7. ENERGY EFFICIENCY

Key data (2013 estimated)

Energy supply per capita: 6.9 toe (IEA average: 4.5 toe), -11.3% since 2003

Energy intensity: 0.15 toe per USD 1 000 GDP PPP (IEA average: 0.13 toe per USD 1 000 GDP PPP), -18.6% since 2003

TFC (2012): 1 432.7 Mtoe (oil 50.2%, electricity 22.4%, natural gas 20.7%, biofuels and waste 4.6%, coal 1.5%, heat 0.5%, solar 0.1%), -5.9% since 2002

TFC by sector: transport 41.7%, industry 24.6%, residential 17.7%, commercial and other services 15.9%

OVERVIEW

The United States remains an energy-intensive economy relative to other IEA countries in terms of both GDP and per capita income, owing to its large transport sector (41.7% of total final consumption [TFC]) and its relatively high living standards. TFC has fallen by 8.8% since 2007, mostly as a result of the economic slowdown, but also through the steady diffusion of energy efficiency policies. An important trend for consumers has been the fall in household expenditure on energy consumption. Consumers spent almost 20% less on energy in 2011 than in 2000, a trend that is likely to continue as gas prices remain low and the impacts of energy efficiency policies grow.

Investment in energy efficiency measures by manufacturers, builders and consumers is strongly influenced by policies at both federal and state levels. These policies drive energy efficiency investments in two ways: by compelling spending in order to comply with regulatory requirements (e.g. energy performance standards for buildings and appliances, energy efficiency resource procurement standards for utilities), and by stimulating spending through economic and fiscal policies (e.g. stimulus spending, tax incentives).

The United States has made significant improvements in energy efficiency policies since the last in-depth review, notably in the areas of vehicle fuel economy and appliance standards, but also in state-level energy efficiency resources standards. These policies are projected to more than treble the estimated 2011 annual site energy savings by 2020 (Table 7.1). Primary energy savings from these policies would be considerably higher but are not estimated here.

FINAL CONSUMPTION OF ENERGY

United States' TFC was 1 432.7 Mtoe in 2012. This level of consumption was 5.9% lower in 2012 than in 2002. The most significant decline was during 2008 and 2009 when TFC fell by 3% and 5.4%, respectively. The transport sector is the largest energy consumer, accounting for 41.7% of TFC in 2012. Around 93% of transportation is fuelled by oil products, with the remainder from biofuels and waste (4.3%), natural gas (2.9%) and electricity (0.1%). The use of biofuels in transport has increased sixfold compared to 2002, while the use of oil products has declined by 4.1% over the same period. Overall energy consumption in transport has remained unchanged compared to 2002.

Industry consumed 352.7 Mtoe in 2012, accounting for 24.6% of TFC. Compared to 2002, consumption in this sector has declined by 18.4%, with its share of TFC falling from 28.4%. The largest drop was during 2009 and 2012, as consumption fell by 11% in each year. Industry energy use is dominated by natural gas (32.7%), oil (31.5%) and electricity (20.6%). Over the past decade, oil demand by the industrial sector has experienced the strongest decline, with the share of oil falling from 39.1% in 2002. Conversely, natural gas and electricity shares have increased from 29.6% and 17.4%, respectively.

The share of residential and commercial sectors in TFC was 17.7% and 15.9% in 2012, respectively. Energy consumption in these sectors has declined only marginally compared to 2002, down by 2.9% in the residential sector and by 1.2% in the commercial and public services sector (including agriculture). Electricity accounts for half the energy used in the two sectors together, followed by natural gas (33.9%) and oil (11.4%). Demand for coal, oil and natural gas in these sectors has experienced the strongest decline, while the use of electricity, heat, biofuels and waste, and solar power has grown.

Table 7.1 Energy efficiency policies and results

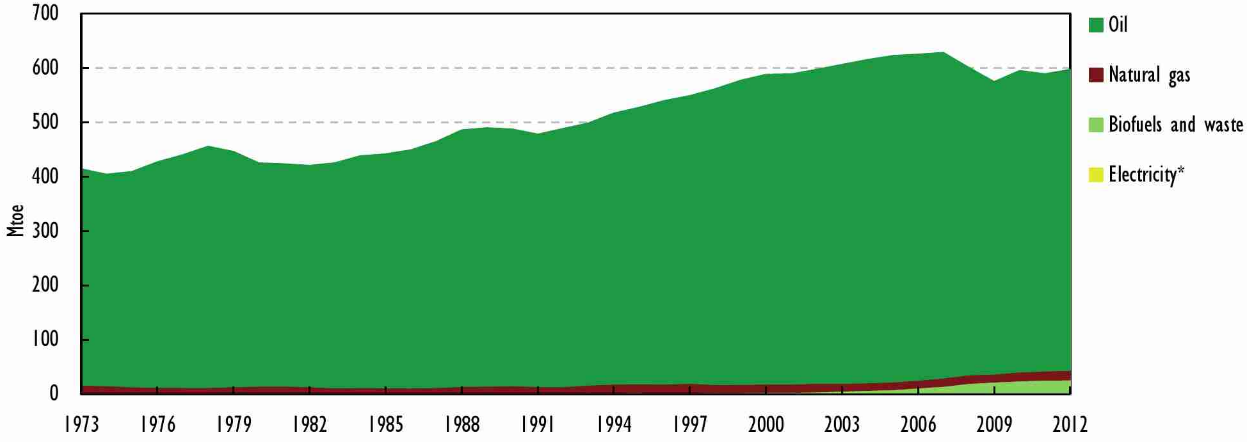
Sector and policy	Policy/legislation	2011 annual site energy savings (TWh)	Forecast annual site energy savings in 2020 (TWh)
Light- and heavy-duty vehicle fuel economy standards	US EPA/NHTSA Joint Rule-makings for 2012-16 and 2017-25.	N/A	962
Appliance and equipment standards programme	National Appliance Energy Conservation Acts of 1987 and 1988 (NAECA). Energy Policy Act of 1992 (EPAct1992). Energy Policy Act of 2005 (EPAct 2005). Energy Independence and Security Act 2007 (EISA).	400 (242 electric) (156 gas)	695 (610 from standards in place today; 85 from new standards)
Ratepayer-funded energy efficiency	State-level legislation and regulation establishing energy efficiency resource standards, and savings obligations.	117.3 (81 electric) (36 gas)	Medium: 210 High: 255
Building codes	State-level residential and commercial building codes.	64 (37 electric, 26 gas, 0.5 heating oil)	244 (89 electric, 67 gas, 1.0 heating oil)
Energy services companies (ESCO) industry	EISA, Section 432. American Recovery and Reinvestment Act (ARRA).	270	770
Total		**851.3**	**2 926**

Note: ASHRAE = American Society of Heating, Refrigerating and Air-Conditioning Engineers; N/A = not applicable; NHTSA = National Highway Traffic Safety Administration; TWh = terawatt hour; US EPA = United States Environmental Protection Agency. IECC = International Energy Conservation Code.

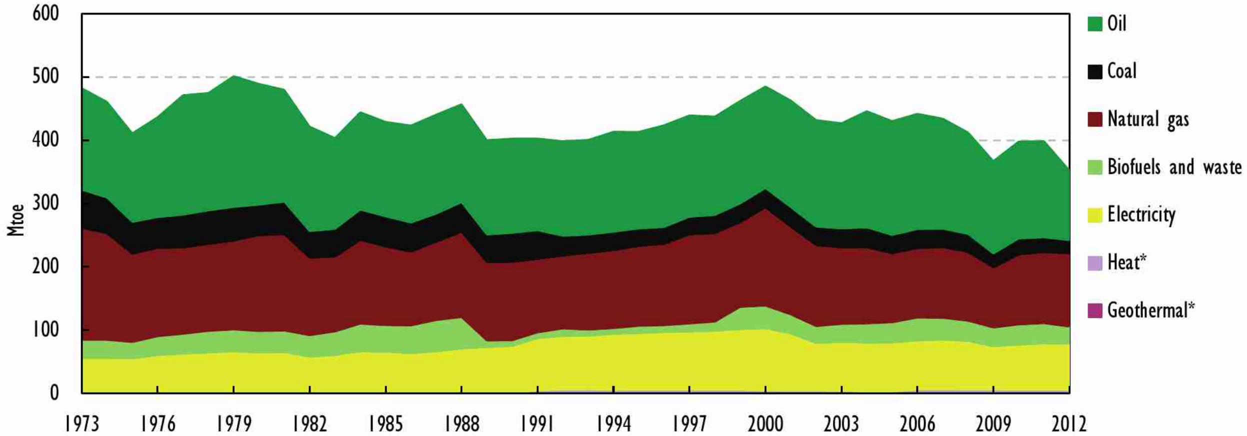
Source: IEA (2013b), *Energy Efficiency Market Report 2013*, OECD/IEA, Paris.

Figure 7.1 TFC by sector and by source, 1973-2012

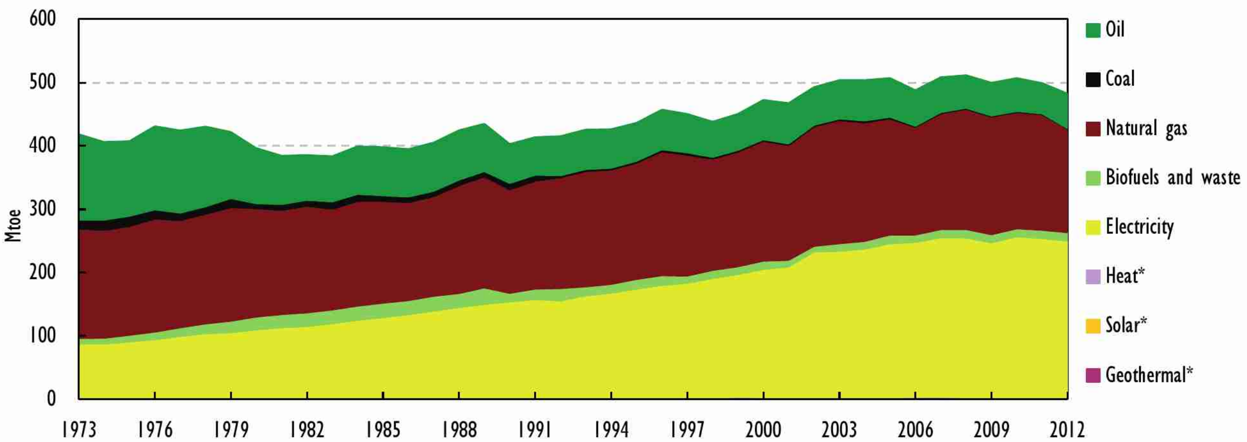
Transport



Industry



Residential/Commercial



* Negligible.

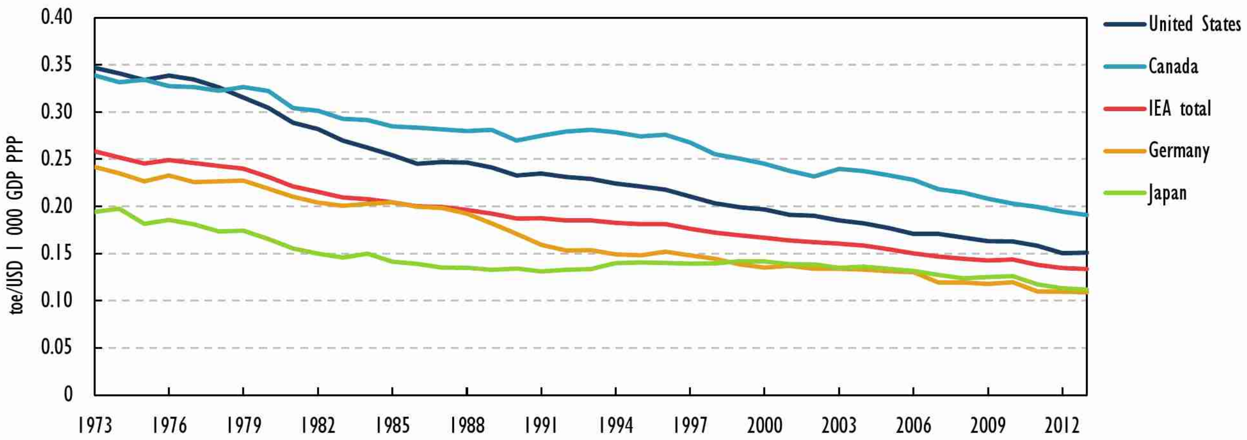
Source: IEA (2014), *Energy Balances of OECD Countries 2014*, OECD/IEA, Paris.

ENERGY INTENSITY

Energy intensity, measured as the ratio of energy supply to GDP, has decreased by 18.6% over the ten years to 2013, down from 0.19 to 0.15 tonne of oil-equivalent (toe) per USD 1 000 GDP PPP (toe/USD 1 000 GDP PPP). The United States ranks as eighth most-intensive country among IEA member countries, behind Estonia, Finland, Canada, the Slovak Republic, the Czech Republic, Korea and Poland. The average IEA energy intensity is 0.13 toe/USD 1 000 GDP PPP has declined at a similar rate to that of the United States over the past ten years.

Energy supply per capita is 6.9 toe, which is higher than the IEA average of 4.5 toe. In 2013, the United States ranked third among IEA member countries in terms of TPES per capita, behind Luxembourg and Canada. Energy supply per capita has declined by 11.3% since 2003, while the top-three ranking has remained unchanged.

Figure 7.2 Energy intensity in the United States and in other selected IEA member countries, 1973-2013



Note: data are estimated for 2013.

Source: IEA (2014), *Energy Balances of OECD Countries 2014*, OECD/IEA, Paris.

INSTITUTIONS

Generally, the **federal government** is directly responsible for energy efficiency policies affecting appliances and equipment, and vehicles (some state policies and standards beyond the national ones exist). Appliance and equipment standards are promulgated by the **Department of Energy** (DOE) while the **Environmental Protection Agency** (EPA) and **Department of Transportation** share responsibility for light- and heavy-duty vehicle fuel economy standards. State energy offices and state regulators are responsible for energy efficiency resource standards placed on gas and electric utilities. The federal government has no direct responsibility regarding energy efficiency policies for buildings and retail energy providers. Nonetheless, DOE plays an important supporting role in building the capacity of state regulators, legislators, and energy offices to consider and implement energy efficiency policies. Both the federal and state governments employ economic and fiscal policies to promote energy efficiency investment (Table 7.2).

Table 7.2 Energy efficiency institutional map

	Major policies	Responsibility
Transformation sector	Clean Air Act	US Environmental Protection Agency
Residential and commercial sector	Appliance and equipment standards	US Department of Energy
	Building codes	States and localities
	Tax incentives	Federal and some states
	Ratepayer-funded energy efficiency programmes	Energy utilities State regulators Energy efficiency offices
	Stimulus spending under ARRA	US Department of Energy State and local energy and community agencies
Industrial sector	Equipment standards Tax incentives	US Department of Energy Federal government and some states
Transport sector	Vehicle fuel economy standards	US EPA and DOT NHTSA

Note: EPA = Environmental Protection Agency: DOT NHTSA = Department of Transportation, National Highway Traffic Safety Administration.

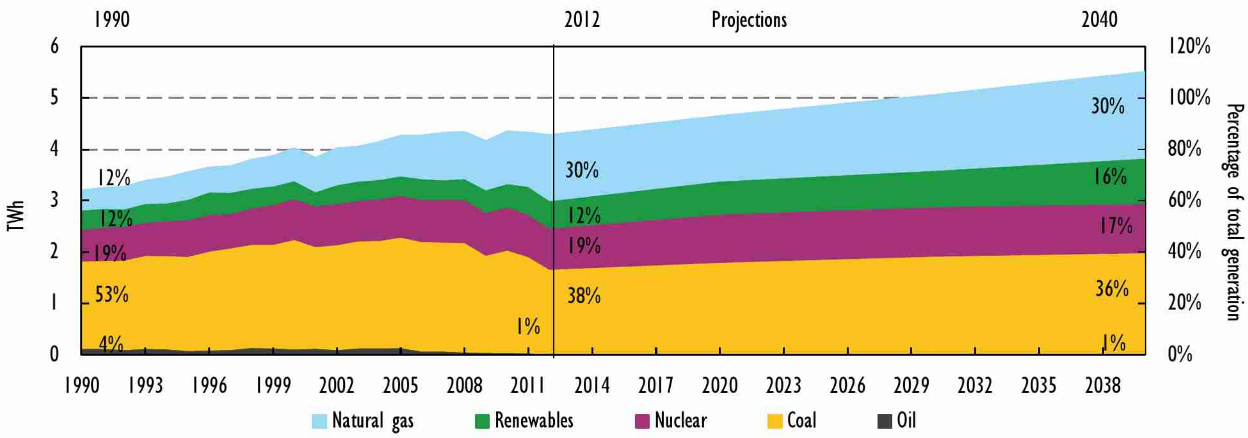
SECTORAL DEVELOPMENTS

TFC has fallen by almost 10% since 2007, largely as a consequence of the financial crisis but also of structural changes and the growth in energy efficiency markets. Consuming sector shares have remained remarkably constant over the past ten years, with transport accounting for the largest share (approximately 40%) and the industrial and residential sectors contributing nearly 20% each.

TRANSFORMATION SECTOR

Electricity consumption dipped over the period 2006-13 largely as a result of the global economic downturn, but is expected to resume at an annual growth rate of 0.7%. Renewable generation continues to grow in relative importance, with nuclear remaining stable and coal dipping sharply. Gas-fired generation grew most rapidly.

Figure 7.3 Power generation by fuel source, actual and projected, 1990-2040



Source: IEA (2014), *Energy Balances of OECD Countries 2014*, OECD/IEA, Paris.

RESIDENTIAL AND COMMERCIAL SECTOR

The residential/commercial sector constitutes a major portion of energy use, accounting for one-third of total final energy use and over 70% of electricity consumed. Regional climate differences – from hot, humid and arid climates to severe cold – contribute to high energy demand for space cooling and heating.

The population is growing by an average of between 2.5 million to 3 million people per year, through births and immigration. While new buildings construction slowed as a result of the financial crisis and of a sharp decline in real estate prices, the construction market started to recover in 2012 – suggesting a reversal in this trend. The residential housing stock is expected to grow substantially in the coming decades, driven by rising population and decreasing occupancy rates (people per household). Services floor area will increase also, albeit at a slower pace (Table 7.3).

Table 7.3 Indicators for energy demand in the United States buildings sector

Indicator	2010	2020
Population (million)	310	337
GDP (million 2010 USD at PPP)	14 678	18 902
Per capita income (USD GDP/capita)	47 289	56 071
Services floor area (million m^2)	7 534	8 278
Residential floor area (m^2)	22 950	26 290
Number of households (million)	113	126
Occupancy rate (people per household)	2.8	2.7

Note: PPP is purchasing power parity.

Sources: UN DESA (United Nations Department of Economic and Social Affairs) (2011), *Rural Population, Development and the Environment 2011*, UNDESA, IEA (2012), World Energy Outlook 2012, OECD/IEA, Paris, other data from IEA analysis.

The buildings sector has advanced significantly over the last three decades encouraged by incentives for efficiency investments, voluntary labelling of many high-efficiency buildings, renovation programmes for low-income housing and government buildings, and numerous technology development and deployment initiatives. Policy activity has also resulted in more aggressive appliance and equipment standards and more rigorous building codes.

The American Recovery and Reconstruction Act of 2009 directed a large influx of stimulus funding into the sector. The Act, the federal government's direct response to the economic crisis, earmarked approximately USD 16 billion in relation to energy efficiency, weatherisation and state grants, that is likely to be fully spent before the end of 2014. While future funding is expected to be modest, policies and funding for efficiency programmes for buildings continue to enjoy significant support across the political spectrum.

INDUSTRIAL SECTOR

According to the Energy Information Administration's abridged version of its *Annual Energy Outlook* (2014), approximately one-third of total United States delivered energy in 2012, or 23.6 quadrillion British thermal units (Btu) was consumed in the industrial sector, which includes manufacturing, agriculture, construction, and mining (EIA, 2013b). In August 2012, the President of the United States signed an executive order, "Accelerating

Investment in Industrial Energy Efficiency". The purpose of the executive order was to accelerate investments in industry to strengthen the competitiveness of the manufacturing sector, lower energy costs, free up future capital for businesses to invest, reduce air pollution, and create jobs. The Order also directs the acceleration of greater investment in industrial energy efficiency and in combined heat and power (CHP) production.

Manufacturing sector: Advanced Manufacturing Office

Programmes to support energy efficiency in the manufacturing sector are overseen by the DOE's Advanced Manufacturing Office (AMO). The AMO works with industry, small businesses, universities, regional entities, and other stakeholders to identify and invest in emerging clean energy technologies. The AMO works to play a leadership role in the national interagency Advanced Manufacturing Partnership. The goal of the AMO is to reduce by 50% in 10 years the life-cycle energy consumption of manufactured goods by targeting the production and use of advanced manufacturing technologies.

Chemical and refining sector

The chemical and petrochemical sector is by far the largest industrial energy user, accounting for roughly 10% of total worldwide final energy demand and 7% of global GHG emissions (American Chemistry Council, 2012). The deployment of best practice/established technologies (BPT) such as state-of-the-art equipment, better catalysts, separations, among others, in existing plants or new facilities can result in substantial energy savings. The most cost-effective way to implement BPT is during building of new plants.

In the United States, typically 26% of capital investments go into replacing plant equipment and another 26% into expanding capacity of existing plants. As a result, the energy intensity of the chemical sector improved by 39% and GHG emissions intensity was reduced by 10% between 1994 and 2007. The cumulative energy saved would have been enough to supply Japan with electricity for one year. The United States has about 150 refineries, which account for roughly 25% of the world refinery output; they consume 3.4 EJ of energy and emit some 244 MtCO_2-eq. of process-related GHGs. Studies show that BPT refineries consume 20% to 30% less energy than the industry average (IEA, 2013a).

Combined heat and power and utility sector

The average efficiency of power generation in the United States has remained at 34% since the 1960s and the energy lost in wasted heat from power generation in the United States is greater than the total energy use of Japan (DEEPA, 2012).

Combined heat and power (CHP or co-generation) represents approximately 8% of United States generating capacity and the present Administration is supporting a target to achieve 40 GW of new, cost-effective CHP by 2020. Meeting this target would increase CHP capacity by 50% in less than a decade and save one quadrillion Btu of energy – the equivalent of 1% of all energy use in the United States. The DOE and EPA have established the Industrial Energy Efficiency and Combined Heat and Power Working Group providing guidance on model programmes and policies that support industrial efficiency and implementation of CHP. The working group has developed a blueprint for action that drives the following goals:

- achieve a 2.5% average annual reduction in industrial energy intensity through 2020
- install 40 GW of new, cost-effective CHP by 2020.

Network losses

According to EIA data, national electricity transmission and distribution losses average about 7% per year of the electricity that is transmitted in the United States.

TRANSPORT SECTOR

Transport remains by far the largest energy-consuming sector, accounting for 600 Mtoe, around 42% of total final energy consumption. Transport sector demand, however, has been flat over the past decade, as a result of higher gasoline prices, slow improvements in vehicle fuel economy, gradual changes in commuting patterns, and the knock-on effects of the economic downturn. Vehicle fuel economy standards in 2012 remained among the least-stringent of all car-producing countries, lower than in Canada, Japan, Korea, China, the European Union, and India.

By far the most significant transportation energy efficiency policy development since the last in-depth review was published in 2008 was the 2012 adoption of a 15-year national programme to improve the fuel economy of cars and trucks sold in the United States. If the automotive industry keeps to the agreed trajectory, light-duty vehicle fuel economy will rise from 25.5 miles per gallon (mpg) in 2008 to 35.5 mpg in 2016 and 50 mpg in 2025 (EPA, 2012).

POLICIES AND MEASURES

POLICIES AND LEGISLATION

Federal government energy efficiency policies are determined by legislation and subsequent rulemaking. Landmark energy efficiency legislation enacted over the past 25 years includes the National Appliance Energy Conservation Acts of 1987 and 1988 (NAECA); the Energy Policy Act of 1992 (EPAct1992); the Energy Policy Act of 2005 (EPAct2005); the Energy Independence and Security Act 2007 (EISA); and, under current consideration, the Shaheen-Portman Energy Efficiency Bill (2014). Taken together this package of legislation provides the basis for most federal government energy efficiency policies, including vehicle fuel economy standards, appliance and equipment energy performance standards, federal support to the adoption of building energy codes, and obligatory energy-saving targets for federal agencies and facilities (Table 7.1).

PROGRAMMES AND MEASURES

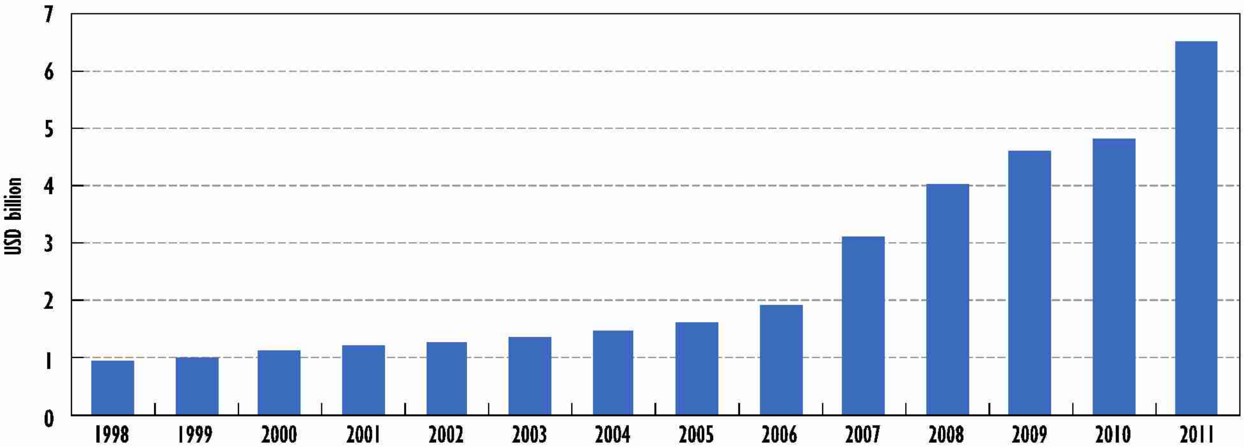
Utility ratepayer-funded programmes

Ratepayer-funded energy efficiency programmes have been a pillar of energy efficiency efforts since the late 1990s. Spending levels have grown from USD 1.0 billion in 2000 to USD 7.0 billion in 2012 (Figure 7.4). Energy savings from these programmes are significant. The latest industry report, a collaborative initiative by the Consortium for Energy Efficiency, the America Gas Association and the Institute for Electric Efficiency, estimated gross annual energy savings of 117 TWh from cumulative spending on energy efficiency through 2011 (Forster et al., 2013).

Until recently, only a handful of western and northeastern states used ratepayer funds to invest in energy efficiency programmes. In 2010, ten states with less than one-third of total natural gas and electricity sales accounted for two-thirds of total ratepayer-funded energy efficiency. These regional disparities are beginning to ease, as a result of wider adoption of regulatory mechanisms promoting energy efficiency.[1] By the end of 2013 there were 25 states with energy efficiency resource standards (EERS), and another nine states adopting policies requiring significant energy-provider involvement in energy efficiency (ACEEE, 2012).[2] Ten states doubled their ratepayer-funded energy efficiency expenditure in 2010 (IEE, 2012).[3]

Of the 25 EERS schemes, 18 incorporate incremental energy savings targets that, if followed, could result in a 30% annual (cumulative) energy savings or more by 2020. Some analysts question whether this rapid growth can be sustained. A recent study published by the Lawrence Berkeley National Laboratory (LBNL) examined the outlook for ratepayer-funded energy efficiency. The study projected ratepayer-funded energy efficiency spending and savings for three scenarios (low, medium and high), based on a review of state-level policies and plans, and interviews with regulators and utility experts. The low scenario projects lower interest by regulators in energy efficiency as a resource, with spending remaining at 2010 levels. The medium scenario projects continued growth in spending by the states with ambitious EERS plus continued expansion of energy efficiency policies in other states, subject to constraints of technical capacity and rate/spending caps imposed by statute or regulatory order. Under this scenario, ratepayer-funded spending growth is lower than historical rates: about 4% annually. The high scenario is based on adoption of energy efficiency regulatory mechanisms by those states that have not yet pursued energy efficiency. This scenario foresees a tripling of combined gas and electric energy efficiency spending over the period to 2025, towards USD 16 billion annually (Figure 7.5) (Barbose et al., 2013).

Figure 7.4 Ratepayer-funded natural gas and electric energy efficiency spending in the United States, 1998-2011



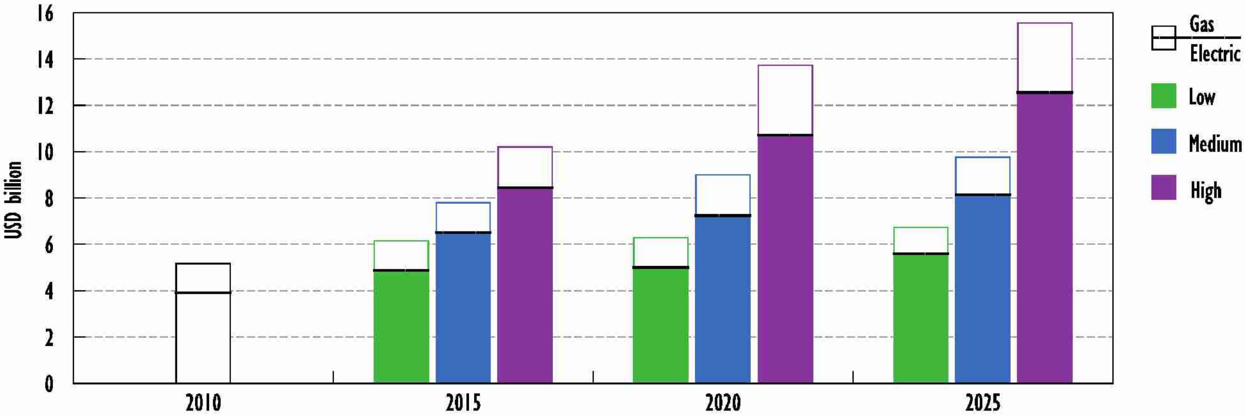
Sources: Forster H.J., Wallace P. and Dahlberg N. (2013), *2012 State of the Efficiency Program Industry – Budgets, Expenditures, and Impacts*, Consortium for Energy Efficiency, 28 March ; Barbose, G., Goldman, G., Hoffman, I. and Billingsley, M. (2013), *The Future of Utility Customer-Funded Energy Efficiency Programs in the United States: Projected Spending and Savings to 2025*, LBNL-5803E, January; ACEEE (American Council for an Energy Efficiency Economy) (2012), *Three Decades and Counting: A Historical Review and Current Assessment of Electric Utility Energy Efficiency Activity in the States, Report Number U123*, ACEEE, June.

1. Regulatory mechanisms promoting energy efficiency include resource standards, statutory requirements setting goals or criteria for ratepayer-funded energy efficiency efforts, system benefit charges, integrated resource planning requirements and decoupling of revenues from sales (Regulatory Assistance Project, 2012).

2. An energy efficiency resource standard (EERS) is a regulatory mechanism used by regulators to establish specific energy savings targets that regulated gas and electricity companies must achieve, or face penalties. An EERS is similar in concept to a renewable portfolio standard (RPS), in that an EERS requires utilities to reduce energy use by a specified and increasing percentage or amount each year.

3. Louisiana, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, South Dakota, Tennessee, Virginia and Wyoming.

Figure 7.5 Electric and gas energy efficiency programme spending projected to 2010-25



Source: Barbose, G., Goldman, G., Hoffman, I. and Billingsley, M. (2013), *The Future of Utility Customer-Funded Energy Efficiency Programs in the United States: Projected Spending and Savings to 2025*, LBNL-5803E, January.

Energy savings projections follow a similar path, with energy savings from ratepayer-funded electric efficiency programmes projected at 210 TWh to 255 TWh in 2020, equivalent to 6% of projected electricity consumption in that year (EIA, 2013a). Depending on electricity sales growth over the period, these annual energy savings levels could possibly result in a net decline in electricity sales (Barbose et al., 2013; IEE, 2013).

RESIDENTIAL/COMMERCIAL SECTOR HIGHLIGHTS

Tax incentives

Tax incentives can be used to promote residential and commercial energy efficiency investments. Tax credits for energy-efficient appliance purchases and efficiency upgrades of residential buildings were first authorised in 1978 via the Energy Tax Act, and more recently via the Energy Policy Act of 2005. The most successful (based on participation) tax incentives were for new appliances and home improvements, including new homes. These tax incentives encouraged manufacturers to develop high-efficiency models within appliance product classes (refrigerators, washing machines, dishwashers). The high-efficiency models which qualified for tax credits eventually became the basis for more stringent minimum energy performance standards, thus creating a virtuous market transformation and an efficiency improvement circle between incentive policies and regulatory policies (ACEEE 2012). The non-business energy property tax credit encourages home-owners to invest in a variety of energy-saving home improvements, such as insulation, window treatments, and furnace and air-conditioner replacement. By 2009 some 6.8 million households claimed credits accounting for total spending of over USD 25 billion (GAO, 2012).

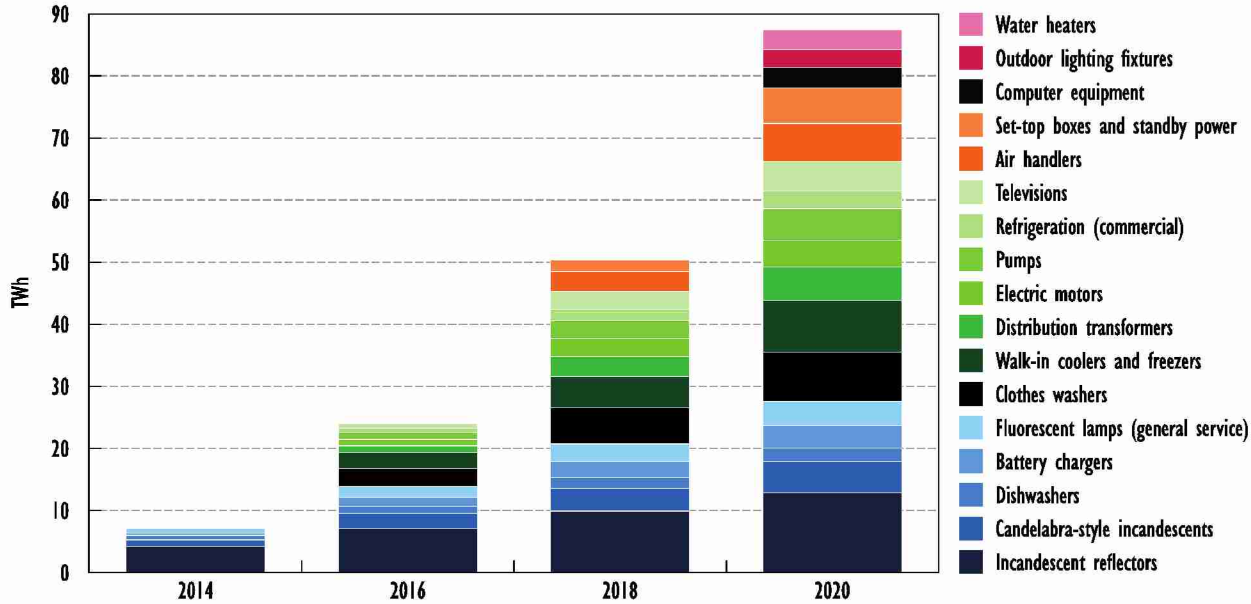
Although "free ridership" is a major drawback of many tax incentive programmes, these policies remain cost-effective. Tax incentives are a flexible tool; they can be used to provide incentives not only to consumers but to manufacturers also. The Appliance Manufacturer's Tax Credit, which was in place from 2008 to 2009 resulted in the production and sale of 13 million dishwashers, washing machines and refrigerators resulting in an annual energy savings of 1.4 TWh. Federal tax incentives have encouraged manufacturers to develop higher-efficiency refrigerators, washing machines and dishwashers (appliance manufacturer's tax credit) and home-owners to invest in insulation, window treatment, and furnace and air-conditioner replacement as well as to purchase electric vehicles, hybrid electric vehicles, and develop energy-efficient commercial buildings (Energy Property Tax Credit).

Optimising the type and level of tax incentives and managing questions of free ridership could improve the prospects for, and results of, this important type of incentive policy. Keeping stable tax incentives in place for extended periods can create stable expectations for consumers and contractors alike. On the whole, tax incentives seem to be an under-utilised policy instrument relative to regulatory approaches and direct investment.

Appliance and equipment standards

Minimum energy performance standards for household appliances and commercial equipment date back to measures introduced by the state of California in 1974. These early efforts by California, beginning with refrigerators, led to a movement for national energy performance standards for common household appliances and resulted in the Energy Policy and Conservation Act (EPCA) of 1975, which called for establishment of energy conservation programmes and efficiency targets. Since 1987, Congress has directed the Department of Energy (DOE) to set efficiency standards for more than 55 product categories. DOE also updates standards to reflect technological improvements and new products. Recent years have seen a record pace of new standards set as a result of court-ordered and statutory deadlines imposed on DOE. Some 20 new standards have been completed since 2009, with more expected over the medium term. Activity will likely focus on the appliance and equipment categories not yet covered, such as battery chargers, consumer electronics, pool pumps and spas, and lighting. According to a recent study by appliance standards advocates, as many as 30 new product categories could be covered over the next six years with an aggressive DOE programme. The American Council for an Energy Efficiency Economy (ACEEE) and ASAP estimate that savings from these new product categories could add up to over 80 TWh of annual energy savings by 2020 (Figure 7.6) (ACEEE/SAP, 2012; ASAP, 2013).[4]

Figure 7.6 Potential energy savings from new appliance energy performance standards



Sources: ACEEE/ASAP (Appliance Standards Awareness Project) (2012), *The Efficiency Boom- Cashing in on the Savings from Appliance Standards, Report Number ASAP 8/ACEEE-A123*, ACEEE/ASAP, March.; ASAP (Appliance Standard Awareness Project) (2013), "*Products*" website, www.appliance-standards.org/products.

4. The IEA derived 2020 annual savings estimates from the effectiveness data of individual standards together with the annual energy savings in 2025 and 2035 projected by ACEEE and ASAP.

Appliance standards produce long-lived energy savings. According to a recent analysis by the Lawrence Berkeley National Laboratory, the standards in place today produced 400 TWh of energy savings in 2011, with savings expected to top 600 TWh by 2020 (Meyers et al., 2013). Adding in the savings estimated from new appliance and equipment standards that may be implemented in the coming years yields a potential annual energy saving of as much as 695 TWh in 2020 (ASAP, 2013).

Building energy codes

Building codes are the responsibility of states, which can adopt or reject new code requirements. Some states have a legislative process; others have a regulatory process. Some "home rule" states devolve the authority to set building codes to localities. States often amend the model codes according to local needs and interests; these procedures are influenced by stakeholders within the development and construction industries. These state and local jurisdictions are also responsible for enforcing compliance with the building codes as adopted. The DOE and state energy agencies play a leading role in encouraging adoption of building energy codes and developing the capacity for inspection and enforcement. In response to the Energy Policy Act of 1992 (EPAct1992), the DOE established the Building Energy Codes Program (BECP) to support the model national building energy codes development process and help states adopt and implement more efficient energy codes. Since its inception 20 years ago, BECP has become the central information resource on national energy codes and standards.

Energy efficiency standards for new buildings have been progressively tightened over the past decade, culminating in the recent introduction of two new model building energy codes: the 2012 International Energy Conservation Code (IECC) covering residential buildings; and the 2010 ASHRAE Standard 90.1-2013 covering commercial buildings. These codes are projected to produce a 30% improvement in the energy efficiency of new buildings compared to buildings constructed to comply with the 2006 model code.[5] The Pacific Northwest National Laboratory estimates today's savings from building code changes over the past two decades to be 42 TWh (Livingston et al., 2013). The 2012 code changes will produce additional, although difficult-to-estimate, annual energy savings by 2020. The IECC code includes stringent prescriptive elements, such as mandatory whole-house pressure tests, insulated domestic hot water piping and significantly lower duct leakage rates. Diffusion of the latest model building energy codes is expected to proceed quickly because of the ongoing assistance provided by BECP, with energy savings from implementation of more stringent building energy codes expected to triple between 2011 and 2020 (Livingston et al., 2013).

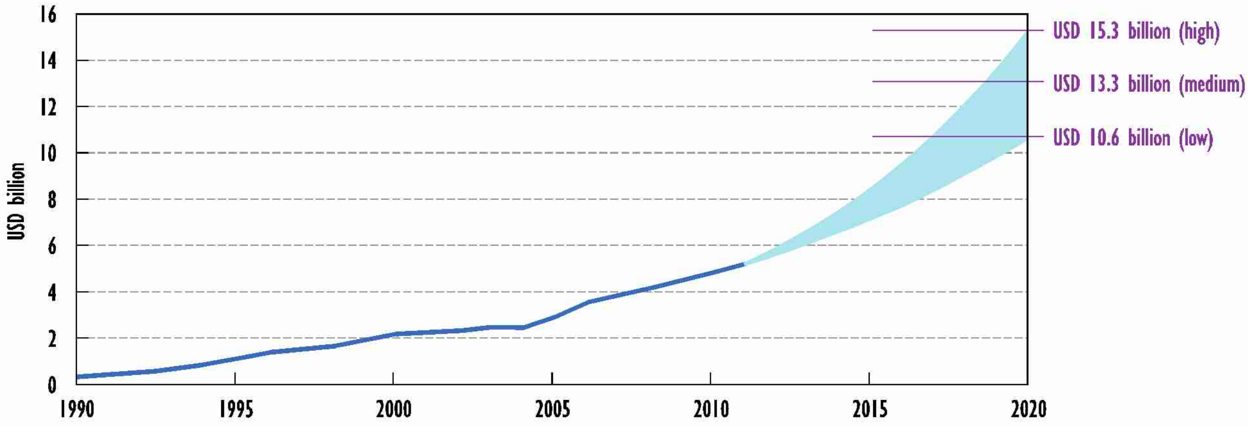
Energy services industry

Energy services companies (ESCOs) are another pillar of the energy efficiency industry. The ESCO industry has grown at 7% to 10% annually despite the financial crisis. The American Recovery and Reinvestment Act (ARRA) helped by directing over USD 10 billion of additional government spending into energy efficiency (DOE, 2012). The ESCO industry is expected to see continued growth of 10% per year in the coming years. A recent LBNL report forecast that the sector will more than double in size over the medium term,

5. Both codes are updated on a three-year cycle. The next cycle will conclude in 2015. As a point of reference, a building constructed to meet ASHRAE 90.1-2010 will consume about half the energy consumed under the first model building energy code, ASHRAE 90-75 (Bloomberg New Energy Finance/Business Council for Sustainable Energy, 2013).

reaching annual turnover of USD 13 billion by 2020 (Stuart et al., 2013) (Figure 7.7). Because the energy savings measures implemented by ESCOs are typically long-lived, the annual energy savings delivered by this industry is expected to grow even faster than annual investment, reaching an estimated 770 TWh (Table 7.1) by 2020 (Larsen and Goldman, 2013).

Figure 7.7 Historical and forecast revenues of US ESCO industry, 1990-2020

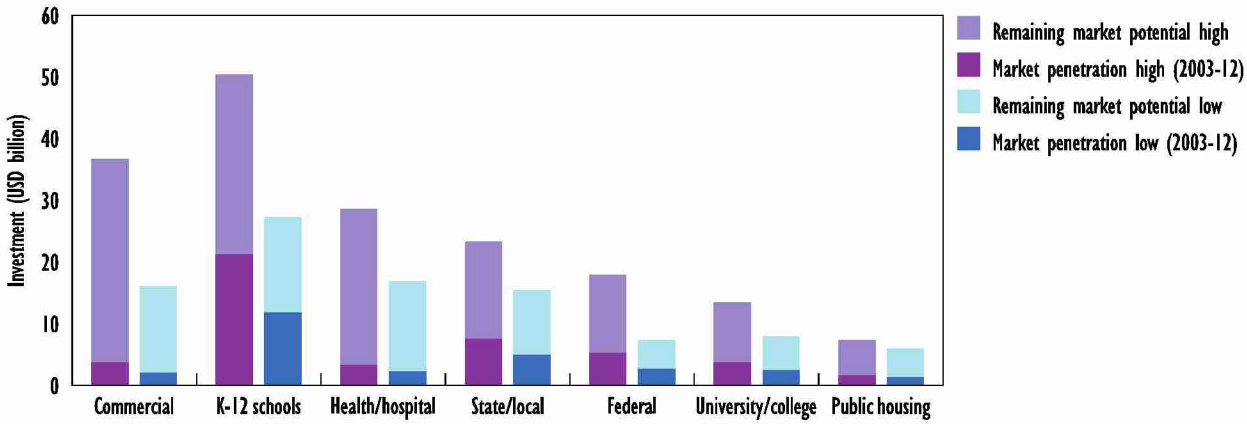


Source: Stuart, E. et al. (2013), *Current Size and Remaining Market Potential of U.S. ESCO Industry, LBNL Report 6300-E*, July.

ESCOs have benefited from policies requiring federal agencies to meet energy savings standards. The Energy Independence and Security Act (2007) and subsequent executive orders require agencies to undertake specified energy and water efficiency measures. Many of these are procured from the ESCO industry via a procurement process such as Energy Services Performance Contracts (ESPCs) and Super-ESPCs (Figure 7.8).

Since its inception, the ESCO industry has remained heavily reliant on the public and institutional buildings sector – the so-called MUSH markets (municipal, universities, schools and hospitals). Industry analysts estimate that 85% of ESCO industry revenues in 2009 came from the public sector (Satchwell et al., 2010). A recent LBNL study examined the market saturation of energy efficiency improvement projects in the commercial and MUSH sectors, estimating the remaining market potential at between USD 71 billion and USD 133 billion (Stuart et al., 2013) (Figure 7.8).

Figure 7.8 Estimated ESCO market potential in commercial and MUSH sectors



Note: MUSH = municipal, universities, schools and hospitals.

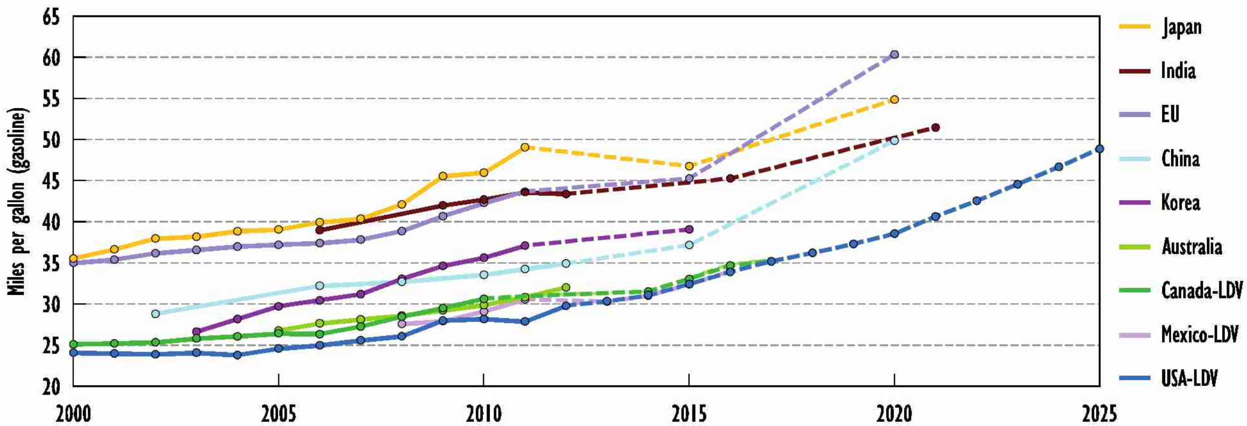
Source: Stuart, E. et al. (2013), *Current Size and Remaining Market Potential of U.S. ESCO Industry, LBNL Report 6300-E*, July.

The outlook for ESCO industry growth is strong. The industry will benefit from continuation of ratepayer-funded energy efficiency and federal energy efficiency procurement requirements. Federal spending will remain at a level of about USD 1 billion in the coming years (Alliance to Save Energy, 2013). Finally, there is ample opportunity for ESCO market growth in both the core MUSH sector and the broader commercial sector (Stuart et al., 2013).

TRANSPORT SECTOR HIGHLIGHTS

As of 2012 the United States ranked last in terms of vehicle fuel economy standards among developed countries and some developing countries – lower than Canada, Japan, Korea, China, the European Union, Mexico, and India (Figure 7.9). This dubious distinction will be relieved, however, as a result of the 2012 adoption by the EPA and the Department of Transportation's National Highway Traffic Safety Administration (NHTSA) of a 15-year national programme to improve the fuel economy and reduce tailpipe carbon dioxide emissions of cars and trucks sold in the United States. The programme is driven by a joint EPA/NHTSA rulemaking establishing progressively more stringent fuel economy standards for light-duty vehicle model years 2012 to 2016 and model years 2017 to 2025. A companion rulemaking provides the first-ever American fuel economy standards for heavy-duty vehicles – tractor-trailers, heavy-duty pick-up trucks and vans, and recreational vehicles – manufactured during model years 2014 to 2018. These standards call for manufacturers to deliver a fleet of light and heavy-duty vehicles with steadily improving fuel economy over a 13-year period. Light-duty vehicle fuel economy is set to rise from 25.5 miles per gallon (mpg) in 2008 to 35.5 mpg in 2016 and more than 50 mpg in 2025 (EPA, 2012).[6] These policies will result in a vehicle fuel economy improvement trajectory from 2014 roughly parallel to the improvements expected in the European Union, Japan and China (albeit from a much lower starting point).

Figure 7.9 International comparisons of light-duty vehicle fuel economy standards



Notes: standards have been developed using the US Corporate Average Fuel Economy (CAFE) test cycle. China's target reflects gasoline vehicles only; the target may be higher after new energy vehicles are considered. The US, Canada and Mexico light-duty vehicles include light commercial vehicles. Solid lines represent historical performance. Dashed lines represent enacted targets. Dotted lines represent proposed targets or targets under study.

Source: ICCT (International Council on Clean Transportation) (2012), *Global comparison of light-duty vehicle fuel economy/GHG emission standards*, ICCT, Washington, D.C.

6. A comprehensive mid-term evaluation of progress in implementing the standards, including public notice and commenting, will be undertaken by the US EPA and NHTSA in conjunction with other federal and state agencies. This review will take place in 2015 and may result in changes to the fuel economy targets.

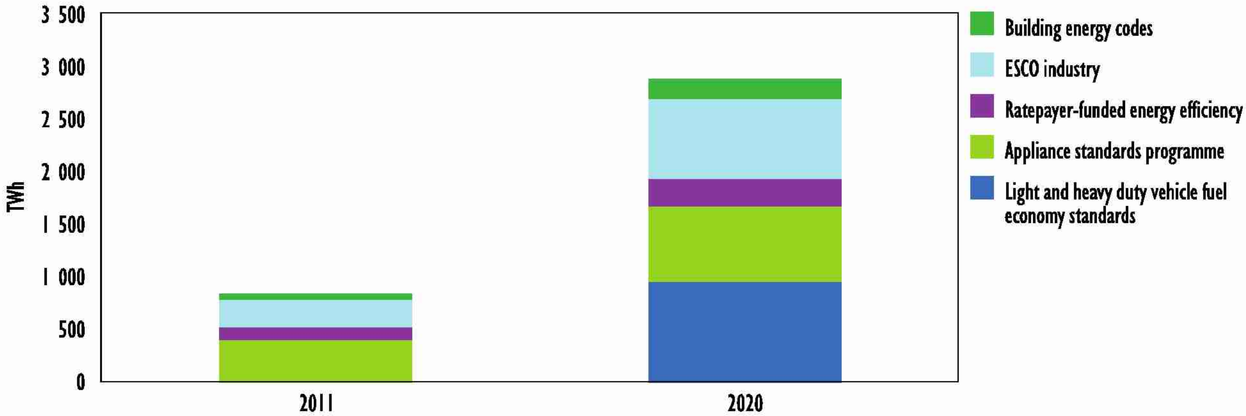
These vehicle fuel economy standards are projected to save about 6.3 billion barrels of oil over the life of light-duty vehicles built from between 2012 and 2024 and heavy-duty vehicles built from 2014 to 2018 model years, or 1.5 million b/d – equivalent to almost one-half of US oil imports in 2012. The standards will also save almost USD 2 trillion for consumers in cumulative fuel costs through 2020 (EPA, 2012).

ASSESSMENT

The United States has made significant progress with implementing energy efficiency policies since the last in-depth review was conducted in 2008 and the country is a leader in facilitating private-sector energy efficiency investments. The 2009 economic stimulus package included new energy efficiency initiatives and substantial additional funding for existing programmes. The direct and indirect funding for these programmes totalled more than USD 30 billion, five times more than 2008 funding levels.

The country is on track to become one of IEA's most energy-efficient countries by 2020. Energy efficiency improvements will continue to unfold over the medium term, as energy efficiency improvement targets for vehicles, appliances and equipment, and new buildings are implemented. These regulatory policies will be supplemented by continued modest growth in ratepayer-funded energy efficiency and the ESCO industry. Tax incentives could provide an additional stimulus to energy efficiency spending by households and businesses. In the aggregate, these policies have the potential to triple annual savings from energy efficiency between 2012 and 2020 (Figure 7.10). Some analysts even predict lower demand for gas, electricity and transport fuels in the coming years as a result of this energy efficiency scaling-up.

Figure 7.10 Actual and forecast annual savings from energy efficiency policies and markets, 2011 and 2020



Source: IEA (2013b), *Energy Efficiency Market Report 2013*, OECD/IEA, Paris

A realistic outlook on energy efficiency in the United States, however, needs to take into account the potential obstacles to continued steady growth (Table 7.4). There are concerns about whether spending on energy efficiency can be sustained, especially in light of the downward pressure on public budgets and continued low natural gas prices. There are concerns that the delivery capability of the energy efficiency industry may not be able to keep up with ambitious targets for savings and efficiency improvements. Delays in technology development could result in downward adjustments in appliance standards or vehicle fuel economy improvement targets.