EIA’s Energy Outlook and Climate Change

Climate and Energy Imperatives for Future Naval Forces Symposium
The Johns Hopkins University Applied Physics Laboratory’s Kossiakoff Center
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Phyllis D. Martin

U.S. Energy Information Administration
Independent Statistics and Analysis
Overview

• Global energy outlook

• U.S. energy outlook

• EIA’s analysis of HR 2454, the American Clean Energy and Security Act (ACESA)
The Global Energy Outlook
Non-OECD countries account for 82% of the increase in global energy use to 2030

Source: EIA International Energy Outlook 2009, Reference Case
Renewables are the fastest growing energy source (but from a relatively small base)

Source: EIA International Energy Outlook 2009, Reference Case
Growth in worldwide economic activity, and population growth in some regions, drives increased energy use.

Source: US: Published AEO2009 (March 2009); ROW: GDP Assumptions based on IHS Global Insight, Inc.; Population from UN World Population Prospects (2006 Revision)
Absent new policies, energy-related CO\textsubscript{2} emissions grow 39% between 2006 and 2030 in EIA’s reference case.
The U.S. Energy Outlook
Energy and CO$_2$ per dollar GDP continue to decline; per capita energy use also declines.
Non-fossil energy use grows rapidly, but fossil fuels still provide 78 percent of total energy use in 2035

Source: Annual Energy Outlook 2010
U.S. reliance on imported liquid fuels is reduced by increased domestic production and greater fuel efficiency

Source: Annual Energy Outlook 2010
Biofuels meet most of the growth in liquid fuels supply

Source: *Annual Energy Outlook 2010*
Biofuels grow, but fall short of the 36 billion gallon RFS target in 2022, exceed it in 2035

Billion gallon-equivalents

Legislated RFS in 2022
RFS with adjustments under CAA Sec.211(o)(7)

Renewable diesel
Biomass-to-liquids
Biodiesel
Net ethanol imports
Cellulosic ethanol
Other feedstocks

2008
2022
2022 in AEO2009
2035

Source: Annual Energy Outlook 2010

Phyllis Martin, Climate and Energy Imperatives for Future Naval Forces Symposium, March 2010
Import share of natural gas supply declines as domestic supply grows.

Source: Annual Energy Outlook 2010
Shale gas and Alaska production offset declines in supply to meet consumption growth and lower import needs.

- **History**
  - Trillion cubic feet
  - Data range: 1990 to 2035

- **Projections**
  - Alaska
  - Shale gas
  - Coalbed methane
  - Non-associated onshore
  - Non-associated offshore
  - Associated with oil
  - Net imports

*Source: Annual Energy Outlook 2010*
Annual Energy Outlook Natural Gas Resources And Production (trillion cubic feet)
Growth in electricity use continues to slow

3-year rolling average percent growth

**History**

<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>2000-2008</td>
<td>0.9</td>
</tr>
<tr>
<td>2008-2035</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Source:** Annual Energy Outlook 2010

**Projections**

Structural Change in Economy - Higher prices - Standards - Improved efficiency
Renewables gain electricity market share; coal share declines

billion kilowatthours and percent shares

<table>
<thead>
<tr>
<th>Year</th>
<th>History</th>
<th>Projections</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>3,000</td>
<td>4,000</td>
</tr>
<tr>
<td>1995</td>
<td>3,300</td>
<td>4,500</td>
</tr>
<tr>
<td>2000</td>
<td>3,600</td>
<td>4,900</td>
</tr>
<tr>
<td>2005</td>
<td>4,000</td>
<td>5,400</td>
</tr>
<tr>
<td>2010</td>
<td>4,400</td>
<td>6,000</td>
</tr>
<tr>
<td>2015</td>
<td>4,800</td>
<td>6,500</td>
</tr>
<tr>
<td>2020</td>
<td>5,200</td>
<td>7,000</td>
</tr>
<tr>
<td>2025</td>
<td>5,600</td>
<td>7,500</td>
</tr>
<tr>
<td>2030</td>
<td>6,000</td>
<td>8,000</td>
</tr>
<tr>
<td>2035</td>
<td>6,400</td>
<td>8,500</td>
</tr>
</tbody>
</table>

Source: Annual Energy Outlook 2010
Nonhydropower renewable sources meet 41% of total electricity generation growth from 2008 to 2035

History

Projections

billion kilowatthours


Source: Annual Energy Outlook 2010

Richard Newell, SAIS, December 14, 2009
Phyllis Martin, Climate and Energy Imperatives for Future Naval Forces Symposium, March 2010

Geothermal

Solar

Waste

Wind

Biomass
Assuming no new policies, growth in energy-related CO₂ is driven by electricity and transportation fuel use.

<table>
<thead>
<tr>
<th>Year</th>
<th>Electric Power</th>
<th>Buildings and Industrial</th>
<th>Total CO₂ Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>2,359 (41%)</td>
<td>1,530 (26%)</td>
<td>5,814 million metric tons</td>
</tr>
<tr>
<td>2035</td>
<td>2,634 (42%)</td>
<td>1,571 (25%)</td>
<td>6,320 million metric tons</td>
</tr>
</tbody>
</table>

% Breakdown:
- Electric Power: 2008 - 41%, 2035 - 42%
- Buildings and Industrial: 2008 - 26%, 2035 - 25%
- Transportation: 2008 - 33%, 2035 - 33%

8.7% growth 
0.3% per year

Source: Annual Energy Outlook 2010

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What if policies change?

Greenhouse Gas Cap and Trade Program

- Renewable Fuels Standards
- Production Tax Credits
- Appliance Efficiency Standards
- Investment Tax Credits
- Corporate Average Fuel Economy Standards
- Renewable Portfolio Standards
EIA Analysis of HR 2454
The American Clean Energy and Security Act (ACESA)
ACESA requires 24.6- billion-metric-ton reduction in covered GHG emissions over 2012-2030; actual reductions could be smaller or larger depending on the use of offsets and banking behavior.

Source: EIA Analysis of the American Clean Energy and Security Act of 2009
# Main cases in EIA’s analysis

<table>
<thead>
<tr>
<th>Case Name</th>
<th>Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic</td>
<td>Integrated analysis of all of the modeled provisions of ACESA.</td>
</tr>
<tr>
<td>Zero Bank</td>
<td>Same as Basic but no carryover of allowances beyond 2030. Proxy for major low-no-carbon energy technology breakthroughs with significant market impacts after 2030.</td>
</tr>
<tr>
<td>High Offsets</td>
<td>Same as Basic but assumes increased use of international offsets.</td>
</tr>
<tr>
<td>High Cost</td>
<td>Same as Basic but assumes that nuclear, fossil with CCS and biomass gasification costs are 50% higher.</td>
</tr>
<tr>
<td>No International</td>
<td>Same as Basic but assumes international offsets are too expensive or unable to meet the requirements for use.</td>
</tr>
<tr>
<td>No International / Limited</td>
<td>Same as Basic but limits additions of nuclear, fossil with CCS and biomass to reference case levels. Also no international offsets.</td>
</tr>
</tbody>
</table>

* Additional report cases examine impacts of high technology assumptions, limited supply technology availability, the recent proposal to modify CAFE standards, a lower banking discount rate, and more aggressive banking through 2030.

Source: EIA Analysis of the American Clean Energy and Security Act of 2009
Energy sector reductions (2 bottom sections) vary with availability of offsets and low-emitting generation options

Cumulative compliance, 2012-2030 (billion metric tons)

- Energy-Related CO2
- Non-Energy-CO2 covered emissions
- Offsets, Biosequestration
- Offsets, Noncovered emissions
- Offsets, International
- Required Abatement

Source: EIA Analysis of the American Clean Energy and Security Act of 2009
Projected allowance prices depend on the availability of offsets and low/no carbon electricity generation technologies

(2007 dollars per metric ton CO$_2$-equivalent)

Source: EIA Analysis of the American Clean Energy and Security Act of 2009
The electricity sector dominates projected reductions in energy-related CO\textsubscript{2} emissions

Source: EIA Analysis of the American Clean Energy and Security Act of 2009
Generation by 2030 shifts from conventional coal to nuclear, renewables, and fossil+CCS, though natural gas use grows dramatically if other options are limited.

Source: EIA Analysis of the American Clean Energy and Security Act of 2009
Capacity Additions, 2008 to 2030
Generally dominated by mix of nuclear, renewables, and fossil with CCS, though natural gas options are more important if those options are limited

(Ref: EIA Analysis of the American Clean Energy and Security Act of 2009)

Source: EIA Analysis of the American Clean Energy and Security Act of 2009
Efficiency programs and higher electricity prices reduce electricity demand growth

Source: EIA Analysis of the American Clean Energy and Security Act of 2009
Electricity prices stay near baseline through 2025 in all but one case, then rise to higher levels through 2030

(2007 cents per kilowatthour, all sectors average)

Source: EIA Analysis of the American Clean Energy and Security Act of 2009
Present-value GDP losses over 2012-2030 range from 0.2% to 0.4%; consumption losses range from 0.1% to 0.3% in 5 analysis cases. Impacts are much higher in the No International/Limited Alternatives case.

Cumulative Change in Real GDP

Cumulative Change in Real Consumption

Source: EIA Analysis of the American Clean Energy and Security Act of 2009
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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