Key results from the AEO2011 Reference case, which assumes current laws remain unchanged

- Increased estimates for U.S. shale gas resources drive increased U.S. production, lower prices, and lower imports of natural gas.
- Industrial natural gas demand recovers, reversing recent trend.
- Non-hydro renewables and natural gas are the fastest growing electricity generation sources, but coal remains the dominant fuel because of the large amount of existing capacity.
- Oil imports fall due to increased domestic production—including biofuels—and greater fuel efficiency.
- U.S. carbon dioxide emissions rise slowly, but do not pass 2005 levels again until 2027.
What is included (and excluded) in developing EIA’s “Reference case” projections?

• Generally assumes current laws and regulations
  – excludes potential future laws and regulations (e.g., proposed greenhouse gas legislation and proposed fuel economy standards are not included)
  – provisions generally sunset as specified in law (e.g., renewable tax credits expire)

• Some grey areas
  – adds a premium to the capital cost of CO₂-intensive technologies to reflect market behavior regarding possible CO₂ regulation
  – assumes implementation of existing regulations that enable the building of new energy infrastructure and resource extraction

• Includes technologies that are commercial or reasonably expected to become commercial over next decade or so
  – includes projected technology cost and efficiency improvements, as well as cost reductions linked to cumulative deployment levels
  – does not assume revolutionary or breakthrough technologies
Key updates included in the AEO2011 Reference case

- **Natural gas and oil supply**
  - More than doubled the technically recoverable U.S. shale gas resources assumed in AEO2010 and added new shale oil resources
  - Updated offshore data and assumptions, pushing out start dates for several projects as a result of the drilling moratoria and delaying Atlantic and Pacific offshore leasing beyond 2017

- **Electricity**
  - Updated costs for new power plants
  - Expanded number of electricity regions to 22 from 13, allowing better regional representation of market structure and power flow

- **Transport**
  - Increased limit for ethanol blending into gasoline from E10 to E15 for approved vehicles, as a result of the EPA waiver granted in October 2010
  - Includes California’s Low Carbon Fuel Standard, which reduces the carbon intensity of gasoline and diesel fuels in that state by 10% from 2012 through 2020
  - Revised light duty vehicle miles travelled downward
  - Updated electric and plug-in hybrid electric battery cost and size
Global energy consumption
Non-OECD countries account for vast majority of the nearly 50% projected increase in global energy use by 2035

energy consumption
quadrillion Btu

- Non-OECD
- OECD w/o U.S.
- U.S.

Source: EIA, *International Energy Outlook 2010*
Overview of U.S. energy supply and demand
Current U.S. energy supply is 83% fossil fuels; demand is broadly distributed among the major sectors

2009 total U.S. energy use = 94.6 quadrillion Btu
Renewables grow rapidly, but under current policies fossil fuels still provide 78% of U.S. energy use in 2035

U.S. primary energy consumption

shares of total U.S. energy

- Coal
- Natural gas
- Liquid biofuels
- Oil and other liquid fuels
- Nuclear

Source: EIA, Annual Energy Outlook 2011
Energy efficiency gains reduce consumption 13% from where it would otherwise be; structural change is even larger

Richard Newell, December 16, 2010

Source: EIA, Annual Energy Outlook 2011
Energy and CO$_2$ per dollar of GDP continue to decline; per-capita energy use also declines.

Source: EIA, Annual Energy Outlook 2011
In the AEO2011 Reference case, energy-related CO₂ emissions grow almost 6% over 2005 levels by 2035.
Electricity
In 2009, electricity generation was 70% fossil fuels, 20% nuclear, and 10% renewable.

2009 Total net generation: 3,953 billion kWh
- Coal: 44.6%
- Natural gas: 23.3%
- Nuclear: 20.2%
- Petroleum: 1.0%
- Other gases: 0.3%

2009 Non-hydro renewable net generation: 141 billion kWh
- Wind: 1.8%
- Geothermal: 0.4%
- Wood and wood-derived fuels: 0.9%
- Other biomass: 0.5%
- Other renewable: 3.6%
- Conventional hydroelectric: 6.9%
- Other: 0.3%

Source: EIA Electric Power Monthly, October 2010

Richard Newell, December 16, 2010
While projected electricity consumption grows by 30%, the rate of growth has slowed.

<table>
<thead>
<tr>
<th>Period</th>
<th>Annual Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950s</td>
<td>9.8</td>
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<tr>
<td>1960s</td>
<td>7.3</td>
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<td>1970s</td>
<td>4.7</td>
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<tr>
<td>1980s</td>
<td>2.9</td>
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<tr>
<td>1990s</td>
<td>2.4</td>
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<tr>
<td>2000-2009</td>
<td>0.5</td>
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<tr>
<td>2009-2035</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Source: EIA, Annual Energy Outlook 2011
The projected electricity mix gradually shifts to lower-carbon options, with generation from natural gas rising 37% and renewables rising 73%.

Source: EIA, Annual Energy Outlook 2011
Updated electric power plant capital costs show increases for nuclear, coal, and wind, while solar costs decline.

Overnight capital cost
2009 dollars per kilowatt

Source: EIA, Annual Energy Outlook 2011
Non-hydro renewable sources grow nearly three-fold, meeting 23% of projected electricity generation growth

non-hydopower renewable generation
billion kilowatthours per year

<table>
<thead>
<tr>
<th>Year</th>
<th>History</th>
<th>2009</th>
<th>Projections</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
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<td>2035</td>
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</tbody>
</table>

Source: EIA, Annual Energy Outlook 2011
Natural gas, wind and other renewables account for the vast majority of capacity additions from 2009 to 2035.
Natural gas
U.S. shale gas production increased 14-fold over the last decade; reserves tripled over the last few years.

Source: Lippman Consulting (2010 estimated)
Shale gas has been the primary source of recent growth in U.S. technically recoverable natural gas resources.

U.S. dry gas resources
trillion cubic feet

- **Unproved shale gas**: 2552 (2011)
- **Unproved other gas**: 1481 (2011)
- **Proved reserves**: 245 (2011)

Source: EIA, *Annual Energy Outlook 2011*
30% domestic gas production growth outpaces 16% consumption growth, leading to declining imports.

U.S. dry gas trillion cubic feet per year

<table>
<thead>
<tr>
<th>Year</th>
<th>Consumption</th>
<th>Net imports</th>
<th>Domestic supply</th>
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<tr>
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<td>2035</td>
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</tbody>
</table>

Source: EIA, Annual Energy Outlook 2011

Richard Newell, December 16, 2010
Shale gas offsets declines in other U.S. supply to meet consumption growth and lower import needs

U.S. dry gas trillion cubic feet per year

History 2009 Projections


Net imports

Shale gas

Non-associated onshore

Non-associated offshore

Tight gas

Coalbed methane

Associated with oil

Alaska

Source: EIA, Annual Energy Outlook 2011
Natural gas consumption is quite dispersed; industrial and electric power use drives future demand growth

U.S. dry gas consumption
trillion cubic feet per year

History 2009 Projections

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<td>2035</td>
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<td>68</td>
<td>70</td>
<td>72</td>
<td>74</td>
<td>76</td>
<td>78</td>
</tr>
</tbody>
</table>

* Includes combined heat-and-power and lease and plant fuel. ** Includes pipeline fuel.

Source: EIA, Annual Energy Outlook 2011

Richard Newell, December 16, 2010
**A number of key economic and market drivers underpin natural gas consumption growth**

<table>
<thead>
<tr>
<th>Sector</th>
<th>TCF gas consumption</th>
<th>Growth (2009-2035)</th>
<th>Key drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial, including combined heat-and-power</td>
<td>7.3 9.3</td>
<td>26%</td>
<td>+187% combined heat-and-power generation; +30% output of gas-intensive industry; lower natural gas prices</td>
</tr>
<tr>
<td>Central electric power</td>
<td>6.9 7.8</td>
<td>13%</td>
<td>+30% electricity consumption; lower natural gas prices; offset by +72% renewable generation and +24% coal generation</td>
</tr>
<tr>
<td>Commercial</td>
<td>3.1 3.8</td>
<td>22%</td>
<td>+37% commercial floorspace; -3% energy intensity</td>
</tr>
<tr>
<td>Residential</td>
<td>4.7 4.8</td>
<td>&lt;1%</td>
<td>+30% number of households; +19% total square footage; -16% energy intensity</td>
</tr>
</tbody>
</table>
Natural gas price projections are significantly lower than past years due to an expanded shale gas resource base.
Oil and other liquid fuels
Oil prices in the Reference case rise steadily; the full AEO2011 will include a wide range of oil prices

annual average price of low sulfur crude oil
real 2009 dollars per barrel

Source: EIA, Annual Energy Outlook 2011
Unconventional sources more than triple globally, but conventional petroleum continues to comprise the vast majority of liquids supply.

global liquids production
million barrels per day

History 2009 Projections


Source: EIA, Annual Energy Outlook 2011

Richard Newell, December 16, 2010
U.S. imports of liquid fuels fall due to increased domestic production—including biofuels—and greater fuel efficiency

U.S. liquid fuels consumption
million barrels per day

Source: EIA, Annual Energy Outlook 2011

Richard Newell, December 16, 2010
Biofuels, natural gas liquids, and crude oil production are key sources of increased domestic liquids supply.

- U.S. liquid fuels
- Net crude oil imports
- Net product imports
- Crude oil production
- Liquids from coal
- Natural gas plant liquids
- Biofuels (including net imports)
- Refinery processing gain

Source: EIA, Annual Energy Outlook 2011

Richard Newell, December 16, 2010
Biofuels fall short of the goal in 2022, but exceed the 36 billion gallon RFS target by 2030

Legislated RFS in 2022

RFS with adjustments under CAA Sec.211(o)(7)

Biodiesel
Net imports
Other Advanced
Cellulosic biofuels
Corn ethanol

Source: EIA, Annual Energy Outlook 2011

Richard Newell, December 16, 2010
New light duty vehicle fuel economy achieves almost 38 mpg by 2035 in the Reference case

Summary of standards

- **2012-2016**: 34.1 mpg CAFE average (based on NHTSA vehicle footprint sales distribution)
- **2020**: 35 mpg by statute
- **2017-2025**: Reference case *does not* include proposal planned for September 2011

Source: EIA, *Annual Energy Outlook 2011*
Most transport fuel growth is in light and heavy duty vehicles

U.S. transportation energy consumption
million barrels per day oil equivalent

History

2009

Projections


Light-duty vehicles

Heavy-duty vehicles

Source: EIA, Annual Energy Outlook 2011

Richard Newell, December 16, 2010

Source: EIA, Annual Energy Outlook 2011
# Efficiency improvements partially offset underlying drivers of growth in transportation services

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2035</th>
<th>Growth (2009-2035)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Light duty vehicles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel consumption (million barrels per day oil equivalent)</td>
<td>8.9</td>
<td>10.2</td>
<td>15%</td>
</tr>
<tr>
<td>Number of licensed drivers (millions)</td>
<td>207</td>
<td>265</td>
<td>28%</td>
</tr>
<tr>
<td>Miles per licensed driver</td>
<td>13,100</td>
<td>15,300</td>
<td>17%</td>
</tr>
<tr>
<td>Efficiency of vehicle stock (mpg)</td>
<td>20.8</td>
<td>27.8</td>
<td>34%*</td>
</tr>
<tr>
<td><strong>Heavy duty vehicles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel consumption (million barrels per day oil equivalent)</td>
<td>2.2</td>
<td>3.2</td>
<td>47%</td>
</tr>
<tr>
<td>Manufacturing output (billion 2005 dollars)</td>
<td>4,197</td>
<td>6,761</td>
<td>61%</td>
</tr>
<tr>
<td>Number of freight trucks (millions)</td>
<td>8.7</td>
<td>16.6</td>
<td>90%</td>
</tr>
<tr>
<td>Miles per vehicle</td>
<td>23,700</td>
<td>20,200</td>
<td>-15%</td>
</tr>
<tr>
<td>Efficiency of vehicle stock (mpg)</td>
<td>6.1</td>
<td>6.6</td>
<td>9%**</td>
</tr>
</tbody>
</table>

* Equal to a 25% reduction in fuel use per mile. ** Equal to an 8% reduction in fuel use per mile.

Richard Newell, December 16, 2010

Source: EIA, Annual Energy Outlook 2011
Unconventional vehicles meet over 40% of U.S. light-duty vehicle sales in 2035

U.S. light car and truck sales
millions

Source: EIA, Annual Energy Outlook 2011
Key results from the AEO2011 Reference case, which assumes current laws remain unchanged

- Increased estimates for U.S. shale gas resources drive increased U.S. production, lower prices, and lower imports of natural gas

- Industrial natural gas demand recovers, reversing recent trend

- Non-hydro renewables and natural gas are the fastest growing electricity generation sources, but coal remains the dominant fuel because of the large amount of existing capacity

- Oil imports fall due to increased domestic production—including biofuels—and greater fuel efficiency

- U.S. carbon dioxide emissions rise slowly, but do not pass 2005 levels again until 2027
For more information


Short-Term Energy Outlook  www.eia.gov/emeu/steo/pub/contents.html

Annual Energy Outlook  www.eia.gov/oiaf/aeo/index.html


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Monday – Friday (excluding Federal holidays)
email: InfoCtr@eia.gov

For information and email updates:
www.eia.gov/conference/2011

2011 EIA Energy Conference

Richard Newell, December 16, 2010
Some supply sources and demand sectors are strongly linked, while others are more dispersed.

Source: EIA Annual Energy Review 2009