Annual Energy Outlook 2011
and an update on EIA activities

NGA Center for Best Practices
State Energy Working Group
February 8, 2011

Richard Newell, Administrator
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 sunset as specified in law (e.g., renewable tax credits expire)

- Includes technologies that are commercial or reasonably expected to become commercial over next decade or so
  - includes projected cost and efficiency improvements due to technology 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
U.S. Energy Consumption
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

Energy supply:
- Petroleum: 37%
- Natural Gas: 25%
- Coal: 21%
- Renewable: 8%
- Nuclear: 9%

Energy demand:
- Transportation: 29%
- Residential & Commercial (non-electric): 11%
- Residential & Commercial (non-electric): 15%
- Electricity – Residential: 15%
- Electricity – Commercial: 15%
- Electricity – Industrial: 10%
- Industrial (non-electric): 20%
- Industrial: 30%
Renewables grow rapidly, but under current policies fossil fuels still provide 78% of U.S. energy use in 2035.

U.S. primary energy consumption quadrillion Btu per year

- **Coal**: 33% in 2009, 24% in 2035
- **Natural gas**: 21% in 2009, 24% in 2035
- **Oil and other liquid fuels**: 1% in 2009, 3% in 2035
- **Renewables (excluding liquid biofuels)**: 7% in 2009, 10% in 2035
- **Liquid biofuels**: 37% in 2009, 33% in 2035
- **Nuclear**: 9% in 2009, 8% in 2035

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

Source: EIA, Annual Energy Outlook 2011

Richard Newell, February 8, 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%
- Other: 0.3%
- Petroleum: 1.0%
- Other gases: 0.3%

2009 Non-hydro renewable net generation: 141 billion kWh
- Wind: 1.8%
- Wood and wood-derived fuels: 0.9%
- Geothermal: 0.4%
- Other renewable: 3.6%
- Other: 0.3%
- Solar thermal and PV: <0.1%

Source: EIA Electric Power Monthly, October 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>
</tr>
<tr>
<td>1960s</td>
<td>7.3</td>
</tr>
<tr>
<td>1970s</td>
<td>4.7</td>
</tr>
<tr>
<td>1980s</td>
<td>2.9</td>
</tr>
<tr>
<td>1990s</td>
<td>2.4</td>
</tr>
<tr>
<td>2000-2009</td>
<td>0.5</td>
</tr>
<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

Richard Newell, February 8, 2011
Non-hydro renewable sources grow nearly three-fold, meeting 23% of projected electricity generation growth

non-hydropower renewable generation
billion kilowatthours per year

Historical data and projections for non-hydropower renewable energy sources from 1990 to 2035. The graph shows a significant increase in renewable energy generation, with projections indicating a three-fold growth by 2035. Sources include wind, solar, biomass, and geothermal energy. The data is sourced from EIA, Annual Energy Outlook 2011.
Natural gas, wind and other renewables account for the vast majority of capacity additions from 2009 to 2035

2009 capacity
- Coal: 313 gigawatts (30%)
- Natural gas: 351 gigawatts (34%)
- Hydropower*: 99 gigawatts (10%)
- Other renewables: 15 gigawatts (1%)
- Wind: 32 gigawatts (3%)
- Nuclear: 101 gigawatts (10%)

Capacity additions 2009 to 2035
- Natural gas: 135 gigawatts (62%)
- Coal: 14 gigawatts (6%)
- Nuclear: 6 gigawatts (3%)
- Wind: 27 gigawatts (12%)
- Other renewables: 27 gigawatts (12%)
- End-use coal: 4 gigawatts (0.3%)
- Other fossil: 1 gigawatts (0.4%)

* Includes pumped storage

Source: EIA, Annual Energy Outlook 2011
Richard Newell, February 8, 2011
Natural gas
Success in the Barnett prompted companies to look at other shale formations in the United States.
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

Richard Newell, February 8, 2011

Source: EIA, Annual Energy Outlook 2011
Four-fold increase in shale gas production offsets declines in other U.S. supply, meeting consumption growth and lowering import needs.

Source: EIA, Annual Energy Outlook 2011
Natural gas consumption is quite dispersed; 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
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

<table>
<thead>
<tr>
<th>Year</th>
<th>History</th>
<th>Projections</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>10%</td>
<td>4%</td>
</tr>
<tr>
<td>1980</td>
<td>34%</td>
<td>12%</td>
</tr>
<tr>
<td>1990</td>
<td>52%</td>
<td>13%</td>
</tr>
<tr>
<td>2000</td>
<td>4%</td>
<td>10%</td>
</tr>
<tr>
<td>2009</td>
<td>31%</td>
<td>34%</td>
</tr>
<tr>
<td>2010</td>
<td>52%</td>
<td>12%</td>
</tr>
<tr>
<td>2015</td>
<td>13%</td>
<td>12%</td>
</tr>
<tr>
<td>2020</td>
<td>2%</td>
<td>12%</td>
</tr>
<tr>
<td>2025</td>
<td>2%</td>
<td>13%</td>
</tr>
<tr>
<td>2030</td>
<td>31%</td>
<td>2%</td>
</tr>
<tr>
<td>2035</td>
<td>42%</td>
<td>2%</td>
</tr>
</tbody>
</table>

Source: EIA, *Annual Energy Outlook 2011*
Biofuels, natural gas liquids, and crude oil production are key sources of increased domestic liquids supply.

U.S. liquid fuels
million barrels per day

- 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, February 8, 2011
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
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</td>
<td>8.9</td>
<td>10.2</td>
<td>15%</td>
</tr>
<tr>
<td>(million barrels per day oil equivalent)</td>
<td></td>
<td></td>
<td></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</td>
<td>2.2</td>
<td>3.2</td>
<td>47%</td>
</tr>
<tr>
<td>(million barrels per day oil equivalent)</td>
<td></td>
<td></td>
<td></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.
Unconventional vehicles meet over 40% of U.S. light-duty vehicle sales in 2035

U.S. light car and truck sales
millions

History

Projections

2000
2009
2015
2020
2025
2030
2035

Source: EIA, Annual Energy Outlook 2011
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
Other EIA activities
EIA’s Energy and Financial Markets Initiative

• Collection of critical energy information to improve market transparency
  – improved petroleum storage capacity data
  – other improvements to data quality and coverage

• Analysis of energy and financial market dynamics to improve understanding of what drives energy prices
  – internal analysis and sponsorship of external research

• Outreach with other Federal agencies, experts, and the public
  – expert workshops
  – public sessions at EIA’s energy conferences
  – solicitation of public comment on EIA’s data collections
On Dec. 1, 2010, EIA started publishing much-improved data on petroleum products storage capacity

- Analysis of inventory levels in the context of storage capacity is important for understanding petroleum market activity and price movements, especially at key market centers such as Cushing, OK.

- EIA’s new storage capacity data will be a major improvement over previous data:
  - **greater coverage**: EIA is collecting the new data from terminals and pipelines, in addition to refineries.
  - **more frequent**: unlike prior annual refinery-only data collection, the new data will be semi-annual, which is particularly important given opportunities to shift storage capacity across products to meet seasonal needs that vary across products.
  - **market center information**: in addition to standard PADD-level reporting, the new data will break out storage capacity at Cushing.
Many factors influence the formation of oil prices and other energy prices

<table>
<thead>
<tr>
<th>Supply</th>
<th>Physical balancing</th>
<th>Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affected by current conditions and future expectations for:</td>
<td>• Inventories</td>
<td>Affected by current conditions and future expectations for:</td>
</tr>
<tr>
<td>• energy prices</td>
<td></td>
<td>• energy prices</td>
</tr>
<tr>
<td>• OPEC supply capacity</td>
<td>• Energy prices</td>
<td>• economic growth</td>
</tr>
<tr>
<td>• usable spare capacity</td>
<td>- spot</td>
<td>• industrial production</td>
</tr>
<tr>
<td>• non-OPEC capacity</td>
<td>- futures</td>
<td>• goods transport</td>
</tr>
<tr>
<td>• geopolitics</td>
<td>- options</td>
<td>• personal transport</td>
</tr>
<tr>
<td>• weather</td>
<td>- spreads</td>
<td>• weather</td>
</tr>
<tr>
<td>• E&amp;P costs</td>
<td>- swaps</td>
<td>• innovation in energy-using equipment</td>
</tr>
<tr>
<td>• E&amp;P investments</td>
<td>• Other financial markets</td>
<td></td>
</tr>
<tr>
<td>• E&amp;P innovations</td>
<td>- other commodity prices</td>
<td></td>
</tr>
</tbody>
</table>

Markets & market behavior:

- Energy prices
  - spot
  - futures
  - options
  - spreads
  - swaps
- Other financial markets
  - other commodity prices
  - commodity investment
  - currency exchange rates
  - stocks and other assets
  - interest rates
EIA portals provide State energy data in one convenient place

State Energy Profiles feature...

- **Quick Facts** to provide the most important State energy information
- **Overviews and maps** to explain each State’s energy markets
- **Data tables** to provide the most current State-level statistics from EIA surveys

**State Energy Data System (SEDS)**

- Comprehensive data for analysis
- Analytical tool
- Common units
- All fuels, all sectors
New this year for State Energy Profiles and State Energy Data System

• State Energy Profiles
  – New maps of selected energy-intensive areas (June 2010)
  – New dynamic graphs on State profile pages (in development)
  – Website redesign (launching soon)

• State Energy Data System
  – Improved estimation methodology (June 2010)
  – New tables for total end-use consumption (publishing soon)
  – Website redesign (launching soon)
Residential Energy Consumption Survey (RECS)

- Only comprehensive source of energy-related characteristics and consumption across U.S. households
- Only EIA survey that collects household data; conducted every 4 years

Fuel use varies by region…

…due in part to different end-use needs

Richard Newell, February 8, 2011
Expanded 2009 RECS

### RECS 2005

- 4,382 completed interviews
- Low sampling precision for all areas (census regions, divisions, States)
- National, census region and division estimates, but state-level estimates for only four states
- Sample too small to support complex analyses

### RECS 2009

- 12,083 completed interviews
- Greater precision assured for key geographies and statistics
- End use statistics for 16 states, with more precision (MA, NY, PA, NJ, VA, GA, FL, TN, MI, IL, WI, MO, TX, CO, AZ, CA)
- Greater statistical power for multivariate analyses
- First release of 2009 RECS Home Energy Characteristics in March 2011
A new EIA.gov goes live this week

- New homepage and improved navigation
- Updated logo and new visual identity
- A new “Today in Energy” education product that:
  - Publishes a daily release of timely and topical bites of our information, on the EIA homepage, in plain language.
  - Allows us to highlight current issues, topics, and trends.
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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Richard Newell, February 8, 2011
Some supply sources and demand sectors are strongly linked, while others are more dispersed.