Outlook for US Electric Power

Georgia Tech Clean Energy Speaker Series

November 18, 2009
Energy Information Administration

• Statistical and analytical agency within the Department of Energy
  – www.eia.doe.gov
• Produces monthly short-term and annual long-term forecasts of U.S. and world energy markets
  • Short Term Energy Outlook
  • Annual Energy Outlook, 2009
    • Links to model documentation
      – http://www.eia.doe.gov/oiaf/aeo/index.html
    • International Energy Outlook, 2009
• Produces special analyses of emerging issues and the impacts of regulatory/legislative changes
  – http://www.eia.doe.gov/oiaf/service_rpts.htm
  – http://www.eia.doe.gov/oiaf/analysis.htm
• EIA’s analyses and projections are independent, by law, and should not be seen as representing the views of the Department of Energy, the Administration, or any other organization.
Fuel Prices and Power Plant Costs

Nominal Fuel Prices to Power Plants

CERA Power Plant Cost Index
Electricity Prices to Consumers
(nominal cents per kilowatthour)
Changing Environmental Rules

• **Clean Air Mercury Rule (CAMR) vacated on February 8, 2008**
  - Many States are continuing to pursue their own mercury reduction requirements but the situation is still evolving
  - EPA is developing a new mercury control policy

• **Clean Air Interstate Rule (CAIR) (NO\textsubscript{x} and SO\textsubscript{2}) vacated on July 11, 2008**
  - Most States were counting on CAIR requirements to allow them to comply with the revised national ambient air quality standards (NAAQS) for ground level ozone and particulates
  - They will now have to come up with a new approach to meet the air quality standards that might not utilize a cap and trade system

  - CAIR temporarily reinstated on December 23, 2008
Long-Term Projections
Uncertainty Rules!!!

2009 AEO Cases

- Reference
- No Greenhouse Gas Concern
- LW110 (Lieberman-Warner, S. 2191)
- Low Economic Growth
- High Economic Growth
- Low Oil Price
- High Oil Price
- Residential: 2009 Technology
- Residential: High Technology
- Residential: Best Available Technology
- Commercial: 2009 Technology
- Commercial: High Technology
- Commercial: Best Available Technology
- Industrial: 2009 Technology
- Industrial: High Technology
- Transportation: Low Technology
- Transportation: High Technology
- Electricity: Low Nuclear Cost
- Electricity: High Nuclear Cost
- Electricity: Low Fossil Technology Cost
- Electricity: High Fossil Technology Cost
- Renewable Fuels: High Renewable Cost
- Renewable Fuels: Low Renewable Cost
- Renewable Fuels: PTC Extension
- Oil and Gas: Rapid Technology
- Oil and Gas: Slow Technology
- Oil and Gas: High LNG Supply
- Oil and Gas: Low LNG Supply
- Oil and Gas: ANWR
- Oil and Gas: No Alaska Pipeline
- Coal: Low Coal Cost
- Coal: High Coal Cost
- Integrated 2009 Technology
- Integrated High Technology
- Electricity: Frozen Plant Costs
- Electricity: High Plant Costs
- Electricity: Falling Plant Costs

- Updated Reference (with ARRA)
U.S. electricity demand growth slowing
(3-year moving average)

<table>
<thead>
<tr>
<th>Year</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>2000-2007</td>
<td>1.1%</td>
</tr>
<tr>
<td>2005-2030</td>
<td>0.9%</td>
</tr>
</tbody>
</table>
Reference Case Generation by Fuel
(billion kilowatthours)
Southeast Reference Case Generation by Fuel
(billion kilowatthours)

Coal  Oil  Natural Gas  Nuclear  Renewable  Other

2005  2010  2015  2020  2025  2030
Reference Case Electricity Prices
(cents per kilowatthour)

Real Prices (2007 $)

Nominal Prices

History

Projection

What if policies change?

Greenhouse Gas Cap and Trade Program

- Renewable Fuels Standards
- Production Tax Credits
- Appliance Efficiency Standards
- Investment Tax Credits
- Renewable Portfolio Standards
- Corporate Average Fuel Economy Standards
Analysis of the Waxman-Markey American Clean Energy and Security Act of 2009
Key Provisions of ACESA

Represented:

- The cap-and-trade program for GHGs other than hydrofluorocarbons (HFCs), including provisions for the allocation of allowances to electricity and natural gas distribution utilities, low-income consumers, State efficiency programs, rebate programs, energy-intensive industries, and other specified purposes,
- The combined efficiency and renewable electricity standard for electricity sellers,
- The CCS demonstration and early deployment program,
- Federal building code updates for both residential and commercial buildings,
- Federal efficiency standards for lighting and other appliances,
- Technology improvements driven by the Centers for Energy and Environmental Knowledge and Outreach, and
- The smart grid peak savings program.

Not Represented:

- The Clean Energy Deployment Administration
- The strategic allowance reserve
- The separate cap-and-trade program for HFC emissions
- The GHG performance standards for activities not subject to the cap-and-trade program
- The distribution of allowances to coal merchant plants
- New efficiency standards for transportation equipment, and
- The effects of increased investment in energy research and development
# Main Analysis Cases

<table>
<thead>
<tr>
<th>Case Name</th>
<th>Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td><em>Updated AEO2009 Reference Case, which includes the provisions of the American Recovery and Reinvestment Act.</em></td>
</tr>
<tr>
<td><strong>Policy Cases</strong></td>
<td></td>
</tr>
<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 of 11, 2, and 6 thousand megawatts, respectively. 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, an lower banking discount rate, and more aggressive banking through 2030.
Key Overall Findings

• Offsets (particularly international offsets) and low/no carbon energy technology availability (over the next two decades and beyond) are the key drivers of the compliance mix and the costs of ACESA.

• ACESA raises consumer energy bills, and reduces GDP and household consumption – mainly after 2025. The range of impacts varies across the policy cases, which reflect alternative assumptions regarding offset availability and the cost, timing, and public acceptance of key low- and no-carbon technologies. Generally, the availability of offsets and/or low/no carbon technologies significantly moderates costs.

• The electricity sector accounts for the vast majority of reductions in domestic energy-related emissions through 2030. Coal use without CCS is displaced by low- and no-emissions technologies including nuclear, renewables and fossil plants with CCS, and consumers make investments to reduce their energy use
  - Higher cost, delayed development, or opposition to the deployment of low- and no-carbon technologies that can displace conventional coal-fired generation make compliance with ACESA more challenging and costly.
  - Conventional coal declines, falling most rapidly in cases where offsets are less available or and/or more costly. Natural gas use for electricity generation can either rise or fall relative to the Reference Case projection depending on the cost and availability of low-emitting technologies like nuclear, renewables, fossil with CCS and offsets.
  - The Combined Efficiency and Renewable Energy Standard (CERES) is not binding. It is projected to be exceeded as a byproduct of compliance with the Title III cap-and-trade program.

• The output-based allocation of allowances to energy-intensive industries provides more than enough resources to offset their higher energy costs over the 2014 to 2028 period. As a result, these sectors do not experience disproportionate adverse economic impacts relative to other industries.
Compliance Sources by Year

Energy Sector Contribution (2 bottom blue wedges) Varies With Availability of Offsets and Low-Emitting Generating Technologies

Basic

High Cost

No International/Limited

High Offsets
Projected Allowance Prices

Depend on the availability of offsets and low- and no- carbon electricity generation technologies

(2007 dollars per metric ton CO₂-equivalent)
Key Findings: Electricity Sector

- Electricity sector accounts for bulk of total reductions in energy-related emissions.
- Electricity demand growth slows, driven by efficiency programs and, after 2025, by higher prices.
- The fuel mix for power generation shifts dramatically, mainly from coal to increased use of nuclear, renewables, and fossil with CCS. Coal use and production falls dramatically in some cases because the cost of using it without CCS becomes prohibitive.
- Natural gas use grows sharply if nuclear, CCS and biomass use are limited by commercialization time needed, cost, regulations, or other factors.
- Change in capacity additions parallels shift in fuel mix, with large increases in nuclear, renewables, and fossil with CCS, though natural gas capacity grows if these are limited.
- Electricity prices are higher, but impact is dampened significantly through 2025 by allocation of allowances to electricity retailers. It is assumed that consumers view monthly bill adjustments from allowance allocations as price adjustments.
- The combined efficiency and renewable electricity standard (CERES) is exceeded in all ACESA cases.
Annual Percent Growth in Electricity Use

Efficiency programs and higher electricity prices slow electricity demand growth
2030 Generation by Fuel

Generally shifts from coal with CCS to nuclear, renewables, and fossil with CCS, though natural gas use grows if the use of those options are limited.

(billion kilowatthours)
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
Electricity Prices
Stay near Reference Case level through 2025 in all but one case, then rise to higher levels through 2030

(2007 cents per kilowatthour, all sectors average)
Southeast Electricity Prices
Questions / Concerns
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Backup Slides
NEMS Commercial Demand Module

• Structural in nature
  – Engineering/economic – not econometric
  – End-use technology choice based on annualized life cycle cost in a segmented market

• Purchased electricity demand based on …
  – Commercial floorspace/Equipment stocks
  – Energy efficiency
  – Climate/location
  – Prices
  – Distributed generation/combined heat and power
Factors Affecting Commercial Demand

• Sector growth
  – Based on population, consumer spending, investment in buildings, nonresidential construction, business inventories, employment, interest rates, GDP, and past construction trends
  – Contribution of variables varies by building type

• Energy Efficiency
  – Equipment standards (most major end-uses covered)
  – Building codes
  – Tax credits
  – Non-regulatory programs (Energy Star, etc.)

• Structural Changes
  – Type and location of new commercial floorspace
  – Penetration of new uses (PCs/laptops, server computers, telecommunications, medical imaging, etc.)

• Weather – Heating and Cooling Degree-days

• Distributed Generation/Combined Heat and Power
  – Adoption affects growth in electricity sales
NEMS Residential Demand Module

• Structural engineering/economic in nature
  – Not econometric

• Electricity demand based on…
  – Housing/Equipment stocks
  – Energy efficiency
  – Climate/location
  – Prices
Factors Affecting Residential Demand

• Demographics
  – Household Formation – population driven
  – Age of Population – impacts type and location of housing
• Weather
  – Heating and Cooling Degree-Days
• Energy Efficiency
  – Appliance Standards (incandescent phase out)
  – Building Codes
  – Non-Regulatory Programs (DSM, Energy Star, etc.)
  – Weatherization
  – Tax Credits
• Structural Changes
  – Size of New Construction
  – Penetration of New Appliances (Central Air Conditioning, PCs, Large Screen TVs, etc)