

# UNITED STATES

## 1. GOALS FOR EFFICIENCY IMPROVEMENT

### 1.1 Overall Energy Efficiency Improvement Goals

The United States has adopted the aspirational goal expressed by APEC leaders in 2007 of reducing the energy intensity of GDP 25% by 2030 (relative to 2005).

### 1.2 Sectoral Energy Efficiency Improvement Goals

The United States Department of Energy (DOE) has goals for the research, development and deployment of energy efficient technologies and practices.

#### 1.2.1 Residential Buildings

The DOE's goal for residential buildings is to develop integrated energy efficiency and onsite/renewable power solutions that will be evaluated on a production basis to reduce whole house energy use in new homes by an average of 50% by 2015 and 70% by 2020 (compared to a clearly established DOE benchmark) at positive cash flow. This will help to achieve the strategic goal of net zero energy homes by 2020 when combined with renewable energy supply.

#### 1.2.2 Commercial Buildings

For commercial buildings, the goal is to achieve net-zero energy new buildings by 2025. In support of this goal, DOE is developing integrated whole-building strategies to enable commercial buildings to be designed, constructed, and operated to use up to 70% less energy relative to the relevant commercial building energy standard, ASHRAE Standard 90.1-2004. The balance of the buildings' energy requirements (30% or more) will be met by renewable energy sources.

#### 1.2.3 Other Sectoral Goals

The DOE establishes voluntary agreements with industrial partners to reduce energy intensity (annual energy consumption per unit of physical output) 2.5% per year over a period of 10 years.

Federal government facilities are required to reduce energy intensity (energy consumption per unit area of floor space) 30% by 2015 (relative to 2005).

### 1.3 Action Plans for Promoting Energy Efficiency

#### 1.3.1 The United States Strategic Approach for Promoting Energy Efficiency

##### a) Objectives

Establish energy efficient technologies, processes and practices

##### b) Applicable sectors

All sectors

##### c) Outline

The US government has, over decades, supported the promotion of energy efficiency through legislation, regulation and dedicated funding. Earlier emphasis, in keeping with economy-wide economic practices, has been on leveraging the market system and the self-interest of decision makers, with occasional explicit efficiency requirements in selected sectors. More recently, with greater recognition of the economic, environmental and security benefits offered by energy efficiency, there has been a series of increasingly stringent energy efficiency targets and mandates, most often expressed by sector or technology. Financial incentives and funding levels have also grown.

**d) Financial resources and budget allocation**

The 2009 Recovery Act provided:

- USD 5 billion for the Weatherization Assistance Program
- USD 3.1 billion for the State Energy Program
- USD 3.2 billion for Energy Efficiency and Conservation Block Grants
- USD 346 million for energy efficient building technologies
- USD 256 million for the Industrial Technologies Program
- USD 110 million for the Vehicle Technologies Program
- USD 300 million for an Energy Efficient Appliance Rebate Program and ENERGY STAR<sup>®</sup>.

This represents a considerable increase in funding for these programs.<sup>1</sup>

**1.3.2 The National Action Plan for Energy Efficiency****(a) Objectives**

Boost energy efficiency through actions by participating organisations to overcome barriers to energy efficiency investment

**(b) Applicable sectors**

Utilities, industry, NGOs, private and public sectors

**(c) Outline**

The National Action Plan for Energy Efficiency was issued by the electric and gas utility industry and State regulators who see the need to increase energy efficiency and have the ability to do so. This Action Plan, facilitated by technical assistance from the US Department of Energy and US Environmental Protection Agency, aims to create a sustainable, aggressive commitment to energy efficiency through gas and electric utilities, utility regulators, and partner organisations. Over 120 organisations, including leading electric and gas utilities, all three of their trade associations, many state regulators and governors, and the National Association of Regulatory Utility Commissioners have endorsed the Action Plan's five main recommendations and have pledged to take individual actions to carry them out.

The five main recommendations are:

- 1) Recognise energy efficiency (EE) as a high priority resource
- 2) Make a long-term commitment to implement cost-effective EE
- 3) Communicate benefits of EE
- 4) Fund programs to deliver EE
- 5) Align utility incentives with delivery of cost-effective EE.

**d) Financial resources and budget allocation**

Commitments by participating organisations are expressed as advocacy for priority and funding, communication/education, support for legislation, commitments to efficiency and procurement goals, and funding, among other commitments. Many of the participating organisations fund/operate energy efficiency programs within their spheres of influence.

**e) Method for monitoring and measuring effects of action plans**

Self-reporting by stakeholders

**f) Expected results**

Not quantified

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<sup>1</sup>DOE (2009).

**g) Outputs of monitoring**

Annual update describing accomplishments

**h) Outcomes**

The wide range of outcomes includes legislation, deployed efficiency, education, and increased funding

**1.3.3 Industrial Technologies Program****a) Objectives**

Reduce energy consumption per unit of output of an industrial partner by 25% over 10 years

**b) Applicable sectors**

Industry

**c) Outline**

The DOE supports the US energy goals for industry through two critical pathways: technology delivery and energy efficiency R&D. These pathways support immediate and long-term efforts to reduce industrial energy consumption. Through technology delivery, DOE helps plants save energy immediately by assessing opportunities and facilitating adoption of best energy management practices and efficient new technologies. Technology delivery activities include: energy assessments, best practices, training and qualification, energy management certification, software tools, technical publications, and deployment/demonstration. Energy efficiency R&D develops technologies addressing top energy saving opportunities in the industrial sector. R&D activities are divided between industry specific R&D and crosscutting R&D. Industries supported in the industry-specific R&D include aluminium, cement, chemicals, food processing, forest products, glass, metal casting, mining, refining, and steel. Crosscutting areas cover energy-intensive processes, nanomanufacturing, fuel and feedstock flexibility, clean distributed energy and materials R&D.

**d) Financial resources and budget allocation**

The 2009 budget allocation was USD 90 million. The Recovery Act of 2009 provided USD 256 million.

**e) Method for monitoring and measuring effects of action plans**

The DOE maintains databases of activities and results for a majority of industrial activities. Impacts are reported annually in a publication of results. Effects of the plan are analysed annually as required by the Government Performance and Results Act of 1993 (GPRA). This analysis includes a GPRA data call and DOE programmatic evaluations.

**f) Expected results**

Working with industry, DOE's Industrial Technologies Program seeks to reduce industrial energy intensity by 25% over 10 years.

**g) Responsibility for monitoring**

The Industrial Technologies Program

**h) Outputs of monitoring**

The Industrial Technologies Program releases an annual Impacts Report

**i) Outcomes**

Energy savings, reduction in industrial energy intensity, and newly commercialised

technologies<sup>2</sup>

### 1.3.4 Federal Fleet Petroleum Reduction and Alternative Fuel Use Increase

#### a) Objectives

Reduce petroleum consumed by Federal transport fleets in favour of alternative fuels and hybrid-electric vehicles

#### b) Applicable sectors

Federal transport

#### c) Outline

United States Federal agencies have requirements to decrease vehicle fleet petroleum consumption 2% annually and increase vehicle fleet alternative fuel use 10% annually through the year 2015, relative to a year 2005 baseline. Assisting in achieving these goals are mandates requiring Federal agencies to acquire alternative fuel vehicles and hybrid electric vehicles, and requirements to use alternative fuel in Federal alternative fuel vehicles when alternative fuel is available and reasonably priced.

#### d) Financial resources and budget allocation

No information available

#### e) Method for monitoring and measuring effects of action plans

Federal agency self-reporting

#### f) Expected results

20% reduction in fleet petroleum consumption, more than double the amount of alternative fuel use, and increased inventory of hybrid electric vehicles

#### g) Responsibility for monitoring

Agencies report on their own progress and the DOE monitors results

#### h) Outputs of monitoring

Annual report on Federal Fleet Compliance with EPACT and E.O. 13423

#### i) Outcomes

Targets were met, or nearly met, in 2007. Twenty-one covered Federal agencies reported progress toward petroleum reduction and alternative fuel goals.

## 1.4 Institutional Structure

### 1.4.1 Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy

#### a) Status of organisation

Implementer

#### b) Roles and responsibilities

The Office of Energy Efficiency and Renewable Energy (EERE) develops cost-effective energy efficiency and renewable energy technologies that provide a diverse supply of reliable, affordable, and environmentally sound energy for the economy. EERE achieves this goal through a strong and balanced program of research, development and market deployment. EERE is organised around the three main energy users in the renewable and energy efficiency resource and demand markets—industry, transportation, and buildings.

The *Industrial Technologies Program* reduces the energy intensity of the US industrial sector

<sup>2</sup> OMB (2009).

through a coordinated program of research and development and deployment activities. The Program collaborates with industry (e.g., energy-intensive industries such as forest and paper products, steel, aluminium, metal casting, and chemicals) on R&D to improve the energy efficiency and productivity of industrial processes.

The *Vehicle Technologies Program* supports R&D in vehicle systems, hybrid electric systems, hybrid and electric propulsion, advanced combustion engines, advanced materials technologies, and fuels technology. Focus areas for technology deployment include: alternative fuel vehicles, alternative fuel infrastructure development, idling reduction for commercial trucks and buses, expanded use of non-petroleum and renewable fuel blends, hybrid vehicles, driving practices for improved efficiency, and engine/vehicle technologies that maximise fuel economy.

The *Building Technologies Program* develops technologies, techniques and tools for making residential and commercial buildings more energy efficient, productive, and affordable. The portfolio of activities includes efforts to improve the energy efficiency of building components and equipment and their effective integration using whole building system design techniques, the development of building codes and equipment standards, the integration of renewable energy systems into building design and operation, and the accelerated adoption of these technologies and practices.

The *Federal Energy Management Program* works with Federal agencies and private sector partners to help agencies realise energy, environmental and cost savings potentials, including Federal energy intensity goals, as set by Presidential Executive Orders or Congressional legislation.

**c) Covered sectors**

Residential, commercial, industry, transport, power, and public sectors

**d) Established date**

Department of Energy Organization Act (1974)

**e) Number of staff members**

Approximately 430 (in Washington D.C. and Golden, Colorado)

**1.4.2 Environmental Protection Agency**

**a) Status of organisation**

Regulator, implementer

**b) Roles and responsibilities**

The EPA mission is to protect human health and the environment by developing and enforcing regulation, giving grants, studying environmental issues, sponsoring partnerships, and informing people about the environment. Efforts in support of energy efficiency include Clean Energy programs, Energy Star (with DOE), the Responsible Appliance Disposal program, the Electronic Product Environmental Assessment tool, and activities to improve energy efficiency at water utilities.

**c) Covered sectors**

Residential, commercial, industry, transport, and public sectors

**d) Established date**

1970

**e) Number of staff members**

Estimated dozens of people spread across clean energy and other EPA programs

### 1.4.3 Regional Organisations

State and local governments and utility regulators have introduced energy efficiency policy measures that address all sectors. These measures include minimum performance standards (that is, building codes) and a variety of financial incentives.

## 1.5 Information Dissemination, Awareness-Raising and Capacity-Building

### a) Information collection and dissemination

*Energy Information Administration:* The Energy Information Administration collects and interprets data on energy production, trade, transformation, and consumption. This includes collection of energy use data for many industrial sectors and for residential and commercial buildings.<sup>3</sup>

*Database of State Incentives for Renewables & Efficiency (DSIRE):* DSIRE is a comprehensive source of information on state, local, utility, and Federal incentives that promote renewable energy and energy efficiency. The DSIRE website ([www.dsireusa.org](http://www.dsireusa.org)) provides Federal, state, local governments, and the public with a fast and convenient method for accessing information about renewable energy and energy efficiency incentives and regulatory policies administered by Federal and state agencies, utilities, and local organisations across the economy.

*www.EnergySavingTips.gov:* In December 2004, DOE launched a new website ([www.EnergySavingTips.gov](http://www.EnergySavingTips.gov)) as a consumer-friendly portal to detailed energy saving information from various Federal agencies.

### b) Awareness-raising

*Powerful Savings Campaign:* In May 2004, DOE and the Alliance to Save Energy teamed up on a Powerful Savings campaign to help consumers reduce their energy bills and the economy reduce its energy use through smart energy practices and energy-efficiency. Powerful Savings focuses on increasing public awareness of the importance of energy efficiency and on smart energy practices both at home and on the road through an extensive media outreach campaign.

*“Easy Ways to Save Energy”:* This campaign promotes energy savings through an “Energy Savers Guide.” The Guide is being distributed to consumers across the economy. Aggressive radio and print advertisements to promote more efficient energy use are also under way.

*Public Energy Education Program:* The EPACT 2005 states that DOE is required to convene a conference with representatives from industry, education, professional societies, trade associations, and government agencies to design and establish an ongoing economy-wide public education program focused on energy efficiency and other topics. The Office of Science held this conference in January 2007.

*Energy Efficiency Public Information Initiative:* DOE is required to conduct an advertising and public outreach program about the need to reduce energy use, the consumer benefits of reduced use, the relationship to jobs and economic growth, and cost-effective consumer measures to reduce energy use. Funding at US D90 million per year is authorised for FY2006 to FY2010. DOE is implementing this provision within the limits of annual Congressional appropriations.

Many more information programs are operated by state and local governments and utilities.

### c) Capacity-building

*Advanced Technology Transfer Centers:* The Energy Policy Act of 2005 directs DOE to provide grants to non-profit institutions, state and local governments, or universities to establish a geographically dispersed network of Advanced Energy Technology Transfer

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<sup>3</sup>EIA (2009).

Centers. DOE has so far funded pilot projects at the Florida Solar Energy Center and Washington State University. The centres are to encourage the demonstration and commercial application of advanced energy methods and technology through education and outreach to building and industry professionals. The Recovery Act of 2009 has allocated USD 500 million for energy efficiency and renewable energy workforce investment programs.

*Industrial Energy Management:* Industrial energy management is encouraged through information and training offered by many Federal, state and utility voluntary programs. The Department of Energy's Industrial Technologies Program and the Environmental Protection Agencies Energy Star Program are two key Federal resources for information and training on industrial energy management.<sup>4</sup>

*Small Businesses:* The US Environmental Protection Agency's Energy Star program provides education and technical resources to help small businesses improve energy efficiency. In addition, many state and local programs provide technical assistance as well as access to funding for implementing energy efficiency measures.<sup>5</sup>

## 1.6 Research and Development in Energy Efficiency and Conservation

### 1.6.1 Research and Development on Building System Components

The goal of this program is to develop a range of technologies to reduce energy use in buildings and eventually make possible the construction of zero-energy buildings. The 2009 budget allocation for the Building Program was USD 140 million, of which about 28% was devoted to R&D. The Recovery Act provides USD 346 million for the Building Technologies Program.

Research on the building envelope focuses on systems that determine or control the flow of heat, air, moisture, and light in and out of a building; and on materials that can affect energy use. Goals include market-viable windows with R5 insulation performance by 2010, advanced systems capable of net-zero energy use by 2025, and eventual reduction in average thermal load of 30% for existing residential buildings and 66% for new buildings.

Research on building equipment focuses on means to significantly improve the efficiency of heating, cooling, ventilating, thermal distribution, lighting, home appliances, and on-site energy use. This area also includes advanced refrigerants and cycles, solid-state lighting, smart sensors and controls, microturbines, and heat recovery. A research goal is to develop solid state lighting equipment, which provides 79 lumens per watt in general applications by 2008 and 200 lumens per watt in laboratory devices by 2025.

Development of analysis and design tools emphasises areas, such as performance simulation software, and design tools for building technology professionals. Home performance programs for builders and home buyers/owners have also been supported.

R&D on solid state lighting aims to demonstrate energy-efficient, high-quality, long-lasting lighting technologies by 2025 that can illuminate buildings with half as much electricity as in 2005. More about DOE's comprehensive SSL program is available at [www.netl.doe.gov/ssl/](http://www.netl.doe.gov/ssl/).

### 1.6.2 Industrial Sector Energy Efficiency Research and Development

The overall goal of the Industrial Technologies Program is to contribute to a 20% reduction in the energy intensity (energy per unit of industrial output, as compared to 2002) of energy-intensive industries by 2020. The appropriation for fiscal year 2009 was USD 90 million, of which approximately 18% was allocated to research and development. The Recovery Act provides the USD 256 million Industrial Technologies Program.

Research on *energy conversion and utilisation* focuses on a diverse range of advanced and integrated systems. These include advanced combustion technologies, gasification

<sup>4</sup>DOE (2009b) and EPA and DOE (n.d. - a).

<sup>5</sup>DOE and EPA (n.d. - b).

technologies, high-efficiency burners and boilers, thermoelectric technologies to produce electricity using industrial waste heat streams, co-firing with low-GHG fuels, advanced waste heat recovery heat exchangers, and heat integrated furnace designs. Integrated approaches include combined-cycle power generation, and cogeneration of power and process heat or cooling.

Research on specific, *energy-intensive and high-CO<sub>2</sub>-emitting industrial processes* focuses on identifying and removing process inefficiencies, lowering energy requirements for heat and power, and reducing CO<sub>2</sub> emissions. One process under development is a means to produce high-quality iron without the use of metallurgical coke, which is a significant source of CO<sub>2</sub> emissions in steelmaking. Other research concerns processes that may improve product yield, including oxidation catalysis, advanced processes, and alternative processes that take a completely different route to the same end product, such as use of non-carbon inert anodes in aluminium production.

Research on *resource recovery and utilisation* focuses on separating, capturing, and reprocessing materials for feedstock. Recovery technologies include materials designed for recyclability, advanced separations, new and improved process chemistries, and sensors and controls. Reuse technologies include recycling, closed-loop process and plant designs, catalysts for conversion to suitable feedstock, and post-consumer processing. Research in this area aims to improve recycling and recovery efficiencies. For example, in the chemicals industry the goal is to improve recyclability of materials by as much as 30%. Research also aims at new and improved processes to use wastes or by-products; improve separations to capture and recycle materials, by-products, solvents, and process water; and identify new markets for recovered materials, including ash and other residuals such as scrubber sludges.

### 1.6.3 Research and Development in Transport Sector Energy Efficiency

The overall goal of the Vehicle Technologies Program is to develop and deploy vehicle technologies that will reduce petroleum consumption by increasing efficiency or switching to alternative fuels. The 2009 budget allocation for the program was USD 273 million, of which approximately 54% was allocated to research and development. The Recovery Act provides USD 110 million for the Vehicle Technologies Program.

Research on *light vehicles*, organised primarily in support of the FreedomCAR and Fuel Partnership, focuses on materials; power electronics; hybrid vehicles operating on gasoline, diesel, or alternative fuels; high-efficiency, low-emission advanced combustion engines, enabled by improved fuels; and high-volume, cost-effective production of lightweight materials. Beginning in Fiscal 2007, the Department of Energy is increasing the funding for advanced batteries, power electronics, and systems analyses specifically needed to accelerate the introduction of “plug-in” hybrid vehicles.

The vehicle technologies research programs have a number of specific goals:

- 1) Electric propulsion systems with a 15-year life capable of delivering at least 55 kW for 18 seconds and 30 kW continuous at a system cost of USD 12/kW peak
- 2) Internal combustion engine powertrain systems costing USD 30/kW, having peak brake engine efficiency of 45%, and that meet or exceed emissions standards
- 3) Electric drivetrain energy storage with a 15-year life at 300 Wh with discharge power of 25 kW for 18 seconds and USD 20/kW
- 4) Material and manufacturing technologies for high-volume production vehicles, which enable/support the simultaneous attainment of 50% reduction in the weight of vehicle structure and subsystems, affordability, and increased use of recyclable/renewable materials
- 5) Internal combustion engine powertrain systems, operating on hydrogen with a cost target of USD45/kW by 2010 and USD30/kW in 2015, having a peak brake engine efficiency of 45%, and that meet or exceed emissions standards.

Research areas for *heavy vehicles*, organised primarily under the 21st Century Truck Partnership, include lightweight materials, aerodynamic drag, tire rolling resistance, electrification of ancillary equipment, advanced high-efficiency combustion propulsion systems (including energy-efficient emissions reduction), fuel options (both petroleum- and non-petroleum based), hybrid technologies for urban driving applications, and onboard power units for auxiliary power needs.

The research objectives are to:

- 1) Reduce energy consumption in long haul operations
- 2) Increase efficiency and reduce emissions during stop-and-go operations
- 3) Develop more efficient and less-polluting energy sources to meet truck stationary power requirements (i.e., anti-idling).

By 2010, the goals include a laboratory demonstration of an emissions-compliant engine system that is commercially viable for Class 7-8 highway trucks, and an engine that improves the system efficiency to 53% by 2010 and to 55% by 2013, from the 2002 baseline of 40%. By 2012, the goals include advanced technology concepts that reduce the aerodynamic drag of a Class 8 tractor-trailer combination by 20%.

Research on aviation fuel efficiency includes engine and airframe design improvements. Aviation fuel efficiency goals include new technologies with the potential to reduce CO<sub>2</sub> emissions from future aircraft by 25% within 10 years and by 50% within 25 years.

#### **1.6.4 Electric Power Sector Energy Efficiency Technology Research and Development**

The Office of Electric Delivery & Energy Reliability supports the development of technologies to modernise the electric grid. Some of these technologies will have important benefits for energy efficiency. The total 2009 budget allocation for this office was approximately USD 100 million. The Recovery Act provided USD 4.5 billion to the Office of Electric Delivery & Energy Reliability.

Research on *high-temperature superconductivity* (HTS) is focused on improving the current carrying capability of long-distance cables; its manufacturability; and cost-effective ways to use the cable in equipment such as motors, transformers, and compensators. Research goals include HTS wires with 100 times the capacity of conventional copper/aluminium wires. The program aims to develop and demonstrate a diverse portfolio of electric equipment based on HTS, with half the energy losses and half the size of conventional equipment with the same rating.

Research on *transmission and distribution technologies* is focused on real-time information and control technologies; and systems that increase transmission capability, allow economic and efficient electricity markets, and improve grid reliability. Examples include high-strength composite overhead conductors, grid-status measurement systems that improve reliability by giving early warning of unstable conditions over major geographic regions, and technologies and regulations that enable the customer to participate more in electric markets through a demand response. Research program goals in this area include, by 2010, demonstrated reliability of energy-storage systems; reduced cost of advanced conductors systems by 30%; and operation of a prototype smart, switchable grid in a region within the United States transmission grid.

Research on *energy storage* is focused in two general areas. One goal is storage technologies that reduce power-quality disturbances and peak electricity demand, and improve system flexibility to reduce adverse effects to industrial and other users. A second goal is to improve electrical energy storage for stationary (utility, customer-side, and renewable) applications. Research focuses on storage technologies with high reliability and affordable cost.

## 2. MEASURES FOR ENERGY EFFICIENCY IMPROVEMENTS

### 2.1. Government Laws, Decrees, Acts

#### a) Name

There have been many laws, decrees and acts including provisions intended to achieve energy efficiency improvements enacted at Federal, state and local levels. Some of the most important examples at the Federal level include US Code Title 42, Chapter 77; Code of Federal Regulations (CFR) Title 10, Chapter II; Energy Policy Act of 2005 (EPAAct 2005); Executive Order 13423; and the Energy Independence and Security Act of 2007 (EISA). The American Recovery and Reinvestment Act of 2009 has also directed substantial energy efficiency investments.

#### b) Purpose

Promote energy efficiency in all sectors of the economy

#### c) Applicable sectors

Residential, commercial, industry, agriculture, power, and public sectors

### 2.2. Regulatory Measures

#### 2.2.1. Minimum Energy Performance Standards (MEPS) and Labelling

#### a) Name

- Appliances and Commercial Equipment Standards (many standards were added or revised by the Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007)
- Energy Star Labels.

#### b) Purpose

Improve the energy efficiency of appliances and equipment

#### c) Applicable sectors

Residential, commercial, industry, and public sectors

#### d) Outline

The DOE *Appliance Standards* program develops, promulgates, and enforces test procedures and energy conservation standards for residential appliances and certain commercial equipment. DOE has energy efficiency standards in place for most major types of energy-using appliances, including air conditioners, clothes washers and dryers, space and water heaters, kitchen ranges and ovens, refrigerators and freezers, and lighting. Section 135 of EPAAct 2005 establishes new or revised energy conservation standards for a number of products as follows:

- *Residential*: ceiling fans, compact fluorescent lighting fixtures (medium base), dehumidifiers, torchiere lighting fixtures
- *Commercial*: commercial refrigerators and freezers, commercial package air conditioning and heating equipment, fan-type unit heaters, coin-operated clothes washers, low-voltage dry-type distribution transformers, illuminated exit signs, traffic signal indicator light modules, pedestrian signals, automatic ice makers, commercial ice cream freezers, mercury vapour light ballasts, tubular fluorescent lamp ballasts (34, 60, 95 watts), pre-rinse spray valves, air flow through duct work, refrigerated beverage vending machines, determination of standards for battery chargers and external power supplies.

The Energy Independence and Security Act of 2007 (EISA) set standards for certain consumer and industrial products and requires new or revised standards for others. EISA sets

incandescent lighting standards that will cut energy consumption 30% by 2014 and substantially more by 2020. These standards will encourage but not require the use of compact fluorescent bulbs and advanced solid state lighting technologies. Other related provisions of EISA include:

- Statutory efficiency standards for external power supplies (0.5 watts for units up to 250 watts), residential boilers, dehumidifiers, electric motors, and walk-in coolers
- Requirement for electric motors to meet efficiency levels specified by the National Electrical Manufacturers Association (these were previously voluntary)
- Water use standards for clothes washers and dishwashers
- Authority to set regional standards for home heating and cooling equipment
- Mandates to develop standards for furnace fans, refrigerators, and standby power
- Requirements for periodic updating of all standards and test procedures labelling of electronic products.

EISA also outlines a rigorous lighting efficiency program, which mandates increases in the energy efficiency of light bulbs by 30%. This will effectively phase out most common types of incandescent light bulbs by 2014. EISA mandates revised lighting efficiency standards effective in 2020 which could be met by compact fluorescents, LED or other energy efficient bulbs. EISA sets efficiency standards for metal halide lamps and requires amended standards in 2012 and 2019. DOE is progressing on rule-making to update and expand the scope of energy efficiency standards for fluorescent lamps and ballasts, and incandescent reflector lamps.

The Energy Security and Independence Act of 2007 requires that test procedures for covered consumer products be amended to include standby mode and off mode energy consumption, taking into consideration the most current versions of Standards 62301 and 62087 of the International Electrotechnical Commission. EISA mandates that any final rule establishing or revising a standard for a covered consumer product, adopted after 1 July 2010, incorporate standby mode and off mode energy use. DOE is revising test procedures for battery chargers and external power supplies and developing an efficiency standard to address standby energy use. With accurate measurement of standby power needs included in testing to meet appliance standards, as well as with standards for external power supplies, typical appliances will use less standby power. The Federal government is required to buy devices that use less than 1 watt of standby power. Some states have implemented standby limits on certain consumer electronics products.

The *Energy Star*® labelling program is designed to clearly signal high efficiency in buildings and products to consumers and businesses. Over 50 types of products can now earn the label. The US Environmental Protection Agency (EPA) manages the labelling of buildings, new homes, office equipment, home electronics, and residential heating, ventilation and air conditioning (HVAC). The US DOE manages the labelling for a variety of residential products, including appliances, compact fluorescent lamps (CFL), solid state lighting, windows, and residential water heaters.

### 2.2.2. Building Energy Codes

#### a) Name

Energy Efficiency Standards for Buildings

#### b) Purpose

Reduce energy used in the heating, cooling and ventilation of buildings

#### c) Applicable sectors

Residential and commercial

**d) Outline**

The United States has developed energy efficiency standards for new buildings since 1975, with the first codification of those standards taking place in 1977. Adoption and enforcement of these codes and standards is the responsibility of the states, with the US DOE playing a major support role in the development of new economy-wide model codes. According to the Database of State Incentives for Renewables & Efficiency, all 50 states and the District of Columbia have building energy codes. In 2007, DOE undertook to support a 30% improvement in ASHRAE/IESNA Standard 90.1 for the year 2010 (relative to Standard 90.1-2004). Standard 90.1 is the primary reference for economy-wide model commercial codes. In 2008, DOE provided support to a 30% improvement in the economy-wide model residential code.

**e) Financial resources and budget allocation**

At the Federal level, about USD 4 million was allocated in 2008. Additional budget is allocated at the state level.

**f) Expected results**

Many new residential and commercial buildings will use 30% less energy in 2010 than in 2007 due to widespread state compliance with model buildings codes developed.

**2.2.3. Fuel Efficiency Standards****a) Name**

Corporate Average Fuel Economy (CAFE) Standards for Light Vehicles

**b) Purpose**

Improve the fuel economy of light vehicles

**c) Applicable sectors**

Transport

**d) Outline**

The Energy Independence and Security Act of 2007 (EISA) mandates a corporate average fuel economy standard of 35 miles per gallon for new light vehicles (cars and light trucks (vans, SUVs, and pickups)) throughout the United States by 2020. On 19 May 2009, President Obama greatly accelerated the vehicle efficiency improvement by introducing a policy aimed at both increasing fuel economy and reducing greenhouse gas pollution. The new standards, covering model years 2012-16, require an average fuel economy standard of 35.5 miles per gallon in 2016. They are projected to save 1.8 billion barrels of oil over the life of the program, with a fuel economy gain averaging more than 5% per year and a reduction of approximately 900 million tonnes in greenhouse gas emissions.

Early in 2009, the Department of Transportation issued updated fuel economy standards for new vehicles produced in Model Year 2011. Updated standards for future model years are expected to be finalised during 2010.

The United States has also greatly expanded support for development and manufacture of more fuel-efficient vehicles. Loan guarantee authority funded in 2008 and the economic stimulus program enacted in 2009 have expanded support for the retooling of auto manufacturing plants to increase fuel efficiency, the manufacture of advanced batteries, and purchase of plug-in hybrid vehicles. This support is in the form of expanded R&D, loan guarantees, direct financial assistance, and tax incentives.

**e) Financial resources and budget allocation**

Information not available

**f) Expected results**

Fuel economy for new cars and light trucks will gradually increase to 35 miles per gallon by 2020. Then, as the vehicle stock turns over, the overall vehicle stock will approach this level of efficiency by 2040.

**2.3. Voluntary Measures****2.3.1. Climate VISION-Voluntary Innovative Sector Initiatives****a) Purpose**

Reduce energy intensity and greenhouse gas intensity of industrial output

**b) Applicable sectors**

Industry

**c) Outline**

Climate VISION works with its partners to standardise measuring and monitoring, find cost-effective solutions to reduce energy use and GHG emissions, accelerate R&D, and explore cross-sector efficiency gains to reduce emissions. Partners represent a broad range of industrial sectors: oil and gas production, transportation, and refining; electricity generation; coal and mineral production and mining; manufacturing; railroads; and forestry products.

**2.3.2. Commercial Lighting Initiative****a) Purpose**

Reduce energy use for commercial lighting

**b) Applicable sectors**

Commercial

**c) Outline**

This initiative works to reduce energy use for lighting in stores, offices, hospitals, and other commercial buildings to 30% below the prevailing US commercial buildings energy standard, the ASHRAE/IESNA Standard 90.1-2004, using voluntary market pull strategies.

**2.4. Financial Measures Taken by the Government****2.4.1. Tax Schemes**

*Federal Tax Credits for Energy Efficiency: Home Improvements*

**a) Level**

Federal

**b) Purpose**

Promote energy efficiency in existing residential buildings

**c) Applicable sectors**

Residential

**d) Outline**

Individuals can get an income tax credit for 30% of the cost of energy efficiency measures.

**e) Financial resources and budget allocation**

Given there are about 100 000 000 households in the United States, this credit represents a potential investment in the order of USD 150 billion dollars for as much as USD 450 billion in efficiency improvements. Clearly the actual uptake will be some fraction of this potential.

**f) Expected results**

Improved residential uptake of energy efficiency measures

**g) Description**

Home improvement tax credits are now available for home improvements “placed in service” from 1 January 2009 through 31 December 2010. Any qualified home improvements made in 2008 are not eligible for the tax credit. The maximum lifetime amount that a taxpayer may claim is USD 1500.

*Tax Credit for Manufacturers of Energy-Efficient Appliances***a) Level**

Federal

**b) Purpose**

Promote the production of energy-efficient appliances

**c) Applicable sectors**

Commercial

**d) Outline**

Tax credits for manufacturers of high-efficiency residential clothes washers, refrigerators, and dishwashers

**e) Financial resources and budget allocation**

Information not available

**f) Expected results**

Increased domestic manufacturing of energy efficiency appliances

**g) Description**

The credits are in the form of a tax credit for increases in unit production of efficient appliances over a two-year baseline. The amount of the credit is tied to specified efficiency ratings, and varies according to appliance and the level of achieved efficiency. The appliances must be produced in the United States.

*Federal Tax Credits for Energy Efficiency: Vehicle Fuel Efficiency***a) Level**

Federal

**b) Purpose**

Encourage market penetration of fuel-efficient hybrid electric vehicles

**c) Applicable sectors**

Residential and commercial transport

**d) Outline**

Credits are available for hybrid vehicles placed in service after 31 December 2006 and purchased on or before 31 December 2010. A similar credit is also available for plug-in hybrid, all-electric, and diesel vehicles.

**e) Financial resources and budget allocation**

The net US investment depends on consumer uptake of the certified vehicles.

**f) Expected results**

Increased consumer uptake of the certified vehicles, reducing fuel consumption and associated emissions

**g) Description**

Private or commercial purchasers of certified vehicles receive a USD 250-USD 3400 tax credit for certified vehicles. For the case of hybrid-electric vehicles, the tax credit for a given manufacturer is phased out after the first 60 000 certified vehicles are sold. For plug-in hybrid-electric vehicles, the tax credits are: PHEV10 (vehicles with a range of 10 miles): USD 2500, PHEV20 (20 miles): USD 4000, PHEV30: USD 5000, PHEV40: USD 5000. In this case the tax credit for a given manufacturer is to be phased out after 200 000 vehicles are sold.

*Federal Tax Credits for Energy Efficiency: Fuel Cells***a) Level**

Federal

**b) Purpose**

Promote the use of energy-efficient fuel cells for stationary applications

**c) Applicable sectors**

Residential

**d) Outline**

Credits are available for residential fuel cells and micro turbine systems.

**e) Financial resources and budget allocation**

Information not available

**f) Expected results**

Increased installation of fuel cell/microturbine systems

**g) Description**

There is a residential consumer tax credit of up to 30% of the cost (up to USD 1500 per 0.5 kW of capacity maximum) for installing a qualified fuel cell and microturbine system. The system must have an efficiency of at least 30% and a capacity of at least 0.5 kW. The credits are available for systems placed in service from 1 January 2006 through 31 December 2016. This credit is not limited to the USD 1500 home improvement cap.

**2.4.2. Low-Interest Loans***Qualified Energy Conservation Bonds***a) Level**

Federal

**b) Purpose**

Accelerate the deployment of energy efficiency improvements

**c) Applicable sectors**

State, local, and tribal governments

**d) Outline**

For qualified projects, which include certain energy efficiency improvements, the borrower pays back the principal of the bond, and the bondholder receives Federal tax credits instead of bond interest.

**e) Financial resources and budget allocation**

The tax credit bond limit in the original October 2008 legislation was USD 800 million but was increased in the ARRA 09 to USD 3.2 billion.

**f) Expected results**

Larger-scale adoption of energy efficiency measures

*DOE Loan Guarantee Program***a) Level**

Federal

**b) Purpose**

Accelerate the deployment of energy efficiency improvements, including efficient windows, lighting, and roofs

**c) Applicable sectors**

Commercial, industry, state and local government, agriculture, others

**d) Outline**

The loans, available to non-Federal entities, must be repaid by the lesser of 30 years or 90% of the projected useful life of the physical asset.

**e) Financial resources and budget allocation**

As extended under ARRA, up to USD 6 billion may be allocated through September 2011.

**f) Expected results**

Larger-scale adoption of energy efficiency measures

*Energy Efficient Mortgages***a) Level**

Federal

**b) Purpose**

Help homebuyers or homeowners save money on energy bills by enabling them to finance the cost of adding energy-efficiency features to new or existing housing as part of their home purchase or refinancing mortgage.

**c) Applicable sectors**

Residential

**d) Outline**

Cost-effective energy saving measures may be financed as part of the mortgage. A buyer's debt-to-income ratio on the loan for an energy efficient home could be stretched, so that a larger percentage of the borrower's monthly income can be applied to the monthly mortgage payment. All homes built to the Council of American Building Officials Model Energy Code (MEC) can qualify for an Energy Efficient Mortgage.

**e) Financial resources and budget allocation**

Maximum loan amounts vary by originator, but may be expressed in terms of a maximum dollar amount or as a percentage of the home's appraised value.

**f) Expected results**

Larger-scale adoption of energy efficient technologies

*State and Utility Based Loan Programs***a) Level**

State and local government, utilities

**b) Purpose**

Promote adoption of energy efficient technologies

**c) Applicable sectors**

Residential, commercial, non-profit, state/local government

**d) Outline**

More than 200 state and utility programs are identified at the DSIRE website [www.dsireusa.org/summarytables/FinEE.cfm?&CurrentPageID=7&EE=1&RE=1](http://www.dsireusa.org/summarytables/FinEE.cfm?&CurrentPageID=7&EE=1&RE=1).

**e) Financial resources and budget allocation**

Varies

**f) Expected results**

Wider adoption of qualifying energy efficiency measures

**2.4.3. Subsidies and Budgetary Measures***Weatherization Assistance Program***a) Level**

Federal

**b) Purpose**

Improve the energy efficiency of homes inhabited by low-income families

**c) Applicable sectors**

Residential

**d) Outline**

The program provides cost-effective energy efficiency improvements to low-income households through the weatherisation of homes. It thereby helps low-income families to permanently reduce their energy bills. DOE's weatherisation program performs energy audits to identify the most cost-effective measures for each home, which typically includes adding insulation, reducing air infiltration, servicing heating and cooling systems, and providing health and safety diagnostic services. Priority is given to the elderly, persons with disabilities, families with children, and households that spend a disproportionate amount of their income on energy bills (utility bills make up 15% to 20 % of household expenses for low income families, compared to 5% or less for all other Americans).

**e) Financial resources and budget allocation**

A major expansion of the program is funded by the economic stimulus bill passed in February 2009. The bill includes USD 6.2 billion for weatherisation efforts.

**f) Expected results**

Some 6.2 million homes have been weatherised since the program began in 1974. Over 1.2 million more homes should be weatherised during 2009 and 2010 in view of the maximum expenditure per home of USD 5000.

*Numerous economy-wide, state and local energy efficiency subsidies*

**a) Level**

Federal, state and local governments, local utilities

**b) Purpose**

Improve the energy efficiency of residences and commercial buildings

**c) Applicable sectors**

Residential, commercial, industry, and agriculture

**d) Outline**

Numerous subsidies are available to assist private citizens and business owners in obtaining energy efficiency audits and perform efficiency improvements. See the summary information at [www.dsireusa.org](http://www.dsireusa.org).

**e) Financial resources and budget allocation**

Varies

**f) Expected results**

Improved energy efficiency in applicable sectors

*Energy Savings Performance Contracts*

**a) Level**

Federal

**b) Purpose**

Facilitate financing of energy efficiency improvements by Federal government agencies

**c) Applicable sectors**

Public sector

**d) Outline**

Energy Savings Performance Contracts (ESPCs) are a contracting vehicle that allows agencies to accomplish energy efficiency projects for their facilities without up-front capital costs and without Congressional appropriations. An ESPC project is a partnership between the customer and an energy services company (ESCO). The ESCO conducts a comprehensive energy audit and identifies improvements that will save energy at the facility. In consultation with the agency customer, the ESCO designs and constructs a project that meets the agency's needs and arranges financing to pay for it. The ESCO guarantees that the improvements will generate savings sufficient to pay for the project over the term of the contract. After the contract ends, all additional cost savings accrue to the agency. Contract terms up to 25 years are allowed. Federal agencies structure ESPCs so that financial savings cover costs of their investments.

**e) Financial resources and budget allocation**

Since the program inception in 1998, there has been about USD 2.3 billion in private sector investment in Federal sector energy efficiency improvements, resulting in about USD 1.4

billion in net cost savings to the government.

**f) Expected results**

The current ESPC contract permits contractor payment of up to USD 5 billion. Contracts with 16 private companies were awarded.

*Utility Energy Service Contracts*

**a) Level**

Federal

**b) Purpose**

Facilitate financing of energy efficiency improvements by Federal government agencies

**c) Applicable sectors**

Public sector

**d) Outline**

Utility arranges financing to cover the capital costs of an efficiency project; the costs are paid back by efficiency savings achieved by the installed measures.

**e) Financial resources and budget allocation**

More than 45 electric and gas utilities have provided project financing for energy and water efficiency upgrades at Federal facilities, investing more than USD 600 million through utility energy services contracts since 1995.

**f) Expected results**

The Edison Electric Institute has committed to encouraging USD 2 billion in private investment by 2010.

**2.5. Energy Pricing**

The pricing mechanism is generally market based. However, particularly in the electric power sector, there is a significant regulated element in the price for many customers. Most of the wholesale electricity business is based on competitive supply to various utilities. But only about half the states offer retail choice of suppliers to small customers. The transmission and distribution component of price is generally regulated by states on a cost-of-service model. There are also a variety of taxes and fees which are levied, for example highway tolls and gasoline taxes on automobiles, which affect market prices and vary considerably from state to state within the United States.

Demand for energy fluctuates with price but is rather inelastic, particularly in transport and residential buildings. As a result, policies to improve automotive fuel efficiency have focused on regulating the fuel economy of new vehicles, and policies to reduce energy use in buildings have focused on efficiency standards and labels.

**2.6. Other efforts for energy efficiency improvements**

**2.6.1. Cooperation with non-government organisations**

Many NGOs are prominent in promoting energy efficiency in the United States. Examples include Alliance to Save Energy; American Council for an Energy Efficient Economy; American Society for Heating, Refrigeration and Air Conditioning Engineering; Northwest Energy Efficiency Alliance; Precourt Institute for Energy Efficiency; Resources for the Future; Rocky Mountain Institute; and various trade associations.

### 2.6.2. Cooperation through bilateral, regional and multilateral schemes

The United States cooperates extensively with other economies to develop energy efficiency standards, and on developing and deploying energy efficient technologies and processes. US agencies including DOE, EPA, and AID maintain relevant cooperative efforts with numerous economies and organisations involving work on all continents. For example, the United States participates in IEA Implementing Agreements on Buildings and Community Systems, Demand Side Management, District Heating and Cooling, Energy Storage, Heat Pumps, Combustion, Superconductivity, Fuel Cells, Hybrid and Electric Vehicles, and Advanced Motor Fuels. The United States participates in APEC, United Nations programs, and the Asia Pacific Partnership on Clean Development and Climate (APP). The United States is also actively engaged in efforts to launch the International Partnership for Energy Efficiency Cooperation (IPEEC) which will help economies to share best practices in implementing energy efficiency technologies and monitoring progress toward their energy efficiency goals.

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