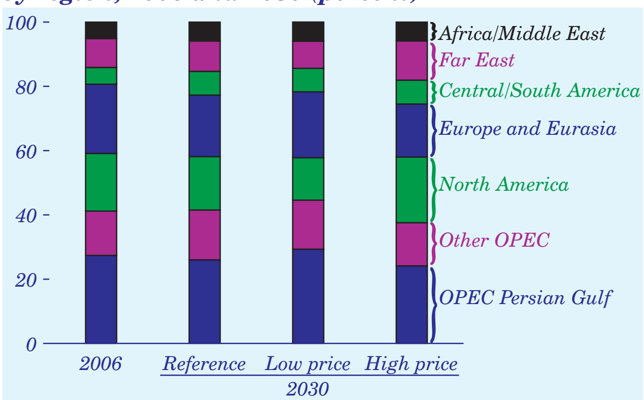
World Liquids Supply Is Projected To Remain Diversified in All Cases

Figure 39. World liquids production shares by region, 2006 and 2030 (percent)



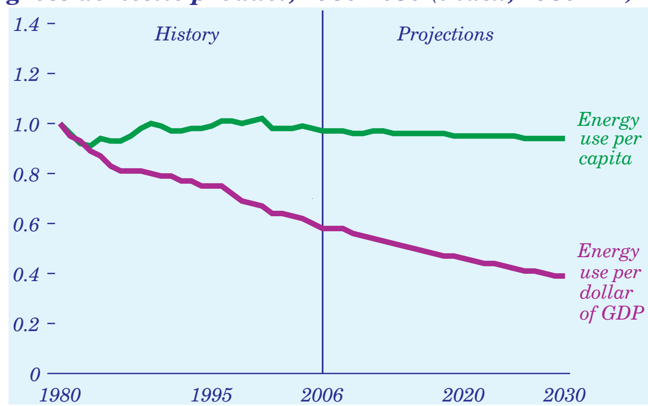
In 2006, OPEC producers in the Persian Gulf accounted for 28 percent of the world's conventional liquids supply, and other OPEC producers accounted for 14 percent. Europe and Eurasia produced 22 percent of conventional supply, North America 17 percent, and the rest of the world 19 percent (Figure 39).

In the reference case, OPEC conventional production maintains approximately a 40-percent share of world total liquids supply through 2030, which is consistent with recent historical trends and reflects an expectation that OPEC suppliers will vary their production levels to influence world oil prices. In all the *AEO2008* cases, OECD liquids production is between 23 and 24 million barrels per day in 2030, constrained by resource availability rather than price or political concerns.

In the high price case, several resource-rich countries, including Saudi Arabia, Mexico, and Russia, limit production, lowering both total world liquids supply and their own shares of the supply. In the high price case, the largest increases in liquids production occur in the United States, China, Canada, Brazil, and India, where substantial increases in unconventional production are expected, underscoring the rising importance of unconventional fuels to the world's supply of liquids. In the low price case, resource-rich countries either maintain current production behavior or increase their openness to foreign capital investment. As a result, the largest increases in world liquids supply shares in the low price case occur in Iraq and the Caspian Sea Basin.

Average Energy Use per Person Levels Off Through 2030

Figure 40. Energy use per capita and per dollar of gross domestic product, 1980-2030 (index, 1980 = 1)



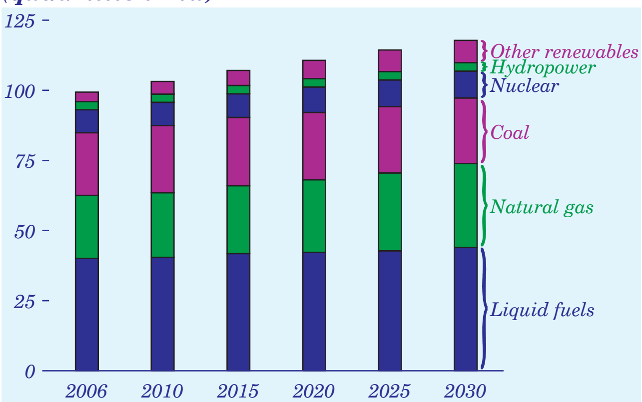
Because energy use for housing, services, and travel in the United States is closely linked to population levels, energy use per capita is relatively stable (Figure 40). In addition, the economy is becoming less dependent on energy in general.

Energy intensity (energy use per 2000 dollar of GDP) declines by an average of 1.4 percent per year in the low growth case, 1.7 percent in the reference case, and 1.9 percent in the high growth case. Efficiency gains and faster growth in less energy-intensive industries account for most of the projected decline, more than offsetting growth in demand for energy services in buildings, transportation, and electricity generation. The decline is more rapid in the high economic growth case, because with higher economic growth the number of new, more efficient systems grows faster, and the additional growth is concentrated in less energy-intensive industries. As energy prices moderate over the longer term, energy intensity declines at a slower rate in the reference, high growth, and low growth cases.

The *AEO2008* cases developed to illustrate the uncertainties associated with those factors include low and high growth cases, low and high price cases, and alternative technology cases (see Appendixes B, C, D, and E).

Coal and Liquid Fuels Lead Increases in Primary Energy Use

Figure 41. Primary energy use by fuel, 2006-2030 (quadrillion Btu)



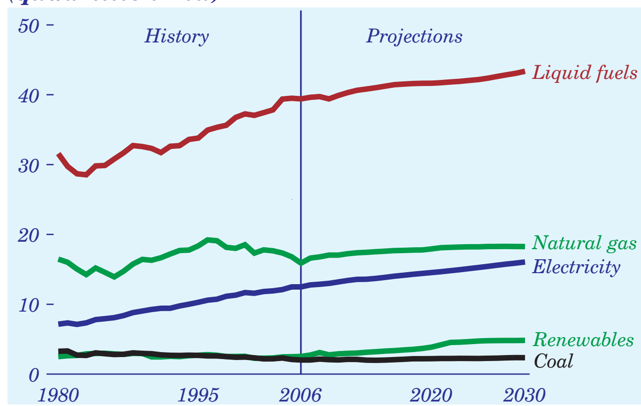
Total primary energy consumption, including energy for electricity generation, grows by 0.7 percent per year from 2006 to 2030 in the reference case (Figure 41). Fossil fuels account for 55 percent of the increase. Coal use increases in the electric power sector, where electricity demand growth and current environmental policies favor coal-fired capacity additions. About 54 percent of the projected increase in coal consumption occurs after 2020, when higher natural gas prices make coal the fuel of choice for most new power plants under current laws and regulations, which do not limit greenhouse gas emissions. Increasing demand for natural gas in the buildings and industrial sectors offsets the decline in natural gas use in the electricity sector after 2016, resulting in a net increase of 5 percent from 2006 to 2030.

The transportation sector accounted for more than two-thirds of all liquid fuel consumption in 2006, and 60 percent of that share went to LDVs. Demand for liquid transportation fuels increases by 17 percent from 2006 to 2030, dominated by growing fuel use for LDVs, trucking, and air travel. The industrial sector accounted for 25 percent of total liquid fuel use in 2006, but its share declines to 21 percent in 2030.

AEO2008 also projects rapid percentage growth in renewable energy production, as a result of the EISA2007 RFS and the various State mandates for renewable electricity generation. Additions of new nuclear power plants are also projected, spurred by improving economics relative to plants fired with fossil fuels and by the EPACT2005 PTCs.

Electricity and Liquid Fuels Lead Rise in Delivered Energy Consumption

Figure 42. Delivered energy use by fuel, 1980-2030 (quadrillion Btu)



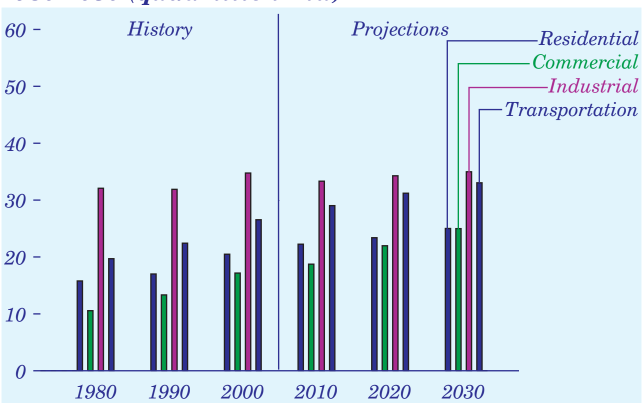
Delivered energy use (excluding losses in electricity generation) grows by 0.7 percent per year from 2006 to 2030 in the reference case. The growth in electricity use is driven by growing demand in the residential and commercial sectors. With the growing market penetration of electric appliances, residential electricity use increases slightly faster than the total number of households, and commercial electricity use outpaces the growth in commercial floorspace. With different assumptions about population and economic growth, average annual growth in delivered energy use from 2006 to 2030 ranges from 0.3 percent in the low growth case to 1.0 percent in the high growth case.

Growth in demand for liquid fuels is led by the transportation sector, as rising population, incomes, and economic output boost demand for travel, partially offsetting improvements in vehicle efficiency (Figure 42). Natural gas use grows more slowly than overall delivered energy demand, reflecting its relatively higher cost, particularly in the industrial sector.

Industrial biomass accounts for the largest share of end-use consumption of renewable energy. Currently it is used mostly as a byproduct fuel in the pulp and paper industry, but that use will be surpassed by consumption of biomass heat and co-products from ethanol manufacture when the biofuel mandate under EISA2007 reaches 36 billion gallons in 2022. Consumption of nonmarketed solar, geothermal, and wind energy also increases dramatically in the projections; however, it continues to account for less than 1 percent of all delivered energy use in the residential and commercial sectors.

U.S. Primary Energy Use Climbs to 118 Quadrillion Btu in 2030

Figure 43. Primary energy consumption by sector, 1980-2030 (quadrillion Btu)



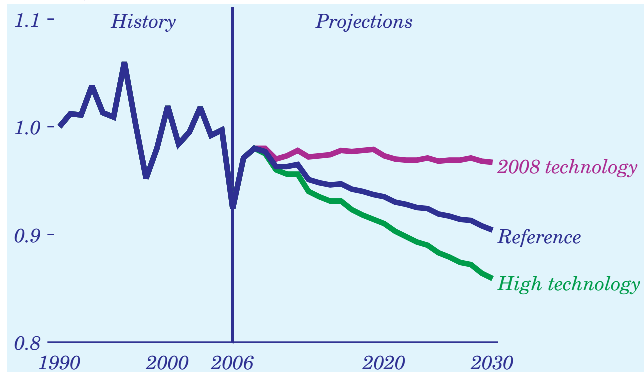
The most significant impact of EISA2007 is in the transportation sector, where the CAFE standard for LDVs is raised to 35 mpg in 2020. Still, from 2006 to 2030 the transportation sector sees the second-largest increase in energy consumption, at 5 quadrillion Btu (Figure 43), as a result of increases in vehicle miles traveled, jet fuel consumption, and demand for fuels such as E10, E85, and diesel to displace motor gasoline.

EISA2007 has little effect on the commercial sector, where energy demand continues to expand more rapidly than the economy as a whole. Dependence on natural gas and electricity, already heavy in the residential and commercial sectors, increases over time. Demand for electricity grows faster than demand for natural gas in both sectors, however, because electricity is used for a wider diversity of applications (including the fastest growing end uses, office equipment, personal computers, and televisions), whereas natural gas is used mainly for space heating, cooking, and water heating, which grow more slowly than households and floorspace.

The variation in residential and commercial energy demand between the high and low price cases is relatively small, and natural gas consumption accounts for most of the difference. In the industrial sector, fuel use in 2030 is higher in the high price case than in the reference case, reflecting differences in CTL, ethanol, and biodiesel production. Different growth rates for manufacturing output in the low and high macroeconomic growth cases account for most of the difference in industrial energy consumption between the two cases.

Residential Energy Use per Capita Varies With Technology Assumptions

Figure 44. Residential delivered energy consumption per capita, 1990-2030 (index, 1990 = 1)

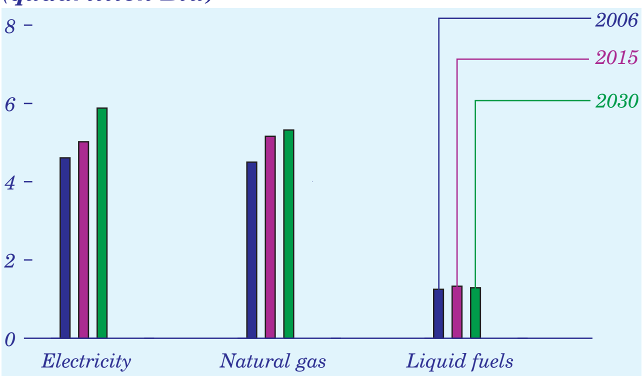


Residential energy use per person has remained fairly constant since 1990 (taking into account year-to-year fluctuations in weather), with increases in energy efficiency offset by consumer preference for larger homes and by new residential uses for energy. Over the past 10 years, the weather has generally been warmer than the 30-year average, causing energy use per person to remain mostly below its 1990 level. Given the preponderance of warmer winters and summers, the *AEO2008* projections define normal weather as the average of the most recent 10 years of historical data, which decreases the need for heating fuels, such as natural gas and fuel oil, and increases the need for electricity used for air conditioning, all else being equal [*79*].

In the *AEO2008* projections, residential energy use per capita changes with assumptions about the rate at which more efficient technologies are adopted. The 2008 technology case assumes no increase in the efficiency of equipment or building shells beyond those available in 2008. The high technology case assumes lower costs, higher efficiencies, and earlier availability of some advanced equipment. In the reference case, residential energy use per capita is projected to fall below the 2006 level after 2024. The 2008 technology case approximates an upper bound on residential energy use per capita in the future: delivered energy use per capita in the residential sector remains above the 2006 level through 2030, when it is 7 percent higher than projected in the reference case (Figure 44). The high technology case provides a lower bound, falling below the 2006 level after 2016 and reaching a 2030 level that is 5 percent below the reference case projection.

Household Uses for Electricity Continue To Expand

Figure 45. Residential delivered energy consumption by fuel, 2006, 2015, and 2030 (quadrillion Btu)



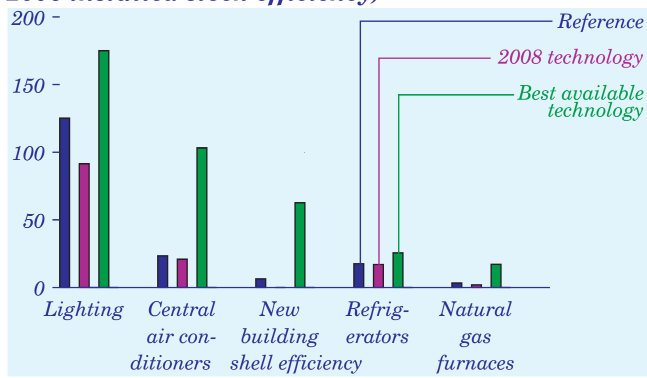
In 2006, households consumed more electricity than natural gas for the first time, as warmer winter temperatures reduced the need for natural gas heating. Over the past decade, residential electricity use has grown steadily, as a result of the increase in air conditioning use and the introduction of new applications. That trend is expected to continue in *AEO2008* (Figure 45). In 2030, electricity use for home cooling is 38 percent higher than the 2006 level in the reference case, as the U.S. population continues to migrate to the South and West, and older homes convert from room air conditioning to central air conditioning. A projected 25-percent increase in the number of households also increases the demand for appliances, and total electricity use in the residential sector increases by 27 percent from 2006 to 2030 in the reference case.

Natural gas and liquid fuels are used in the residential sector primarily for space and water heating. Few new uses have emerged over the past decade, and few are expected in the future. Thus, natural gas and liquids consumption per household decreases as the energy efficiency of furnaces and building components continues to improve.

The 2008 technology and high technology cases provide high and low ranges for the projections. In the high technology case, for example, high-efficiency air conditioners and condensing gas furnaces become more prevalent. Recent developments in solid-state lighting technologies, such as light-emitting diodes (LEDs), are reflected in the reference case as a reduction of up to 85 percent in the amount of electricity needed to provide a given amount of useful light.

Increases in Energy Efficiency Are Projected To Continue

Figure 46. Efficiency gains for selected residential appliances, 2030 (percent change from 2006 installed stock efficiency)



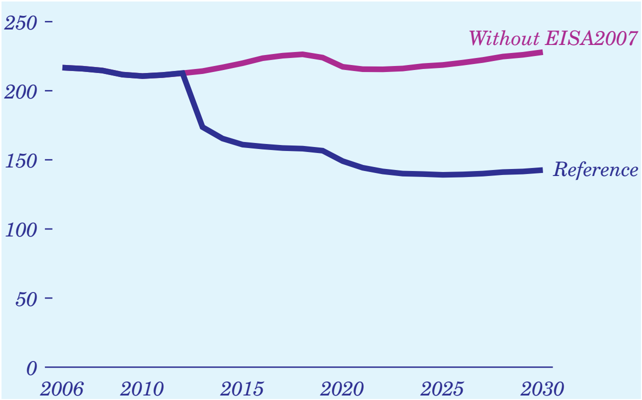
The energy efficiency of new household appliances plays a key role in determining the types and amounts of energy used in residential buildings. As a result of stock turnover and purchases of more efficient equipment, energy use by residential consumers, both per household and per capita, has fallen over time. In the 2008 technology case, which assumes no efficiency improvement of available appliances beyond 2008 levels, normal stock turnover results in higher average energy efficiency for most end uses in 2030, as older appliances are replaced with more efficient models from the existing stock of appliances (Figure 46).

The largest gains in residential energy efficiency are projected in the best available technology case, which assumes that consumers purchase the most efficient products available at normal replacement intervals regardless of cost, and that new buildings are built to the most energy-efficient specifications available, starting in 2009. In this case, residential delivered energy consumption in 2030 is 27 percent less than in the 2008 technology case and 22 percent less than in the reference case. Purchases of new energy-efficient products, especially compact fluorescent and solid-state lighting and condensing gas furnaces, reduce energy use without lowering service levels.

Several current Federal programs, including Zero Energy Homes and ENERGY STAR Homes, promote the use of efficient appliances and building envelope components, such as windows and insulation. In the best available technology case, use of the most efficient building envelope components available can reduce heating requirements in an average new home by more than 60 percent.

Residential Electricity Use for Lighting Is Expected To Decline

Figure 47. Electricity consumption for residential lighting, 2006-2030 (billion kilowatthours per year)



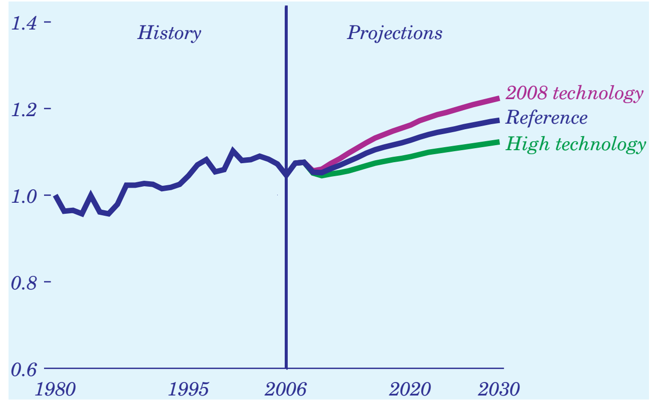
Residential electricity use for lighting accounted for about 16 percent of the sector's total electricity consumption in 2006, making it the second largest use for electricity in households. In the *AEO2008* reference case, electricity use for lighting declines as a result of the lighting efficiency standards in EISA2007, which require general-service incandescent light bulbs to reduce wattage by about 28 percent by 2014, increasing to 65 percent in 2020. DOE is required to examine the potential for tighter standards after 2020, but the details are uncertain and are not included in the *AEO2008* reference case.

Figure 47 summarizes residential lighting use in the *AEO2008* reference case and a case without EISA-2007. Given the relatively rapid turnover in incandescent lighting, EISA2007 achieves electricity savings immediately, reducing lighting demand by 27 percent (59 billion kilowatthours) in 2015. With continued tightening of the standard through 2020, demand for lighting is reduced by 85 billion kilowatthours in 2030, as efficient lighting options, mainly LEDs, gain market share.

In 2007, roughly 200 million compact fluorescent light (CFL) bulbs were sold in the United States, accounting for about 10 percent of total sales. Even without the new standards, CFL sales in the residential market were expected to continue growing in the coming years. LED lamps, which are just now being introduced in the general-service residential lighting market, reach nearly 20 percent of sales in 2020 without the EISA2007 standards. With the EISA2007 standards, the market share for LED bulbs in 2020 doubles.

Rise in Commercial Energy Use per Capita Is Projected To Continue

Figure 48. Commercial delivered energy consumption per capita, 1980-2030 (index, 1980 = 1)

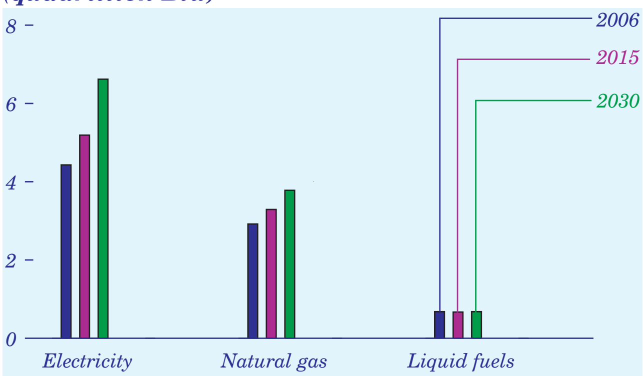


Assumptions about the availability and adoption of energy-efficient technologies define the range for delivered commercial energy use per person in the *AEO2008* projections. Commercial energy consumption per capita increases by a total of 12 percent from 2006 to 2030 in the reference case, primarily as a result of rising electricity use as the Nation continues to move to a service economy. The size of the projected increase varies from a low of 7 percent in the high technology case to a high of 17 percent in the 2008 technology case (Figure 48).

In terms of floorspace, growth in the commercial sector averages 1.2 percent per year from 2006 to 2030, driven by trends in economic and population growth. The reference case assumes future improvements in efficiency for commercial equipment and building shells, as well as increased demand for services. Consequently, commercial energy use increases at about the same rate as floorspace in the reference case, and commercial energy intensity (delivered energy consumption per square foot of floorspace) shows little change, increasing by less than 2 percent. The 2008 technology case assumes no increase in the energy efficiency of commercial equipment and building shells beyond those available in 2008. The result is a 4-percent increase in commercial delivered energy use in 2030 relative to the reference case. In the high technology case, assuming earlier availability, lower costs, and higher efficiencies for more advanced equipment and building shells, delivered energy consumption in 2030 is 4 percent below the reference case projection.

Electricity Leads Expected Growth in Commercial Energy Use

Figure 49. Commercial delivered energy consumption by fuel, 2006, 2015, and 2030 (quadrillion Btu)

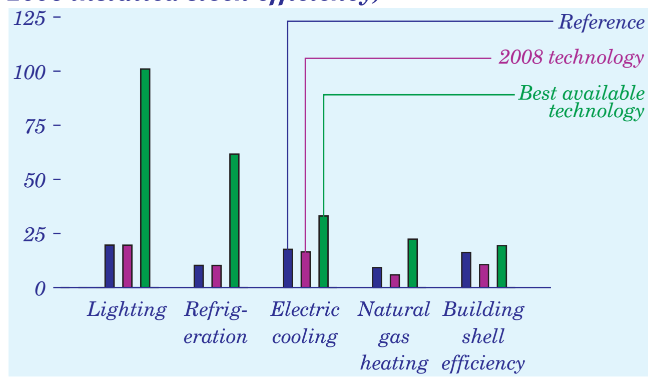


In the *AEO2008* projections, growth in disposable income leads to increased demand for services from hotels, restaurants, stores, theaters, galleries, arenas, and other commercial establishments, which in turn are increasingly dependent on computers and other electronic office equipment both for basic services and for business services and customer transactions. In addition, the growing share of the population over age 65 increases demand for health care and assisted-living facilities and for electricity to power medical and monitoring equipment at those facilities. The reference case projects increases in commercial electricity use averaging 1.7 percent per year from 2006 to 2030 (Figure 49). The high technology and 2008 technology cases provide low and high ranges for the average annual growth rate of commercial electricity consumption from 2006 to 2030, at 1.4 percent and 2.0 percent, respectively.

Use of natural gas and liquids for heating shows limited growth, as commercial activity reflects the U.S. population shift to the South and West and the efficiency of building and equipment stocks improves. Commercial natural gas use grows by 1.1 percent per year on average from 2006 to 2030 in the reference case, including more use of CHP in the later years. While there is little change in liquid fuel consumption, the projections for natural gas use in 2030 range from 3.8 quadrillion Btu in the reference case to 4.0 quadrillion Btu in the high growth case and 3.5 in the low growth case. The high and low oil price cases show the widest range for liquid fuels use, varying from 7 percent below to 12 percent above the reference case projection of 0.7 quadrillion Btu in 2030.

Technology Provides Potential Energy Savings in the Commercial Sector

Figure 50. Efficiency gains for selected commercial equipment, 2030 (percent change from 2006 installed stock efficiency)



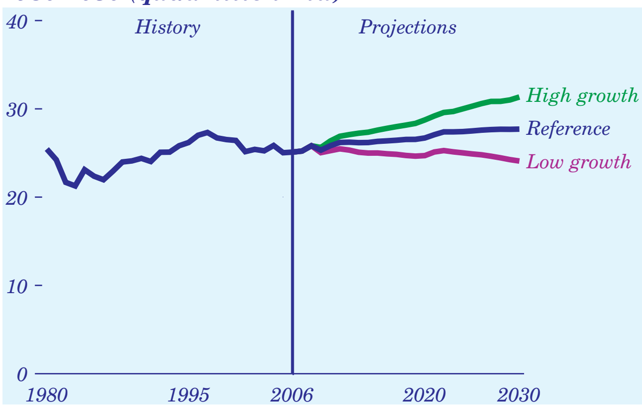
The stock efficiency of energy-using equipment in the commercial sector increases in the *AEO2008* reference case. Adoption of more energy-efficient equipment moderates the growth in demand, in part because of existing building codes for new construction and minimum efficiency standards, including those in EPACT2005 and EISA2007; however, the long service lives of many kinds of energy-using equipment limit the pace of efficiency improvements.

The most rapid increase in overall energy efficiency for the commercial sector occurs in the best available technology case, which assumes that only the most efficient technologies are chosen, regardless of cost, and that new building shells in 2030 are 19 percent more efficient than the commercial buildings stock in 2006. With the adoption of improved heat exchangers for space heating and cooling equipment, solid-state lighting, and more efficient compressors for commercial refrigeration, commercial delivered energy consumption in 2030 in the best technology case is 12 percent less than in the reference case and 16 percent less than in the 2008 technology case.

In the 2008 technology case, which assumes equipment and building shell efficiencies limited to those available in 2008, energy efficiency in the commercial sector still improves from 2006 to 2030 (Figure 50), because the technologies available in 2008 can provide savings relative to equipment currently in place. When businesses consider equipment purchases, however, the additional capital investment needed to buy the most efficient technologies often carries more weight than do future energy savings.

Economic Growth Cases Show Range for Projected Industrial Energy Use

Figure 51. Industrial delivered energy consumption, 1980-2030 (quadrillion Btu)

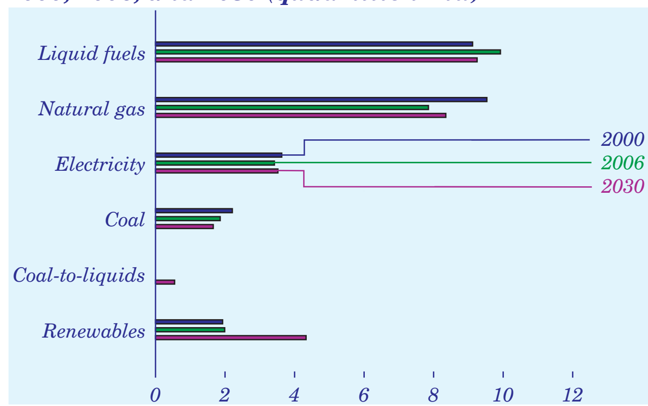


In the *AEO2008* reference case, industrial value of shipments grows at an annual rate of 1.3 percent from 2006 to 2030. Industrial delivered energy consumption increases by just 0.4 percent per year, from 25.1 quadrillion Btu in 2006 to 27.7 quadrillion Btu in 2030, as increased efficiency and changes in the composition of output partially offset growth. In the low economic growth case, industrial value of shipments grows by 0.5 percent per year, and delivered energy consumption falls to 24.2 quadrillion Btu in 2030. In the high growth case, industrial value of shipments grows by 2.0 percent per year, and energy consumption rises to 31.7 quadrillion Btu in 2030, 14 percent higher than in the reference case (Figure 51). The variation in industrial output growth among the three cases is well within the typical range over the past 16 years, when output grew by 1.7 percent per year on average from 1990 to 2007, and annual growth rates ranged from 5.7 percent to a decline of 4.7 percent.

The construction and chemical industries were particularly affected by the recent economic slowdown, and their future growth is expected to be modest (averaging 0.5 percent per year for the construction industry from 2006 to 2030 in the reference case). As a result, energy consumption in the construction sector declines from 2.4 quadrillion Btu in 2006 to 2.2 quadrillion Btu in 2030, with about 70 percent of the decrease attributed to reduced use of asphalt. The bulk chemical industry shows little growth from 2006 to 2030, and its fuel consumption for energy and feedstock totals only 5.6 quadrillion Btu in 2030, as compared with an estimated 6.8 quadrillion Btu in 2006.

Industrial Fuel Choices Vary Over Time

Figure 52. Industrial energy consumption by fuel, 2000, 2006, and 2030 (quadrillion Btu)

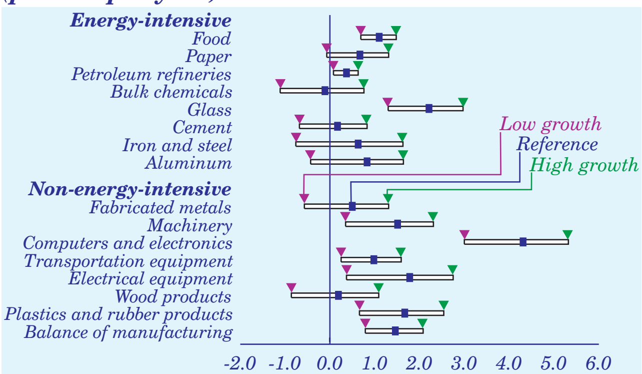


Industries adjust their fuel and product mixes over time to respond to changing markets, as indicated by the falling share of industrial coal use for process steam and the rapid increase in coal use for production of liquid fuels in the *AEO2008* reference case (Figure 52). Traditional coal use falls slightly as the use of metallurgical coal in steelmaking declines, reflecting the difficulty of building additional coke ovens in the United States. Industrial demand for steam coal as a boiler fuel also declines, as industrial processes become more efficient and use less steam, and as the growth of energy- and steam-intensive industries slows. As a result, consumption of steam coal in the industrial sector declines by 0.3 percent per year in the reference case projection.

Natural gas consumption, excluding lease and plant use, increases from 6.7 quadrillion Btu in 2006 to 7.1 quadrillion Btu in 2030—only slightly less than in 1990 (7.2 quadrillion Btu). Consumption of liquid fuels falls slightly, from 9.9 quadrillion Btu in 2006 to 9.3 quadrillion Btu in 2030, but remains the largest category of industrial energy consumption. About three-quarters of industrial liquids consumption is for nonfuel uses or as a byproduct in the refining industry. Industrial consumption of purchased electricity grows by just 0.1 percent per year. The only industrial fuels for which significant increases are projected are coal used in CTL plants and biofuel for ethanol production. From no commercial production in 2006, coal use for CTL grows to 0.6 quadrillion Btu in 2030 in the reference case, and biofuel use for ethanol production increases eightfold, to 2.3 quadrillion Btu in 2030.

Energy-Intensive Industries Grow Less Rapidly Than Industrial Average

Figure 53. Average growth in value of shipments for the manufacturing subsectors, 2006-2030 (percent per year)



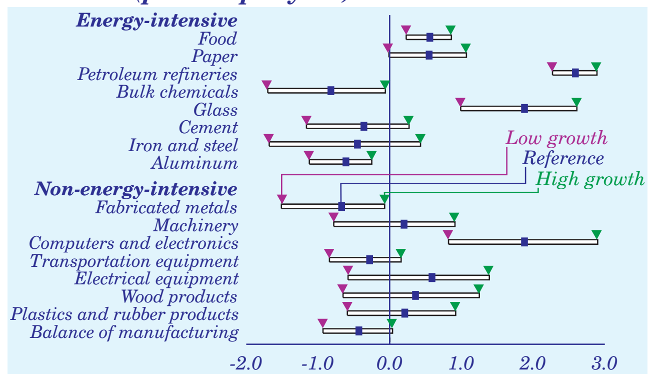
In the *AEO2008* reference case, average annual growth in value of shipments for the manufacturing sectors ranges from a decline of 0.1 percent per year (bulk chemicals) to an increase of 4.3 percent per year (computers). The pattern is similar in the economic growth cases (Figure 53).

For the bulk chemical industry, value of shipments grows slowly for several years and then falls slightly over the last decade of the projection, as export demand falls and other countries increase production. The annual rate of growth in the energy-intensive manufacturing group (0.7 percent) is lower than in the non-energy-intensive group (1.9 percent). Glass is the only energy-intensive subsector with a growth rate above 2 percent per year in the reference case. The growth rate for the industrial sector as a whole in the final 10 years of the projection is slightly lower than in the earlier years (1.2 percent compared with 1.4 percent). Growth rates for the individual subsectors vary considerably, with about one-quarter of them growing more rapidly in the final decade.

The projected growth rates for value of shipments in the industrial subsectors in the high and low economic growth cases generally are symmetrical around the reference case. Industries with the most rapid projected growth in the reference case also have relatively more rapid growth in the high and low economic growth cases. The range across economic growth cases and subsectors is substantial, from a decline of 1.1 percent per year for bulk chemicals in the low economic growth case to an increase of 5.3 percent per year for computer manufacturing in the high economic growth case.

Energy Consumption Growth Varies Widely Across Industry Sectors

Figure 54. Average growth of delivered energy consumption in the manufacturing subsectors, 2006-2030 (percent per year)

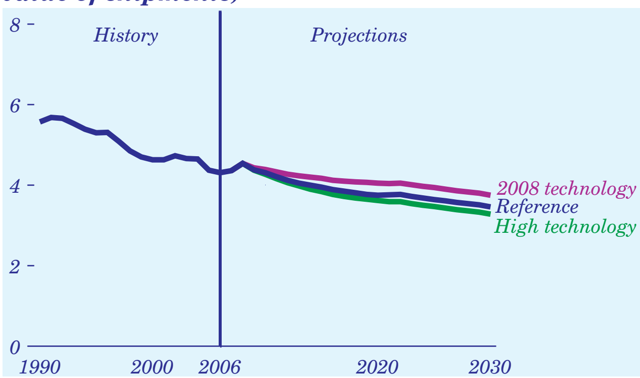


The range of projections for industrial energy consumption in *AEO2008* largely reflects uncertainty about the rate of economic growth. Average annual growth in total delivered energy consumption in the industrial sector from 2006 to 2030 ranges from a decline of 0.1 percent in the low economic growth case to an increase of 1.0 percent in the high economic growth case. In 2030, consumption is 3.5 quadrillion Btu lower in the low economic growth case and 4.0 quadrillion Btu higher in the high economic growth case when compared with the reference case. Thus, across the cases, the range for industrial energy consumption in 2030 is 7.5 quadrillion Btu.

In the reference case, energy consumption growth varies substantially among industry subsectors (Figure 54). Delivered energy consumption falls over the projection period for one-half of the energy-intensive industries (bulk chemicals, cement, iron and steel, and aluminum) as a result of relatively slow output growth rates, combined with expected changes in production technology over the projection period. The declines are reinforced by modest increases in energy prices after 2020. In general, the subsectors with the highest growth rates in energy consumption are those with the highest growth rates in value of shipments (computers and glass). The petroleum refining sector is an exception. As refineries shift to alternative feedstocks for liquids production (biofuels, coal, heavier crude oil), more energy is required per unit of output than is used for traditional petroleum-based refining. Energy consumption at refineries increases from 3.9 quadrillion Btu in 2006 to 7.3 quadrillion Btu in 2030—more than the total growth in industrial sector energy consumption.

Energy Intensity in the Industrial Sector Continues To Decline

Figure 55. Industrial delivered energy intensity, 1990-2030 (thousand Btu per 2000 dollar value of shipments)



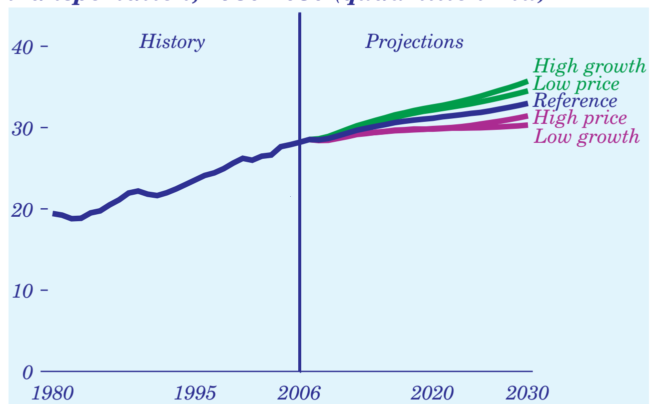
From 1990 to 2006, energy consumption in the industrial sector increased by only 0.5 quadrillion Btu (3 percent), while the value of shipments increased by 33 percent. Thus, industrial delivered energy use per dollar of industrial value of shipments declined by an average of 1.6 percent per year from 1990 to 2006 (Figure 55). Factors contributing to the drop in energy intensity include continued restructuring that reduced the industrial sector share of the most energy-intensive industries; higher petroleum and natural gas prices since 1998, which stimulated greater improvements in energy efficiency; and hurricane-related shutdowns in 2005.

The energy-intensive industries' share of industrial output fell from 23 percent in 1990 to 21 percent in 2006; and in 2030 their share is projected to be 18 percent. Consequently, even if no specific industry showed a reduction in energy intensity, the aggregate energy intensity of the industrial sector would decline. The shift in output share to less energy-intensive industries accounts for 84 percent of the projected change in industrial energy intensity in the reference case [*80*].

The technology cases represent alternative views of the evolution and adoption of energy-saving technologies in the industrial sector. In the high technology case, industrial energy intensity falls by 1.1 percent per year, compared with 0.9 percent per year in the reference case. In the 2008 technology case, energy intensity improves by only 0.5 percent per year. Across the technology cases, industrial energy consumption in 2030 varies over a range from 26.5 to 30.3 quadrillion Btu.

Growth in Transportation Energy Use Is Expected To Slow

Figure 56. Delivered energy consumption for transportation, 1980-2030 (quadrillion Btu)



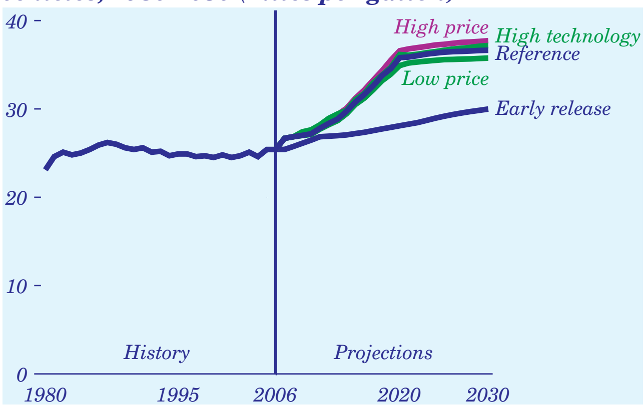
Delivered energy consumption in the transportation sector grows at an average annual rate of 0.7 percent in the *AEO2008* reference case, from 28.2 quadrillion Btu in 2006 to 33.0 quadrillion Btu in 2030 (Figure 56). That rate is less than the historical rate of 1.4 percent per year from 1980 to 2006, because the new EISA2007 fuel economy standards, slower economic growth, and higher fuel prices lead to efficiency improvements and slower growth in travel demand.

Transportation energy consumption is influenced by a variety of factors, including economic growth, population growth, fuel prices, and vehicle fuel efficiency. *AEO2008* includes cases that examine the impacts of those factors on delivered energy consumption. In 2030, transportation sector energy consumption is about 8 percent higher in the high economic growth case and 8 percent lower in the low economic growth case than in the reference case, and it is about 5 percent lower in the high price case and 5 percent higher in the low price case than in the reference case.

By mode, the largest share of total transportation energy consumption is for travel by LDVs (cars, pickup trucks, sport utility vehicles, and vans). The modes with the largest increases in energy demand are heavy trucks (medium and large—classes 3 through 8—freight trucks and buses) and aircraft. Heavy vehicles, which accounted for 18 percent of the sector's total energy use in 2006, account for 20 percent in 2030 in the reference case. With expected strong growth in demand for air travel and more investment in infrastructure, air travel also accounts for a growing portion of total energy consumption (13 percent in 2030, up from 9 percent in 2006).

EISA2007 Improves Fuel Economy of Light-Duty Vehicles

Figure 57. Average fuel economy of new light-duty vehicles, 1980-2030 (miles per gallon)



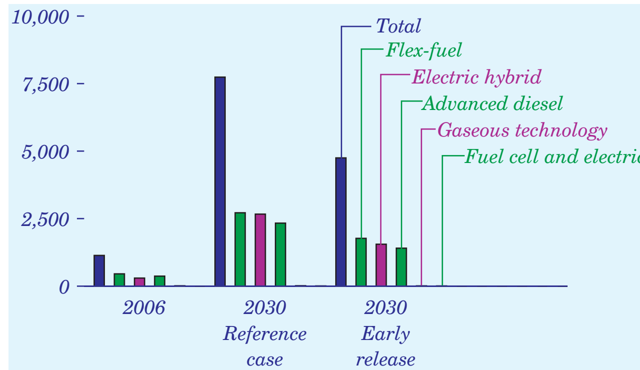
Light trucks have made up a steadily growing share of U.S. LDV sales in recent years, accounting for more than 50 percent of all new LDVs in 2006, compared with 21 percent in 1980 [*81*]. Consequently, despite fuel economy improvements, the average fuel economy of new LDVs declined from a 1987 peak of 26.2 mpg to a low of 25.4 mpg in 2005 and remained at roughly that level in 2006 (Figure 57).

EISA2007, enacted in December 2007, sets a new CAFE standard of 35 mpg for LDVs in 2020. Without EISA2007 (in the early release case), some advanced vehicle technologies are adopted, and the average fuel economy for new LDVs increases to 30.0 mpg in 2030. In the *AEO2008* reference case, with the EISA2007 provisions included, the fuel economy of new LDVs increases to 36.6 mpg in 2030.

The economics of fuel-saving technologies improve further in the high technology and high price cases, and consumers buy more fuel-efficient cars and trucks. In both cases, however, average fuel economy improves only modestly from the reference case level, because meeting the CAFE standards in EISA2007 already requires significant penetration of advanced technologies, pushing fuel economy improvements to the limit of current economic feasibility. In the low price case there is little or no economic incentive for consumers to purchase more fuel-efficient vehicles, and LDV fuel economy in 2030 is slightly lower than in the reference case.

Unconventional Vehicle Technologies Exceed 25 Percent of Sales in 2030

Figure 58. Sales of unconventional light-duty vehicles by fuel type, 2006 and 2030 (thousand vehicles sold)



Concerns about oil supply, fuel prices, and emissions have driven the development and market penetration of unconventional vehicles (which can use alternative fuels, electric motors and advanced electricity storage, advanced engine controls, or other new technologies). Unconventional technologies are expected to play an even greater role in meeting the LDV CAFE standards in EISA2007. In the reference case (with EISA2007), unconventional vehicle sales total 7.7 million units (42 percent of new LDV sales) in 2030. Without EISA2007, only 4.7 million units are sold in 2030, making up 25 percent of total new LDV sales (Figure 58).

Sales of hybrid vehicles grow to 2.7 million units in 2030 in the reference case, compared with 1.6 million units without EISA2007. Light-duty diesel engines with advanced direct injection, which can significantly reduce exhaust emissions and improve efficiency, capture 13 percent of the market for new LDVs in 2030. The availability of ultra-low-sulfur diesel (ULSD) and biodiesel fuels, along with advances in emission control technologies that reduce criteria pollutants, increase the sales of unconventional diesel vehicles.

Currently, manufacturers have an incentive to sell flex-fuel vehicles (FFVs), because they receive fuel economy credits that count toward CAFE compliance. Although the credits are phased out by 2020 under EISA2007, FFV sales increase from 454,600 units in 2006 to 2.7 million units in 2030 in the reference case as a result of the growing use of E85 that is needed to satisfy the EISA2007 RFS.