the color of
daylight (more white), the eyes respond as though lighting levels were increased. Spectrally Enhanced Lighting. This low-risk, high-return strategy can provide energy savings of more than 20-40% at no additional cost. SEL Field Evaluation.

10.2.2 Vehicles

Transportation represents about 20% of our overall energy consumption and about 69% of our oil consumption. A wish list comes from the DOE’s Vehicle Technologies Program – which seeks to develop and accelerate clean and efficient vehicle technologies, as well as renewable fuels, thus to reduce the U.S. demand for petroleum products. Here’s the program’s “to do” list:

- Development of hybrid-electric and plug-in hybrid-electric vehicles, which can provide significant improvement in fuel economy and decreased petroleum use
- Deployment of alternative fuels (i.e. ethanol blends, biodiesel, hydrogen, electricity, propane, and compressed natural gas), which can rapidly reduce oil imports
- Reduction of vehicle weight, which directly improves vehicle efficiency and fuel economy and can potentially reduce vehicle operating costs
- Improved combustion technologies and optimized fuel systems, improving fuel economy for passenger vehicles by 25-40% and 20% for commercial vehicles by 2015

Reducing petroleum use is said to improve the nation’s energy security more than any other action – at least, this is what was said before fracking put the United States on track to become a net exporter of petroleum. The DOE has calculated that a 1% improvement in vehicle fuel efficiency would save consumers over $2 billion annually.

Remember some of the “efficiency” initiatives for transportation:

**Hybrid-Electric and Plug-In Hybrid-Electric Vehicles.** A promising energy efficient technology is hybrid-electric vehicles, which uses a small, fuel-efficient gas engine combined with an electric motor that assists the engine when accelerating. Batteries recharge automatically while the car is being driven and power the electric motor. Hybrid engines are up to 50% more fuel-efficient and produce up to 50% less emissions than conventional gas engines. NRDC: Grasping Green Car Technology.

There are two types of hybrid-electric vehicles: the parallel hybrid and the series hybrid. The parallel hybrid has a gas engine and an electric motor that work together to propel the car. The series hybrid has a gas engine that either (1) directly powers an electric motor that powers the car or (2) charges batteries that power the car’s motor. See DOE interactive website.
Hybrids increase fuel efficiency with their overall design: efficient electric motors, smaller and more efficient gas engines, regenerative braking (electric motor acts as generator and charges the batteries while the car is decelerating), periodic engine shut off (hybrid engines temporarily shut off when the vehicle is stopped and automatically restart when put back into gear), advanced aerodynamics, low-rolling resistance tires, and lightweight materials. Eartheasy: Hybrid Cars. Hybrids cost more than non-hybrid vehicles, but as technology develops their price is falling. In fact, for high-mile-per-gallon hybrids, studies show that consumers will recoup the extra cost over the course of ownership. NRDC: Grasping Green Car Technology. The number of hybrid vehicle options is expected to expand to 55 models over the next five years. NRDC: Grasping Green Car Technology.

Plug-ins offer the fuel-efficiency benefits of hybrids, with the added benefit of plugging into household (or other) electricity sources when the car is not being driven. This increases mileage and fuel savings. A plug-in offers extended electric-only propulsion, where drivers can use the electric mode for short trips and use the “blended” mode (combining gas and electric), when the battery runs low or higher performance is needed. Because plug-ins require larger batteries made of more expensive materials than hybrids, improvements in battery storage capacity are vital to the future of plug-ins. Eartheasy: Plug-In Cars.

**Improved Fuel Efficiency.** In August 2012, the Obama Administration issued new CAFE standards requiring vehicle manufacturers to increase the average efficiency of new cars and trucks to 54.5 miles per gallon by 2025. See Wikipedia, “CAFE Standards”. The current average is approximately 27 miles per gallon. These new rules will force automakers to improve the mileage of their mass-market models by developing better engines, and the Obama administration projects that these rules will reduce oil consumption by the Untied States by 12 billion barrels of oil, which would result in an average savings of more than $8,000 per vehicle by 2025. NY Times: Fuel Efficiency. In addition, the administration estimates that the new rules will cut greenhouse emissions in half by 2025 and reduce emissions by 6 million tons over the life of the program. Currently, auto manufacturers are working toward achieving a miles per gallon average of 35.3 by 2016. NY Times: Fuel Efficiency.

DOE’s Advanced Combustion Research & Development Subprogram (part of its Vehicle Technologies Program) is working on improving the fuel efficiency of the engines. U.S.
In collaboration with the auto industry, national laboratories, universities, and the U.S. DRIVE Partnership, this program has focused on three objectives:

1. Improve the fuel economy of traditional spark-ignited gasoline engines by more than 25% using advanced technologies such as downsizing, variable compression ratio, and lean-burn engine operation.

2. Develop new combustion approaches that are more efficient than diesel combustion, but with near-zero emissions, which could enable engines to meet emissions regulations without the complicated and expensive equipment that is currently required, and

3. Recover energy from the engine's exhaust to achieve a 10% or greater efficiency improvement using turbocharging, bottoming cycles, and thermoelectric devices that convert heat to electricity for powering the vehicle and auxiliary loads.

10.2.3 Manufacturing

Industrial use of energy is our biggest use – accounting for about 30% of energy use in the United States. Manufacturing converts raw materials, components, and parts into finished goods to meet market demand -- and lots of energy in the process.

To increase the energy efficiency of in manufacturing, the DOE’s Advanced Manufacturing Office (AMO) “works with diverse partners to develop and deploy technologies and practices that will help US manufacturers succeed in global markets.” Here’s a summary:

- AMO’s mission: develop and demonstrate new, energy-efficient processing and materials technologies at a scale adequate to prove their value to manufacturers and spur investment.

- AMO’s goal: reduce by 50% in 10 years the life-cycle energy consumption of manufactured goods by targeting the production and use of advanced manufacturing technologies.

- AMO’s target technologies: boilers and steam systems; combustion; compressed air; distributed energy/combined heat and power (CHP); energy intensive processes; fuel and feedstock flexibility; information and communications technology/data centers; materials for industrial use; motors, fans and pumps; nanomanufacturing; process heating; and sensors and automation.

Tools for Optimizing Efficiency. To re-align natural resource efficiency and consumption habits on a global scale, some neat things are happening:
**Biomimetics:** Some engineers are adopting a biomimetic approach to develop products and systems. Biomimetics simply refers to man-made devices or processes that imitate nature.

**Life Cycle Assessment:** To evaluate a product or service, business managers are calculating the material composition, energy, and level of environmental emissions resulting from extraction, production, manufacturing, and other supply chain factors is a routine Life Cycle Assessment (LCA). The EPA’s National Risk Management Research Laboratory promotes the use of LCA to make more informed decisions through better understanding of the human health and environmental impacts of products, processes, and activities. [EPA LCA Resources](#).

**Cradle-to-Cradle Design:** The Cradle to Cradle Certified program is a third party, multi-attribute eco-label that assesses a product’s safety to humans and the environment and design for future life cycles. [Cradle to Cradle Products Innovation Institute](#). Certified by the CCPI Institute, there are five categories of criteria for certification: (1) Material Health; (2) Material Reutilization; (3) Renewable Energy Use; (4) Water Stewardship; (5) Social Responsibility. [Certification Requirements](#). This innovative approach aims for increased whole-system standardization -- at the international level.

**Standardization.** Once something works, it then makes sense to have energy-efficient technology standardized and widely deployed. The American National Standards Institute (ANSI) coordinates the U.S. standards and conformity assessment system, and functions as a source for timely, relevant, actionable information on national, regional, international standards and conformity assessment issues. [American National Standards Institute](#).

Internationally, the International Organization for Standardization (ISO) -- established in 1947 -- has promulgated more than 19,000 international standards for technology, industrial, and commercial standards. [International Organization for Standardization](#). ISO developed the ISO 50001 *Energy management systems – Requirements with guidance for use* in 2011 to specify standards and the requirements for establishing, implementing, maintaining and improving an energy management system. The ISO 50001 encourages organizations to follow a systematic approach to achieve continuous energy efficiency, security, use, and consumption improvements. [ISO 50001:2011 Energy management systems -- Requirements with guidance for use](#).

### 10.2.4 Government

The largest single energy consumer in the United States is the federal government -- especially the military. The federal government has been at the forefront of energy efficiency, often leading the way for all levels of government. [Department of Energy, “Energy Efficiency.”](#)

The DOE’s Federal Energy Management Program (FEMP) is meant to facilitate the federal government’s implementation of sound, cost-effective energy management and investment practices to enhance the nation’s energy security and environmental stewardship. FEMP does this by focusing on the needs of its federal customers, delivering an array of services across a variety of program areas. [Department of Energy, “Federal Energy Management Program.”](#)
Here’s how DOE describes its FEMP program:

(1) FEMP analyzes energy legislation and regulations to help agencies comply with all applicable requirements, such as Executive Order 13514, which requires agencies to inventory and reduce greenhouse gas emissions.

(2) FEMP engages in the design, operation, and maintenance of high-performance buildings – to help Federal agencies implement sustainable design practices that incorporate greenhouse gas reduction, energy efficiency, renewable energy, water efficiency technologies, and other sustainable aspects.

(3) FEMP evaluates and procures energy-efficient products for the Federal government by publishing purchasing specifications to guide the different agencies in their product purchasing decisions.

(4) FEMP implements renewable energy technologies. The Energy Policy Act of 2005 requires Federal agencies to source no less than 5% of total electricity consumption in fiscal years 2010 through 2012 from renewable energy, increasing to 7.5 percent beyond 2012.

(5) FEMP oversees water efficiency and concentration best practices, as Executive Order 13514 and 13423 require Federal agencies to reduce water consumption intensity 2% annually through the 2015 fiscal year.

(6) FEMP measures and abates greenhouse gas emissions of the Federal government. FEMP offers greenhouse gas management and abatement services to help Federal agencies meet the requirements of Executive Order 13514 and other regulations.

(7) FEMP manages energy-efficient and alternative-fuel vehicle fleets. The Federal fleet consists of over 600,000 vehicles, and although 25% of the fleet is comprised of alternative-fuel vehicles, legislation has mandated further reductions in the fleet’s petroleum use by 2% per year through the 2020 fiscal year relative to the 2005 fiscal year baseline.

(8) FEMP trains, communicates, and awards recognition for outstanding achievements in energy management.

Department of Energy, “Federal Energy Management Program.” The FEMP offers First Thursday Seminars, which are training opportunities that target federal energy agencies. These seminars are offered at no cost and are performed by leading experts around the world. To watch the FEMP First Thursday Seminar on Energy-Efficient Product Procurement, click here: First Thursday Seminar on Energy-Efficient Product Procurement.
10.2.5 Smart Grid

The electricity grid that delivers power to U.S. consumers is, in its current state, overburdened. This is a result of years of underinvestment and exponential growth in demand for electricity. Bosselman, at 988. Historically, the mission of the grid was to facilitate the delivery of electricity from centralized power stations to the general public. Going forward, the grid will have this same responsibility, but will also have to efficiently incorporate greater amounts of distributed generation and allow for bi-directional communication between utility providers and customers. Bosselman, at 989-90. The incorporation of technological upgrades that will achieve these goals is referred to as implementing a ‘smart grid’.

In short, a “smart grid is a modernized electrical grid that uses information and communications technology to gather and act on information” Wikipedia, Smart Grid. Such a system, in contrast to the system that is currently in place in the United States, would allow for grid operators to respond, in real-time to changes in customer demand, which is not something the current grid system allows. As a result, utilities will have the ability to better incorporate renewable energy production into the power grid and provide incentives for energy efficient consumer behavior. Wikipedia, Smart Grid.

The implementation of a smart grid is a time consuming and capital-intensive process. In response to provisions in the Energy Independence and Security Act (EISA), the Department of Energy produced a report in 2009 that “outlined [the] specific challenges of designing and implementing a [smart grid].” Bosselman, at 989. In addition, in 2009, the American Recovery and Reinvestment Act of 2009 amended EISA to create the Smart Grid Investment Grant (SGIG) program. The sole purpose of the SGIG program is to “promote investments in smart grid technologies” and “increase flexibility, functionality, [and the] interoperability” of the grid. SmartGrid.gov. Under this program, about $8 billion has been spent on smart grid implementation, with the federal government covering $3.4 billion of that amount. SmartGrid.gov.

10.3 Regulatory Initiatives to Improve Energy Efficiency and Conservation

The history – and breadth – of legislative initiatives promoting energy efficiency and conservation is breath-taking. You can’t count the federal and state energy regulations related to conservation and efficiency, and new regulations are added every year. So we’ll focus on the more recent federal energy regulations, including the Energy Policy Act of 2005, the Energy Independence and Security Act of 2007, and the American Recovery and Reinvestment Act of 2009.

Before looking at these recent regulatory initiatives, it’s useful to look at energy legislation since the 1970s. Here’s a timeline of the major U.S. energy efficiency regulations:
10.3.1 Energy Efficiency and Conservation Regulations: Pre-2000


**Clean Air Act of 1970**: The Clean Air Act, and its subsequent amendments, form the backdrop for federal energy efficiency regulation. The CAA introduced incentives and initiatives to reduce air pollution – including to increase the energy efficiency of stationary and mobile air pollution sources. Alternative Fuels Data Center, "Key Federal Legislation." To safeguard and improve air quality, the EPA was called on to limit stationary and mobile emissions sources by establishing National Ambient Air Quality Standards (NAAQS). EPA, "Summary of the Clean Air Act." The goal was to implement NAAQS in every state by 1975, though the deadline was extended in 1977 and again in 1990.

The 1990 amendments to the Clean Air Act addressed the problems of acid rain, ozone depletion, and toxic air pollution. Wikipedia, "Clean Air Act." The amendments required the 189 toxic pollutants – mostly carcinogens and mutagens – to be significantly reduced within ten years. EPA, "Highlights of the 1990 Clean Air Act Amendments." A two-phase market-based system was further implemented to reduce sulfur-dioxide emissions from power plants by at least 50% by 2000 to curb the effects of acid rain. Moreover, the amendments sought to phase out production of CFCs and methyl chloride by 2000 and to freeze production of CFCs completely in 2015.


EPCA did a few things that are still relevant today: (1) it declared U.S. national policy to establish a reserve of one billion barrels of petroleum to meet emergency energy demands; (2) it promoted conservation when feasible; and (3) it mandated vehicle fuel economy (CAFE) standards. Encyclopedia of Earth, "Energy Policy and Conservation Act of 1975, United States." EPCA was the first step towards a comprehensive and systematic federal energy policy. William & Mary Environmental Law and Policy Review, “The Energy Policy and Conservation Act.”

EPCA gave the Federal Energy Administration (FEA) the authority to implement an “industrial program,” with goals for the voluntary improvement of energy efficiency in main industries, including automobile transportation and building standards. While initially voluntary, these goals were intended to become mandatory, though without non-compliance penalties.

**National Energy Conservation Policy Act (“NECPA”) of 1978.** EPCA was soon amended and expanded by NECPA in 1978. Like much of the early energy legislation, NECPA was enacted in response to the energy crisis of the mid-1970s brought on by the OPEC oil embargo. While the EPCA primarily addressed fossil fuel resources, NECPA focused on energy conservation amid concerns about energy reliability and national security. Purpose of NECPA, NECPA addressed conservation by decreasing the nation’s reliance on non-renewable resources and increasing the efficiency of current energy products, especially vehicles and in-home heating.

NECPA took a multi-prong approach, focusing on the following sectors:

**Residential buildings:** Title II of NECPA addressed residential energy conservation, and developed procedures for state utility regulatory authorities to implement conservation plans for residential buildings. If state action proved inadequate, the Secretary of Energy was authorized to undertake and enforce a federal plan for residential conservation. This title called for weatherization grants and a financing program for the installation of weatherization materials.

**Commercial buildings:** Title III of NECPA addressed energy conservation in hospitals, schools, and government buildings. It authorized the Secretary of Energy to conduct energy audits and finance conservation projects – and to give grants to states to perform these projects.

**Revisions to CAFE standards.** Title IV amended EPCA, to create and adjust civil penalties for violations of the fuel economy standards and to mandated that the EPA report on the accuracy of fuel economy estimates for newly manufactured automobiles.

**Appliances and equipment efficiency.** Title IV authorized the Secretary of Energy to create energy efficiency standards for household appliances and industrial equipment. NECPA’s Minimum Energy Performance Standards (“MEPS”) replaced the standards established by the EPCA.
Solar and cooling technologies. Title V of NECPA amended the EPCA by establishing a program to promote solar heating and cooling technology. It also created a set of criteria to evaluate federal agency proposals for these solar and demonstration programs. This title further mandated that the Secretary must establish energy performance targets for all federal buildings, and developed a photovoltaic (photovoltaic refers to technology that transforms light into energy) energy commercialization program for these facilities. National Energy Conservation Policy Act (1978). Additionally, the Act permitted the federal government to provide families with loans for the purchase of solar heating and cooling equipment.

Government efficiency. NEPCA required federal agencies to undertake and perform energy surveys to reduce the national consumption of non-renewable resources in buildings, vehicles, and other equipment. Then in the Alternative Fuels Act of 1988, the federal government was encouraged to use (and promote the invention of) alternative non-petroleum fuels – specifically, ethanol, methanol, natural gas, liquefied petroleum gas, hydrogen, and electricity. Encyclopedia of Earth, "Energy Policy and Conservation Act of 1975, United States." This amendment required the Secretary of Energy to ensure that a “practical number of federal fleet” be alcohol-powered, dual-energy, or natural gas-powered vehicles. The goal was to reduce U.S. dependence on non-renewable power sources while creating cleaner, and more technologically efficient alternatives.

Thus, NECPA had more impact than the ECPA and prior energy efficiency regulations by not only promoting conservation, but also by creating new standards applicable to residential, hospital, school, and governmental buildings. During the Act’s duration, Congress allocated over $100,000,000 for these programs. NECPA Encyclopedia of Earth.


Section 152 of the Energy Policy Act added water conservation to the list of renewable energy resources that federal legislation and development plans were to address. It also amended NECPA to establish the Federal Energy Efficiency Fund, which provided grants to agencies to assist them in meeting the energy efficiency and conservation requirements. In addition to encouraging investment in energy conservation, the Energy Policy Act enacted more stringent efficiency standards for buildings, lighting, heating systems, windows, and industrial facilities. Energy and Conservation.

The Energy Policy Act also created incentives for energy utilities. To accomplish this:
1. Agencies were encouraged to increase energy efficiency, promote water conservation, and manage electricity demand related to gas, water, and electric utilities.

2. Agencies were expected to accept financial incentives, goods, and services available from utilities to increase energy efficiency and conserve water.

3. Agencies were encouraged to negotiate with electric, water, and gas utilities to design “cost-effective demand management and conservation incentive programs to address the unique needs of facilities utilized by such agencies.”

4. Agencies were entitled to rebates and other financial incentives, with at least 50% of savings realized by the agency to remain available for expenditure for additional energy efficiency measures.

**Federal Energy Management Program.**

As a result of the Energy Policy Act, power producers (whether utility-affiliated or non-affiliated) could compete to build new non-rate-based power plants. Most of these plants were expected to use gas turbines, given their lower upfront capital costs. The electric power industry was thus encouraged to make technological improvements in gas turbines. And the Energy Policy Act of 1992 “contributed to the rise of gas-fired non-utility generators as the fastest growing source of electric generation capacity.” [EIA, EPAct 1992](https://www.eia.gov/).

The Energy Policy Act also established a financial bonus program to reward outstanding federal agency facility energy managers – though limited to $250,000 cumulative for the years 1993–1995. This incentive program further authorized research and development programs for improving energy efficiency in the industrial process. [Energy Policy and Conservation](https://www.epa.gov/).  

Perhaps the main contribution of the Energy Policy Act, however, was that federal agencies were allowed to enter into energy savings performance contracts (“ESPCs”) to promote and obtain energy savings. [Federal Energy Management Program](https://www.energy.gov/). This meant federal agencies could pursue energy savings programs without having to front the capital costs or get special Congressional appropriations. [Energy Savings Performance Contracts](https://www.epa.gov/). An ESPC represented a type of partnership between a federal agency and energy service company (“ESCO”), where performance-based contracting meant an ESCO’s compensation was directly linked to cost savings the agency actually received. [Energy Service Companies](https://www.epa.gov/). (In December 2011, the White House committed to provide $2 billion in ESPCs and utility energy savings contracts (“UESCs”) to federal agencies and executive departments by the end of 2013. See [Presidential Memorandum](https://www.whitehouse.gov/).)

After the partnership between the federal agency and ESCO was formed, the ESCO performed an energy audit for the agency and identified ways it could improve energy efficiency and further conserve energy. After the initial consultation between the ESCO and the federal agency was performed, the ESCO then designed a project to meet the agency’s needs. By creating this project, the ESCO guaranteed that these improvements would increase energy efficiency, improve conservation, and lower costs. All cost savings realized through these programs went directly to the agencies themselves. [Energy Savings Performance Contracts](https://www.epa.gov/).
graph below illustrates ESCO industry activity for the years 1990 to 2008, showing over twenty-two percent annual growth for the years 2004 to 2008.

Figure ES-1

ESCO Industry Activity, 1990-2008

Source: Energy Star

But before you commit all of this to memory, you should know that many of the requirements of the Energy Policy Act have been amended or superseded by the Energy Independence and Security Act of 2007, Executive Order 13423, and the Energy Policy Act of 2005. Read on.

10.3.2 Energy Efficiency and Conservation Regulations: Post-2000


Metering and Reporting: Section 103 of EPAct 2005 requires that all federal buildings be metered to promote more efficient energy use and help reduce the cost of electricity in the buildings. This metering must occur by October 1, 2012. These meters are expected to provide data daily and measure energy consumption of electricity hourly.

Energy-Efficient Product Procurement: Section 104 of EPAct 2005 mandates that all federal agencies must incorporate and develop energy efficiency criteria consistent with ENERGY STAR and FEMP-designated products. Federal buyers thus must comply with federal energy requirements while saving money. The rationale behind the product procurement plan was that federal buyers can more easily reduce energy consumption and achieve cost savings because they represent the largest volume buyer of energy-consuming products. This regulation also affects the international market by setting clear
standards for energy performance, thus to shift the international markets toward more energy-efficient products.


**Renewable Energy Requirement:** Section 203 of EPAct 2005 requires federal agencies to establish a double credit bonus if any form of renewable energy is produced on-site at a federal facility. This section also mandates that the government’s renewable electricity consumption exceed 3% between 2007 and 2009, exceed 5% between 2010, and 2012, and exceed 7.5% after 2013. Section 204 of the EPAct further requires the installation of over 20,000 solar energy systems in federal buildings by 2010.

**Alternative Fuel Use:** Section 701 of the EPAct 2005 required dual-fueled vehicles to be operated on alternative fuels unless the Secretary of Energy grants the agency a waiver. 

**Renewable Fuel Standard program.** EPA 2005 introduced renewable volume mandate in the United States and required 7.5 billion gallons of renewable fuel to be blended and created into gasoline by 2012. The Energy Independence and Security Act of 2007 expanded the programs, requiring the RFS program to include diesel, and increased the volume of renewable fuel to be blended into gasoline to 36 billion gallons by 2022.

**Renewable Fuel Standard.** The “Grow the Energy” graph shows the proposed increase in cellulosic biofuel and corn ethanol to meet the RFS.
For a succinct overview of the EPAct 2005 and a more detailed explanation of the tax reductions associated with this Act, see: EPACT2005 Overview.

**Energy Independence and Security Act of 2007 (EISA).** Originally named the Clean Energy Act of 2007, EISA seeks to move the United States towards greater energy independence, security, and efficiency. Summary of EISA. President Bush signed the bill into law as part of his “Twenty in Ten” challenge, which sought to reduce gasoline consumption by 20% in only ten years. Energy Independence and Security Act 2007.

One main purpose of EISA was to adopt the intense energy reduction goals of Executive Order 13423, which was signed on January 24, 2007. This Executive Order required federal agencies to reduce energy intensity by 3% every year, with energy intensity being reduced by over 30% by 2015. Furthermore, to comply with E.O. 13423, all federal agencies must ensure that half of all renewable energy (as required and specified under EPAct 2005), comes from new renewable sources. Agencies can also purchase renewable energy to meet these specifications. Executive Order 13423.

Executive Order 13423 also established stringent sustainable building standards and highly recommended that federal agencies comply with the Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding (“MOU”). This MOU created policy guidelines for reducing the total ownership cost of the federal government’s 445,000 buildings, while simultaneously improving energy efficiency and water conservation. Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding. EISA furthered these requirements by mandating that the energy consumption per gross square foot of each federal agency building must be reduced by a certain percentage each year, as specified in the table below. Federal Energy Management Program: EISA 2007.

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Percentage Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>2</td>
</tr>
<tr>
<td>2007</td>
<td>4</td>
</tr>
<tr>
<td>2008</td>
<td>9</td>
</tr>
<tr>
<td>2009</td>
<td>12</td>
</tr>
<tr>
<td>2010</td>
<td>15</td>
</tr>
<tr>
<td>2011</td>
<td>18</td>
</tr>
<tr>
<td>2012</td>
<td>21</td>
</tr>
<tr>
<td>2013</td>
<td>24</td>
</tr>
<tr>
<td>2014</td>
<td>27</td>
</tr>
<tr>
<td>2015</td>
<td>30</td>
</tr>
</tbody>
</table>


Additionally, EISA set performance standards for new buildings and major renovations. The General Services Administration (“GSA”), when determining spaces to lease or rent, shall include minimum performance requirements for renewable energy and energy efficiency. Federal Energy Management Program: EISA 2007. Section 323 of the Act also required federal agencies to use energy-efficient lighting fixtures and bulbs in all federal buildings. Federal Energy Management Program: EISA 2007. New standards for fluorescent and incandescent light bulbs require minimum Lumen perWatt (LPW). EISA Lighting Standards. The lighting requirements are to be phased in, but will impact not only federal buildings but also many incandescent household, reflector, and linear fluorescent bulbs. EISA Lighting Standards.
To help consumers better understand light bulb efficiency given the new EISA 2007 requirements, the EISA legislation also directed the Federal Trade Commission to alter its current light bulb labeling requirements for incandescent, halogen, LED, and compact fluorescent bulbs. The new labeling requirement mandates that manufacturers provide the brightness and energy-cost information on the bulb’s packaging within a detailed “Lighting Facts” section. EISA Lighting Standards. Light bulbs affected by EISA regulation include:

- General service incandescent and halogen household bulbs
- Incandescent and halogen reflectors
- Compact fluorescent household bulbs
- General Service LED bulbs

The image below illustrates the comparable efficiencies between the regulated light bulbs:

![Efficiency Chart](image)

**Source:** EISA Lighting Standards.

What are Lumens perWatt (LPW)? It’s an expression of how much light (lumen) we get from a light bulb compared to how much energy (wattage) we put in. The light bulb that produces the greatest number of lumens per one watt of energy is the most efficient bulb (similar to a car that can travel the furthest on a single gallon of gas is the most fuel-efficient car). EISA Lighting Standards. For a short video on the difference between lumens and watts, see: Lumens Not Watts.

Shatter-resistant, vibration-resistant, three-way, and non-screw base bulbs are exempt from EISA’s new rule, including packaging requirements. EISA Lighting Standards. The new packaging requirements are explained:
How will the Federal Trade Commission (FTC) Labeling Laws affect me?
A new, consumer friendly energy usage label will be required on most light bulb packages. These new labels will help you choose the right energy-efficient bulbs for your needs.

Understanding the new FTC label

<table>
<thead>
<tr>
<th>Package Front</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brightness:</strong> Measured in lumens.</td>
</tr>
<tr>
<td><strong>Estimated Yearly Energy Cost:</strong> Based on 3 hrs/day, 11¢ per kWh (kilowatt hour). Cost depends on rates and use.</td>
</tr>
<tr>
<td><strong>Life:</strong> Based on 3 hours per day.</td>
</tr>
<tr>
<td><strong>Light Appearance:</strong> Example, whether the bulb provides warm or cool light.</td>
</tr>
<tr>
<td><strong>Energy Used:</strong> Watts—the amount of energy the bulb uses.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Package Front</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brightness/Bright:</strong> 535 lumens/lumenes</td>
</tr>
<tr>
<td><strong>Estimated Yearly Energy Cost:</strong> $5.42 per year/ año</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lighting Facts/Datos de Iluminación</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brightness/Brillo:</strong> 535 lumens/lumenes</td>
</tr>
<tr>
<td><strong>Estimated Yearly Energy Cost/Costo Estimado Anual de Energía:</strong> $5.42</td>
</tr>
<tr>
<td><strong>Life/Duración:</strong> 2.7 years/años</td>
</tr>
<tr>
<td><strong>Light Appearance/Apariencia de Iluminación:</strong> Warm/Cálida, Cool/Frío</td>
</tr>
<tr>
<td><strong>Energy Used/Uso de Energía:</strong> 45 watts/vatios</td>
</tr>
</tbody>
</table>
American Recovery and Reinvestment Act ("ARRA" or "Recovery Act") of 2009. The final piece of energy-efficiency legislation was signed into law by President Obama on February 17, 2009. The Recovery Act, part of an effort to jumpstart the economy and stimulate investment in a more energy-efficient infrastructure, sought to improve energy efficiency by promoting the use of renewable resources and energy-efficient products through tax incentives. The three major tax incentives created by the ARRA include:

**Residential Energy Property Credit:** This program increased energy tax credits for homeowners making energy efficient improvements. According to ARRA Section 1121, the new law increased the credit rate to 30 percent of the cost of undertaking the energy improvements, and raised the maximum credit limit to $1,5000.

**Residential Energy Efficiency Property Credit:** This energy tax credit helped taxpayers support and install alternative energy equipment (for example solar hot water heaters). This was a non-refundable energy tax credit and allowed for a credit equal to thirty percent of the cost of the qualified property.

**Plug-In Electric Vehicle Credit:** This was a tax credit of ten percent of the cost of the vehicle, with a maximum credit of $2,5000. Vehicles that qualified for this tax credit were low in speed and propelled by an electric motor that takes electricity from a 4 kwh battery, or were 2-3 wheeled vehicles propelled by an electric motor that drew energy from a 2.5 kwh battery. IRS: Energy Incentives for Individuals in the American Recovery and Reinvestment Act.

In addition to providing consumers with substantial tax credits for implementing energy efficient projects, the Recovery Act provided the Office of Energy Efficiency ("EERE") and the Department of Energy with more than $90 billion to fund their programs and initiatives. DOE: Successes of the Recovery Act. The successes of this funding – and the Recovery Act in general – can be seen today through the numerous projects implemented by the EERE and Department of Energy. Since receiving the funding, the Department of Energy was able to support more than $80 billion in clean energy projects that went towards developing long-term infrastructure and technology to address the country’s energy issues. This money also went towards supporting between 40,000 and 50,000 jobs each quarter since 2010. DOE: Successes of the Recovery Act. The
graphs below illustrate where in the United States the DOE and EERE have implemented their various programs, and the percentage of spending used for each category of program.

Source: Department of Energy Recovery Act.

Although the graph on the left does not include the actual dollar amount (in billions) for each category within the chart itself, the numbers are as follows:

- Carbon Capture and Storage: $3 billion
- Transportation: $2 billion
- Modernizing the Grid: $4 billion
- Science and Innovation: $2 billion
- Renewable Energy: $1 billion
- Environmental Clean Up: $5 billion
- Energy Efficiency: $11 billion

10.3.3 Energy Efficiency and Conservation Regulations: Future

Recently, there has been an increase in legislative activity intended to improve energy efficiency. For example, some legislation would reshape U.S. manufacturing in support of a clean energy economy. Pending or unresolved federal legislation include:

- American Clean Energy and Security Act (ACES) H.R. 2454
- American Clean Energy Leadership Act (ACELA) S.1462
- Restoring America’s Manufacturing Leadership through Energy Efficiency (RAMLEE) S.661
- Carbon Limits and Energy for America’s Renewal Act (CLEAR) S.2877
- Clean Energy Jobs and American Power (CEJAP) Act S.1033
- Investments for Manufacturing Progress and Clean Technology Act (IMPACT) S.1610
- Expanding Industrial Energy Efficiency Incentives Act (EIEE) S.1639
- American Power Act (APA) S.1733
- Supply Star Act (SSA) S.3396
- Practical Energy and Climate Plan Act of 2010 (PECP) S.3464