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BEFORE THE

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UNITED STATES HOUSE OF REPRESENTATIVES

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Chairman Lummis, Ranking Member Swalwell and Members of the Committee, I appreciate the opportunity to appear before you today to provide testimony on the U.S. energy outlook.

The U.S. Energy Information Administration (EIA) is the statistical and analytical agency within the U.S. Department of Energy. EIA collects, analyzes, and disseminates independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding regarding energy and its interaction with the economy and the environment. EIA is the Nation's premier source of energy information and, by law, its data, analyses, and forecasts are independent of approval by any other officer or employee of the United States Government. The views expressed in our reports, therefore, should not be construed as representing those of the Department of Energy, Administration, or other federal agencies.

The energy information and projections that I will discuss today are widely used by government agencies, the private sector, and academia as a starting point for their own energy analyses. EIA prepares both short-term energy outlooks, examining monthly trends over the next one to two years, and long-term outlooks, with annual projections over the next 20-to-25 years. Copies of the most recent outlooks are included as part of my testimony. I will summarize some key findings from our February *Short Term Energy Outlook* (STEO), which includes monthly forecasts through the end of 2014, and the recently released 2013 *Annual Energy Outlook* (*AEO*) Reference case. I will then provide more detail on key trends in electricity and transportation markets.

The short-term energy outlook

The February 2013 STEO forecasts for 2014 are the first to include the extension of the federal production tax credits for certain renewable energy sources. Major highlights include:

Crude oil prices projected to decline over next two years

EIA expects that the Brent crude oil spot price, which averaged $112 per barrel in 2012, will fall to an average of $109 per barrel in 2013 and $101 per barrel in 2014. The projected discount of West Texas Intermediate (WTI) crude oil to Brent, which averaged close to $18 per barrel in 2012, falls to an average closer to $17 per barrel in 2013 and $9 per barrel in 2014, as planned new pipeline capacity lowers the cost of moving mid-continent crude oil to the Gulf Coast refining centers.

Gasoline prices expected to follow crude oil prices in near-term

EIA expects that falling crude prices will help national average regular gasoline retail prices fall from an average $3.63 per gallon in 2012 to annual averages of $3.55 per gallon and $3.39 per gallon in 2013 and 2014, respectively. Diesel fuel retail prices averaged $3.97 per gallon during 2012 and are forecasted to fall to an average of $3.92 per gallon in 2013 and $3.82 per gallon in 2014.

U.S. crude oil production increases 1.4 million barrels per day between 2012 and 2014

EIA estimates U.S. total crude oil production averaged 6.4 million barrels per day (bbl/d) in 2012, an increase of 0.8 million bbl/d from the previous year. Projected domestic crude oil

production increases to 7.3 million bbl/d in 2013 and 7.8 million bbl/d in 2014 which would mark the highest annual average level of production since 1988.

Total liquids consumption largely unchanged over next two years

Total U.S. liquid fuels consumption fell from an average 20.8 million bbl/d in 2005 to 18.6 million bbl/d in 2012. EIA expects total consumption to rise slowly over the next two years to an average 18.7 million bbl/d in 2014, driven by increases in distillate and liquefied petroleum gas consumption, with flat gasoline and jet fuel consumption.

Natural gas prices rise from the low levels seen in 2012

Natural gas working inventories, which reached a record-high level in early November, ended 2012 at an estimated 3.4 trillion cubic feet (Tcf), slightly below the level at the same time the previous year. EIA expects the Henry Hub natural gas spot price, which averaged $4.00 per million British thermal units (MMBtu) in 2011 and $2.75 per million MMBtu in 2012, will average $3.53 per MMBtu in 2013 and $3.84 per MMBtu in 2014.

Rising natural gas prices contribute to a modest rise in coal-fired electricity generation

EIA expects the coal share of total electricity generation to rise from 37.4 percent in 2012 to 39.1 percent in 2013 and 2014, as natural gas prices rise relative to coal prices. Lower-than-projected natural gas prices along with the industry's response to future environmental regulations could cause the coal share of total generation to fall below this forecast.

Generation from renewable sources continues to rise

EIA expects generation from conventional hydropower will decline in 2013 then rebound slightly in 2014. Other renewables, especially wind and solar, continue to grow. The amount of electricity generated from wind is expected to grow by 16 percent in 2013 and another 8 percent in 2014. Solar power generation, specifically utility scale in the electric power industry, is expected to grow by 64 percent this year and another 47 percent in 2014. All solar generation, including distributed applications, is expected to grow by roughly 30 percent annually in 2013 and 2014. Overall, EIA expects the share of total electricity generation from all renewables to increase from 12 percent in 2012 to nearly 13 percent in 2013 and 2014.

Long-term energy outlook

Annual Energy Outlook. Turning to the *Annual Energy Outlook 2013* (AEO2013):

Projections in the AEO2013 Reference case focus on the factors that shape U.S. energy markets through 2040, under the assumption that current laws and regulations remain generally unchanged throughout the projection period. The trends discussed here focus on the AEO2013 Reference case, which provides the basis for examination and discussion of energy market trends and serves as a starting point for analysis of potential changes in U.S. energy policies, rules, or regulations or potential technology breakthroughs. Readers are encouraged to review the full range of cases that will be presented when the complete AEO2013 is released in early 2013, exploring key uncertainties in the Reference case. Major highlights in the AEO2013 Reference case include:

Crude oil production, particularly from tight oil plays, rises sharply over the next decade

The advent and continuing improvement of advanced crude oil production technologies continue to lift projected domestic supply. Domestic production of crude oil increases sharply in AEO2013. The growth results largely from a significant increase in onshore crude oil production, particularly from shale and other tight formations.

Natural gas production rises throughout the* AEO2013 *Reference case projection, with natural gas increasingly serving the industrial and electric power sectors, as well as an expanding export market

Relatively low natural gas prices, facilitated by growing shale gas production, spur increased use in the industrial and electric power sectors, particularly over the next 15 years. Natural gas use (excluding lease and plant fuel) in the industrial sector increases by 16 percent, from 6.8 trillion cubic feet per year in 2011 to 7.8 trillion cubic feet per year in 2025. Although natural gas also continues to capture a growing share of total electricity generation, natural gas consumption by power plants does not increase as sharply as generation because new plants are very efficient. The natural gas share of generation reaches 30 percent in 2040. Natural gas also reaches other new markets, such as exports, as a fuel for heavy-duty freight transportation (trucking), and as a feedstock for producing diesel and other fuels.

Projected motor gasoline consumption declines in* AEO2013 *reflecting the introduction of more stringent corporate average fuel economy standards; growth in diesel fuel consumption is moderated by increased use of natural gas in heavy-duty vehicles

AEO2013 incorporates the greenhouse gas (GHG) and corporate average fuel economy (CAFE) standards for light-duty vehicles (LDVs) through the 2025 model year. Motor gasoline consumption, inclusive of ethanol volumes, declines from 8.78 million barrels per day in 2011 to 8.39 million barrels per day in 2020 and 7.23 million barrels per day by 2040. Furthermore, the improved economics of liquefied natural gas (LNG) for heavy-duty vehicles results in an increase in natural gas use in heavy-duty vehicles that offsets a portion of diesel fuel consumption.

The United States exports more natural gas than projected in the AEO2012 Reference case

U.S. dry natural gas production increases throughout the projection period, outpacing domestic consumption by 2020 and spurring net exports of natural gas. Higher volumes of shale gas production in AEO2013 are central to higher total production volumes and an earlier transition to net exports than was projected in the *AEO2012* Reference case. U.S. exports of LNG from domestic sources rise to approximately 1.6 trillion cubic feet (Tcf) in 2027, almost double the 0.8 trillion cubic feet projected in *AEO2012*. U.S. net exports to Mexico via pipeline also increase steadily over the projection period, from 0.5 Tcf in 2011 to 2.4 Tcf in 2040.

Industrial production expands in response to the initial competitive advantage of low natural gas prices

Industrial production grows more rapidly in AEO2013 due to the benefit of strong growth in shale gas production and an extended period of relatively low natural gas prices, which lower the costs of both raw materials and energy, particularly through 2025. Specific industries benefit from the greater availability of natural gas at relatively low prices. For example, industrial production grows by 1.7 percent per year from 2011 to 2025 in the bulk chemicals industries—which also benefit from increased production of natural gas liquids—and by 2.8 percent per year in the primary metals industries, as compared with 1.4 percent and 1.1 percent per year, respectively, in the *AEO2012* Reference case. In the long term, growing competition from abroad in these industries limits output growth, as other nations develop and install newer, more energy-efficient facilities. The higher level of production also leads to greater industrial natural gas demand (excluding lease and plant fuel), which grows from 6.9 quadrillion Btu in 2011 to more than 8.5 quadrillion Btu in 2040 in AEO2013. Most of the increase in industrial energy demand is the result of higher output in the manufacturing sector.

Renewable fuel use grows at a much faster rate than fossil fuel use

The share of generation from renewables grows from 13 percent in 2011 to 16 percent in 2040. Electricity generation from solar and, to a lesser extent, wind energy sources grow as recent cost declines make them more economical. However, the AEO2013 projection is less optimistic than *AEO2012* about the ability of advanced biofuels to capture a rapidly growing share of the liquid fuels market.

With improved efficiency of energy use and a shift away from the most carbon-intensive fuels, U.S. energy-related carbon dioxide (CO_2) emissions remain more than 5 percent below their 2005 level through 2040

Total U.S. energy-related CO_2 emissions do not return to their 2005 level (5,997 million metric tons) by the end of the AEO2013 projection period. Emissions from motor gasoline use are reduced by the adoption of fuel economy standards, biofuel mandates, and shifts in consumer behavior. Emissions from coal use in the generation of electricity are lower as power generation shifts from coal to lower-carbon fuels, including natural gas and renewables.

Electricity Markets

Slowing demand growth (Figures 1 – 3)

As shown in Figure 1, over the next three decades electricity use is expected to continue to grow, but the rate of growth will slow over time as it has almost continuously over the last 60 years. In the 1950s, 1960s, and 1970s the use of electricity often increased more than 5 percent per year. Annual rates of increase in electricity usage then slowed to 2 to 3 percent per year in the 1980s and 1990s and, over the last decade, it has fallen to less than one percent per year.

The factors driving this trend include slowing population growth, near market saturation of key electricity-using appliances like air conditioners, water heaters, stoves, dishwashers, etc., and

the improving efficiency of nearly all equipment and appliances in response to standards and technological change and a shift in the economy towards less energy intensive industry.

The dramatic changes in the residential sector are evident in the 2009 data from EIA's Residential Energy Consumption Survey (RECS) which show that the average household consumed 90 million Btu (Figure 2). Despite increases in the number and the average size of homes plus increased use of electronics, improvements in efficiency for space heating, air conditioning, and major appliances have all led to decreased consumption per household. At the same time, as shown in Figure 3, the average U.S. household uses many more consumer electronics — in particular, personal computers, televisions and related devices.
Over 45 percent of homes have at least one television with a screen size of 37 inches or larger. DVD players and Digital Video Recorders (DVR), which did not exist 20 years ago, are now widespread. As of 2009, 79 percent of homes had a DVD player, and 43 percent had a DVR. Nearly a third of all households also had at least four rechargeable electronic devices, such as cell phones, plugged in and charging at home.

While there is always uncertainty about future electricity demand, efficiency standards for lighting and other appliances that have been put in place over the past few years will continue to place downward pressure on growth as new equipment is added and existing stock is replaced. Absent a very rapid introduction of some new electricity-using device a sharp rebound in electricity demand growth is not expected.

Shifting fuel mix (Figures 4)

As shown in Figure 4, between 1990 and 2008, coal-fired power plants accounted for 50 percent or more of U.S. electricity generation each year. However, since 2008, coal's share of generation has declined each year, reaching 42 percent in 2011 and 37 percent in 2012 (preliminary data through November). The story for natural gas is almost the complete opposite. After falling to less than 10 percent of total generation in 1988, natural gas's share of generation increased to nearly 25 percent in 2011 and 31 percent in 2012 (preliminary data through November).

The decline in coal and the rise of natural gas in recent years has been driven primarily by two factors, the economy and the huge fall in natural gas prices that occurred as shale gas resources were successfully developed. The recession that began in late 2007 contributed to two year-on-year declines in electricity generation, the first time that ever occurred in the data maintained by EIA. Most of that reduction in generation was absorbed by coal. As demand for electricity started to recover in 2010, natural gas prices continued to decline. As a result, natural gas became more competitive with coal as a fuel for electricity generation.

Going forward, coal generation recovers somewhat as gas prices rise, but not enough to increase its market share. Non-hydro renewable generation actually shows the most rapid growth, as state and federal programs spur growth in the near-term and they become increasingly competitive in the long term. By 2040, EIA projects that the natural gas share of generation is at 30 percent (Figure 4).

New Capacity Additions/Retirements (Figure 5)

The relatively low natural gas prices that are projected to persist throughout most of the AEO projections cause new capacity additions to be dominated by new natural gas-fired combined cycle and combustion turbine plants. Through 2040, natural gas plants account for 64 percent of the new capacity added. Most of the remaining capacity additions are based on renewable sources. In the near term, through 2016, new renewable additions are spurred by a combination of federal tax incentives and state renewable portfolio standard (RPS) programs. Though not included in the AEO2013 Reference case, the tax credit extensions recently passed in the American Taxpayer Relief Act of 2012 (H.R. 8) would likely lead to greater near-term renewable capacity additions than are shown here. In the longer term, particularly after 2030, rising natural gas prices and falling new renewable plant costs spur further renewable capacity additions. Overall, through 2040, renewable capacity additions account for 30 percent of total additions.

Additions of other capacity types like nuclear and coal are very modest and consist of a small number of plants that are currently under construction and a small number of additional plants projected to come on after 2030 as natural gas prices rise.

Renewables (Figure 6)

The growth in non-hydro renewable generation is driven by a combination of state renewable portfolio standards and federal tax incentives that spur growth in the near-term as well as the increase in fossil fuel prices that make renewables more competitive in the long term.

Wind, biomass and solar account for the vast majority of the growth. Wind is installed primarily in utility scale facilities, while biomass generation grows in co-firing applications as a co-fuel with coal, and when electricity is produced in biofuel facilities for their own use and sale to the grid.

Growth in solar generation occurs in both utility scale and distributed applications. Among the individual fuels, solar actually shows the most rapid annual percentage growth between now and 2040, but since it starts at such a small level in 2011, its share remains modest in 2040. As more solar facilities have been installed, the costs to install solar generating plants have declined. Based on the preliminary results from a recent study of generating unit capital costs, EIA has lowered its estimate for the capital cost for new utility scale solar plants by over 20 percent. One additional point I would like to make about solar, is that we are concerned that the various data sources we use may not be capturing all of the solar capacity that is being added and we are in the process of trying to improve our solar estimates.

Technological change: improvements in generating unit efficiency (Figure 7)

While the falling price of natural gas has been a key driver in the shift in the fuels used for electricity generation, changes in technology, particularly the efficiency of new generating units

have also been important. Figure 7 highlights the average heat rates of the fossil-fired electric generation fleet from 1990 through 2011. The heat rate is a measure of the thermal efficiency of an electric generating station and is commonly expressed in Btu per kilowatthour. The lower the heat rate, the more efficient the generating unit (i.e. the fewer Btu of fuel required to produce a kilowatthour of electricity). As depicted on the graph, the efficiency of the natural gas generating fleet has improved by over 20 percent.

Historical generating unit installations (Figure 8)

Figure 8 summarizes the capacity installed from 1990 through 2011. As you can see, natural gas-fired units dominated the overall generating unit installations during this time frame, representing 75 percent of the total. Roughly two-thirds of the new natural gas-fired generating capacity installed, or 186 gigawatts, were efficient combined cycle generating units. These new unit installations have contributed to the significant improvement in the overall efficiency of the electricity generating fleet.

Transportation Markets

No growth in transportation energy demand between 2011 and 2040 (Figure 9)

The transportation sector consumes 27.1 quadrillion Btu in 2040 in the AEO2013 Reference case, the same amount of energy demand in 2011. The projection of no growth in transportation energy demand differs markedly from the historical trend, which saw a 1.1 percent average annual growth between 1975 and 2011, and is due to declining light-duty

vehicle (LDV) energy consumption, which offsets increases occurring in the other modes of travel (Figure 9).

Declining light-duty energy demand projected to occur due to more stringent CAFE standards (Figure 10)

Light-duty vehicle energy demand declines from 16.1 quadrillion Btu in 2011 to 13.0 quadrillion Btu in 2040, reducing its share of total transportation demand from 59 percent to 48 percent. This decline contrasts noticeably with the 0.9 percent average annual growth experienced between 1975 and 2011 and is the result of higher projections in light-duty vehicle fuel economy, which more than offsets modest growth in vehicle miles travelled. New light-duty vehicle fuel economy rises in the AEO2013 due to the joint greenhouse gas emissions and CAFE standards for model years 2012 through 2025 (Figure 10). While subsequent standards are held constant after 2025, light-duty vehicle fuel economy continues to rise.

Growing share of light-duty vehicles powered by non-gasoline sources

Light-duty vehicles that use diesel, other alternative fuels, hybrid-electric, or all-electric systems play a significant role in meeting the more stringent GHG emissions and CAFE standards and provide consumers fuel savings. Sales of hybrid-electric and all-electric vehicles that use stored electric energy for motive power grow considerably, led by gasoline- and diesel hybrid-electric vehicles, which account for 6 percent of total light-duty vehicle sales in 2040. Plug-in hybrid and

plug-in all-electric vehicles account for 3 percent of sales in 2040. Diesel vehicle sales remain relatively constant over the projection period at about 3 percent of total sales.

Personal vehicle travel demand, measured as annual vehicle miles traveled (VMT) per licensed driver, grew at an average annual rate of 1 percent between 1970 and 2007 when it peaked at about 12,800 miles. Vehicle miles traveled per licensed driver remain below the 2007 level until 2029 in the AEO2013 Reference case projection before reaching 13,300 miles in 2040, growing at an average annual rate of 0.3 percent. Demographic forces moderate growth in VMT per licensed driver across the projection, as the number of vehicles per licensed driver declines. Further, unemployment remains above pre-recession levels until around 2020, tempering personal travel demand until that time. While the price of motor gasoline increases by 25 percent from 2011 to 2040, real disposable personal income climbs 95 percent. Growth in income relative to the fuel cost of driving lowers the percentage of income spent on fuel, boosting travel demand.

Rising heavy-duty energy demand with some fuel switching to natural gas (Figure 11)

Heavy-duty vehicle energy consumption, which includes tractor trailers, vocational vehicles as varied as ambulances and cement mixers, and heavy-duty pickups and vans, grows from 5.2 quadrillion Btu in 2011 to 7.6 quadrillion Btu in 2040. This represents the largest growth in the transportation sector and increases the heavy-duty vehicle share of total transportation from 19 percent to 28 percent. Heavy-duty vehicle travel grows by 82 percent between 2011 and 2040, from 240 billion miles to 438 billion miles, an average annual increase of 2.1 percent, This

increase results from growth in industrial output over the projection period and an increase in the number of trucks on the road, from 9.0 million in 2011 to 13.7 million in 2040. Growth in heavy-duty vehicle energy demand is somewhat tempered by projected increases in fuel economy, which rise from 6.7 miles per gallon (mpg) in 2011 to 8.2 mpg in 2040 due to the implementation of the Heavy-Duty National Program greenhouse gas emissions and fuel efficiency standards beginning in model year 2014, along with the economic adoption of fuel saving technology.

Natural gas is projected to have a significant impact on heavy-duty vehicle energy consumption in the AEO2013, with demand rising from 0.02 quadrillion Btu in 2011 to 1.03 quadrillion Btu in 2040, an average annual growth rate of 14.6 percent. Although heavy-duty vehicles fueled by natural gas have significant incremental costs compared to their diesel-powered counterparts, the increase in natural gas consumption is due to low natural gas fuel prices compared to diesel fuel and the purchase of natural gas vehicles in relatively high travel applications such as tractor trailers. The largest heavy-duty vehicles, which include those vehicles with a Gross Vehicle Weight Rating of 26,001 pounds or greater and are primarily tractor trailers, account for about two-thirds of all heavy-duty vehicle travel and consume 91 percent of the natural gas in the heavy-duty vehicle sector by 2040. While natural gas accounts for a rapidly rising share of heavy-duty vehicle energy demand, it still amounts to only 14 percent of total heavy-duty vehicle energy demand in 2040 in the AEO2013 Reference case.

Overall, energy consumption by fuel in the transportation sector shows a marked change between 2011 and 2040 due to the key drivers discussed above. Motor gasoline consumption falls from 16.3 quadrillion Btu in 2011 to 12.6 quadrillion Btu in 2040, a decline in share from 60 percent to 47 percent, due to reduced demand by light-duty vehicles. Diesel fuel consumption grows from 5.9 quadrillion Btu in 2011 to 7.9 quadrillion Btu in 2040, an increase in share from 22 percent to 29 percent, due to growth in heavy-duty vehicle demand. Jet fuel energy consumption rises from 3.0 quadrillion Btu in 2011 to 3.4 quadrillion Btu in 2040, a growth in share from 11 percent to 13 percent. Compressed or liquefied natural gas represents the fastest growing fuel in the transportation sector, with an average annual growth rate of 11.9 percent from 2011 to 2040, reaching 1.1 quadrillion Btu by 2040, or 4 percent of total transportation energy consumption, due to increased use by heavy-duty vehicles. Pipeline fuel (3 percent), E85 (1 percent), and other fuels such as lubricants, propane, electricity, and hydrogen (4 percent) represent the remainder of transportation energy demand in 2040.

Conclusion

As I noted at the outset, while EIA does not take policy positions, its data, analyses, and projections are meant to assist policymakers in their energy deliberations. In addition to the work on baseline projections that I have reviewed this morning, EIA has often responded to requests from this Committee and others for analyses of the energy and economic impacts of energy policy proposals.

This concludes my testimony, Madam Chairman and Members of the Committee. I would be happy to answer any questions you may have.

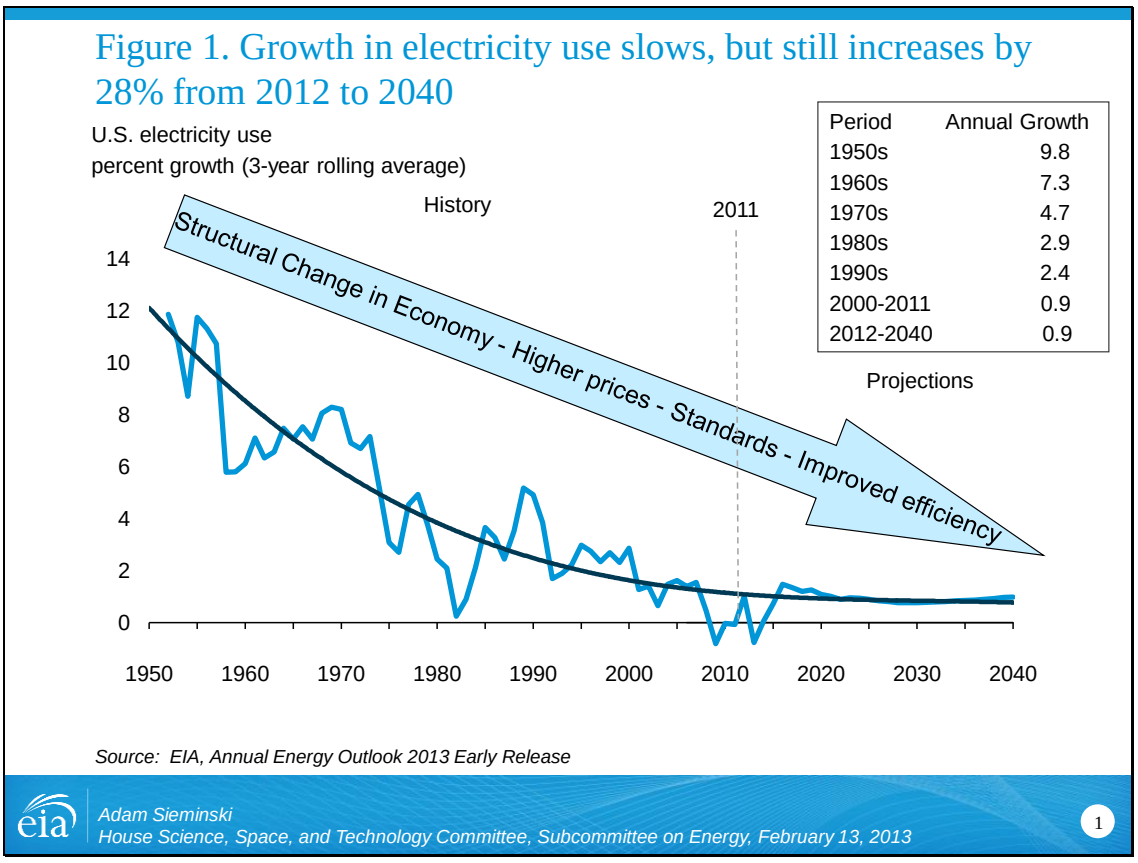
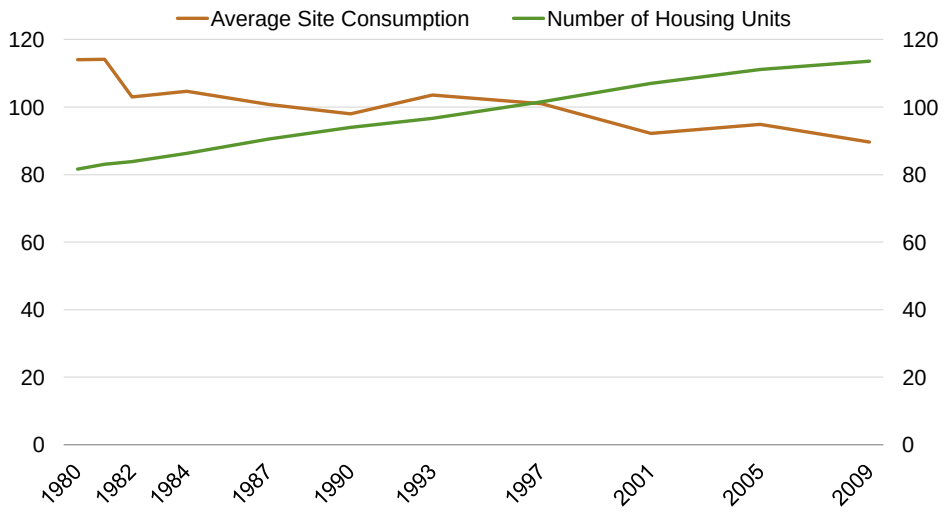


Figure 2. Average residential site consumption has steadily declined over the last 30 years

average site energy consumption per home and number of housing units, 1980 – 2009

million Btu per housing unit | million housing units

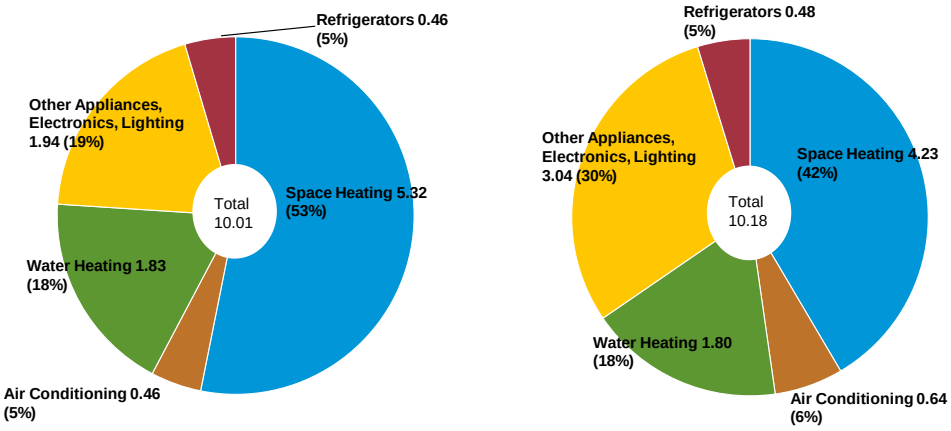


Source: EIA, Residential Energy Consumption Survey (RECS)

Figure 3. Heating and cooling no longer bulk of residential site consumption

total site energy use in homes by end use, 1993 and 2009

quadrillion Btu and percents

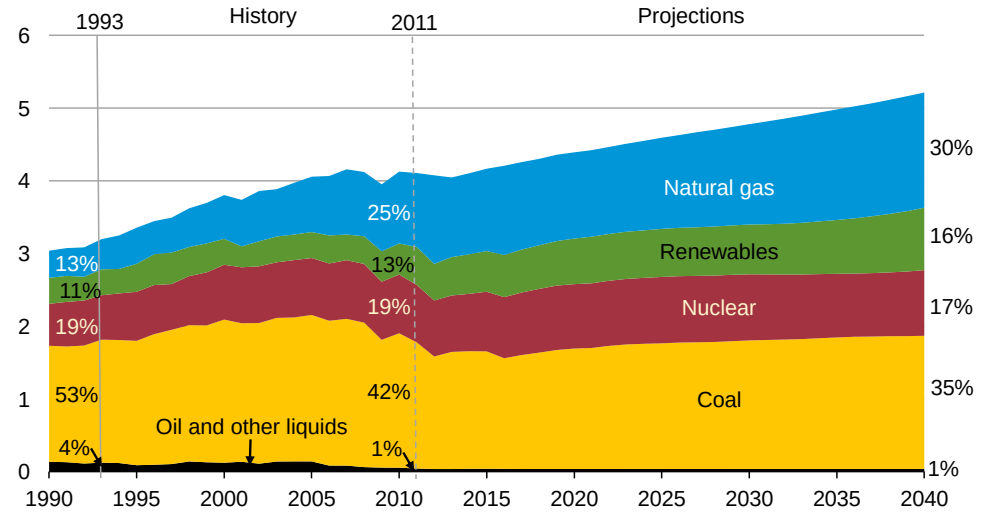


Source: EIA, Residential Energy Consumption Survey (RECS)

Figure 4. Over time the electricity mix gradually shifts to lower-carbon options, led by growth in natural gas and renewables

U.S. electricity net generation

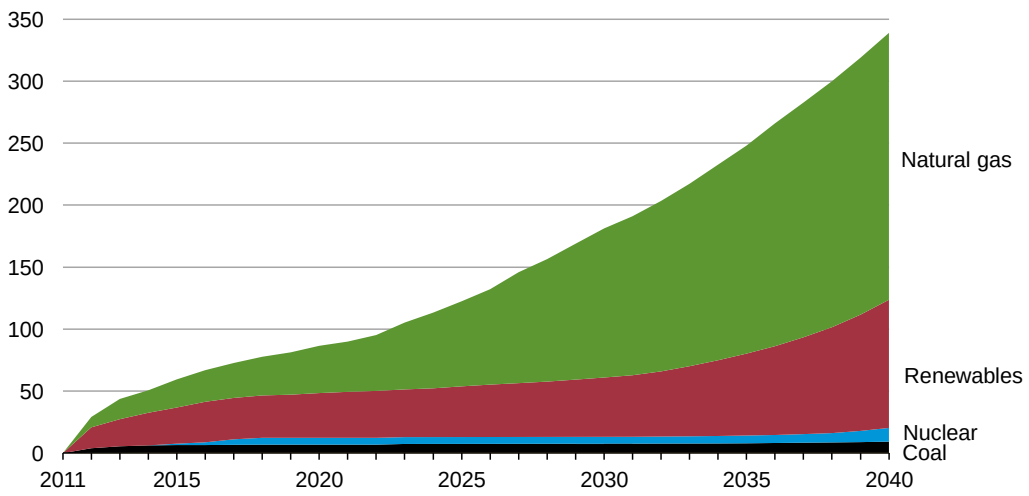
trillion kilowatthours



Source: EIA, Annual Energy Outlook 2013 Early Release

Figure 5. Natural gas and renewables account for the vast majority of capacity additions from 2012 to 2040

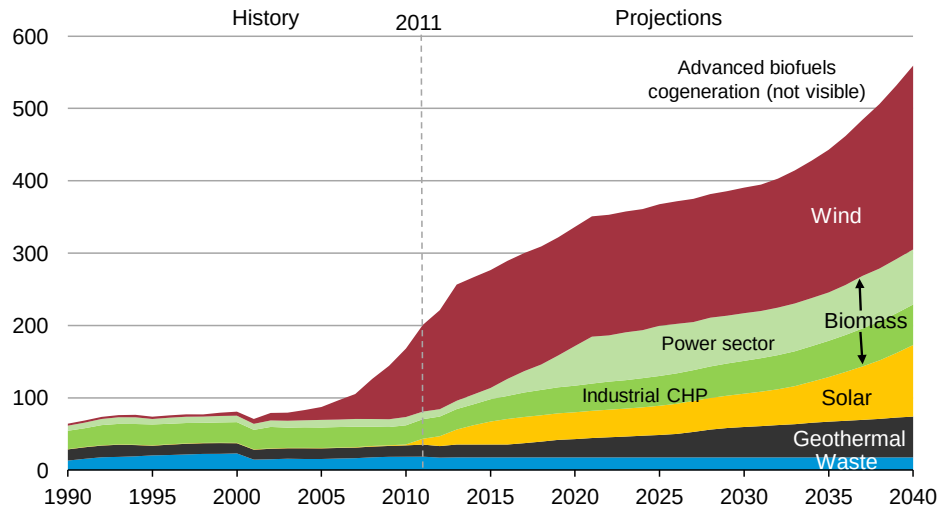
U.S. cumulative capacity additions
gigawatts



Source: EIA, Annual Energy Outlook 2013 Early Release

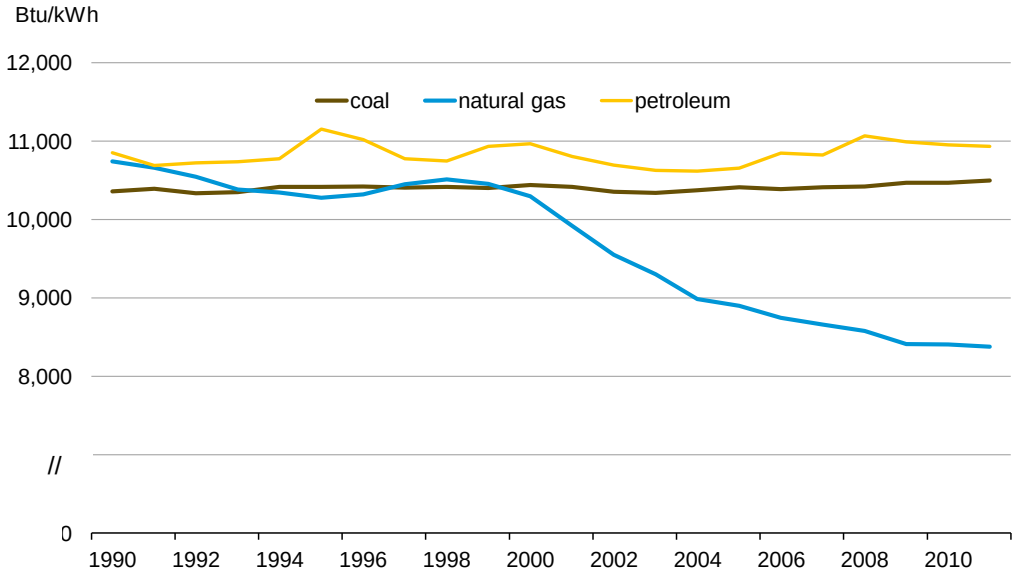
Figure 6. Non-hydro renewable generation more than doubles between 2011 and 2040

Non-hydropower renewable generation
billion kilowatthours per year



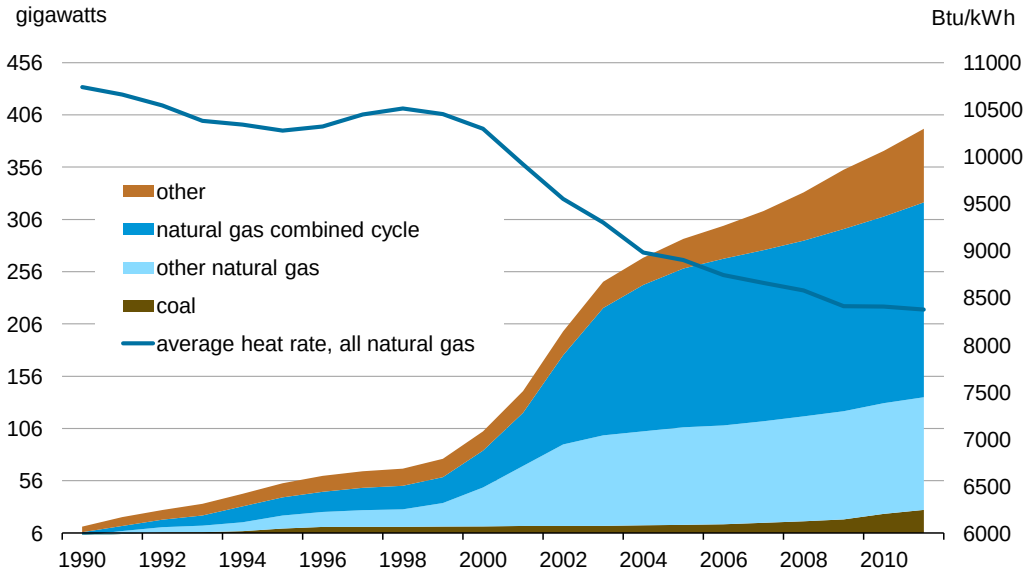
Source: EIA, Annual Energy Outlook 2013 Early Release

Figure 7. Average fossil heat rates in the electric power sector, 1990 – 2011



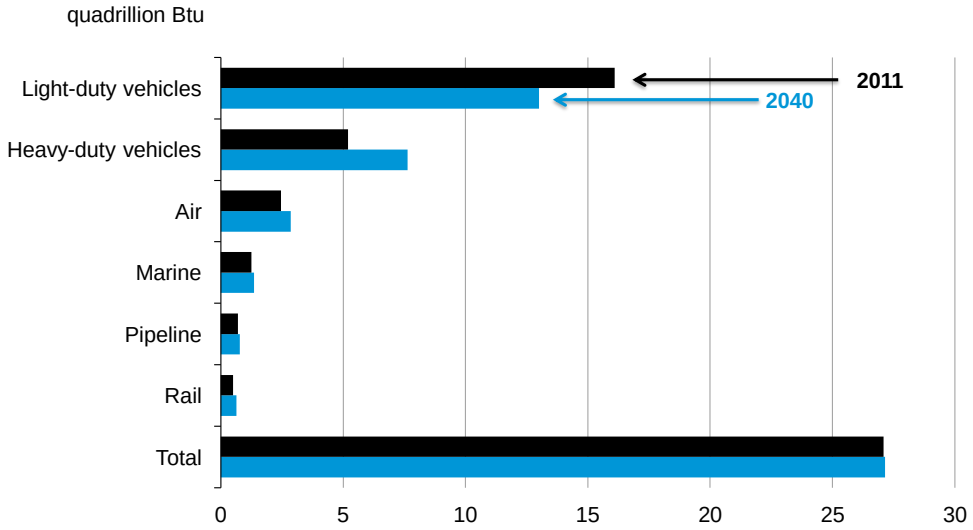
Source: U.S. Energy Information Administration, Form EIA-860, Annual Electric Generator Report

Figure 8. Cumulative capacity additions by fuel and technology type, 1990 – 2011



Source: U.S. Energy Information Administration, Form EIA-860, Annual Electric Generator Report

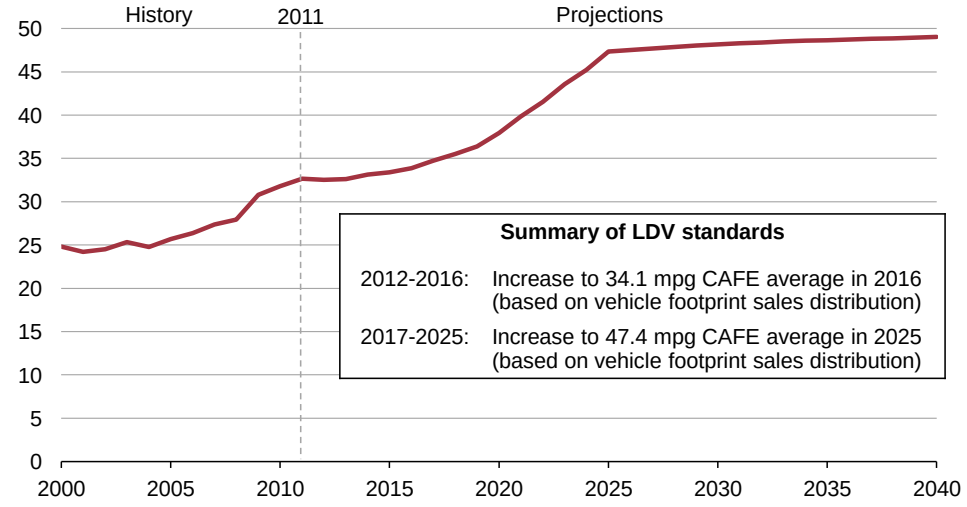
Figure 9. Transportation energy consumption remains almost flat between 2011 and 2040



Source: EIA, Annual Energy Outlook 2013 Early Release

Figure 10. New light duty vehicle fuel economy approaches 50 mpg by 2040

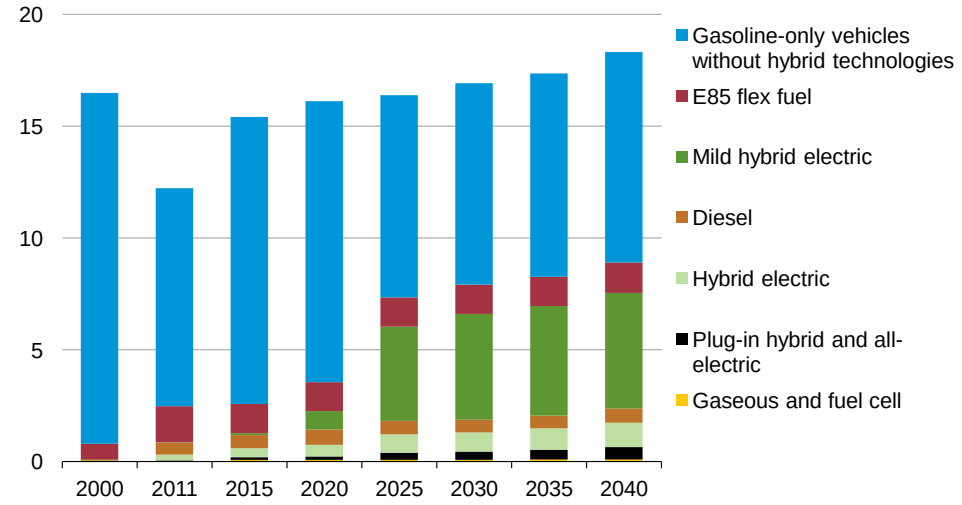
new LDV fuel efficiency
miles per gallon



Source: EIA, Annual Energy Outlook 2013 Early Release

Figure 11. Vehicles with hybrid technologies growing share of new vehicle sales

U.S. light car and truck sales
millions



Source: EIA, Annual Energy Outlook 2013 Early Release