The Role of Coal in an “All of the Above” Energy Strategy
2nd Clean Coal Industry Forum
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Dr. S. Julio Friedmann
Principal Deputy Assistant Secretary
Office of Fossil Energy
This is a time of fossil energy abundance

Once in a generation opportunity to build
This is a time of fossil energy abundance
Coal Use Growing Overall and Important in Many Economies

Continued recent growth
- China
- Europe
- India, Japan

Increased trade and exports

Energy security
- China
- Eastern Europe

Increased CO₂ emissions
More than 40 Gtons /y
Fossil fuels use will continue in the US and worldwide
We must take action to reduce greenhouse gas emissions
CCUS deployment remains the critical action

We must strengthen our commitment to deployment of clean coal with CCUS
Because of abundant fossil energy, clean coal technology remains a critical option

“All of the above” required

<table>
<thead>
<tr>
<th>Technology</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>8%</td>
</tr>
<tr>
<td>Power generation efficiency</td>
<td>3%</td>
</tr>
<tr>
<td>Renewables</td>
<td>21%</td>
</tr>
<tr>
<td>End-use fuel switching</td>
<td>12%</td>
</tr>
<tr>
<td>CCS</td>
<td>14%</td>
</tr>
<tr>
<td>End-use fuel &amp; elec. efficiency</td>
<td>42%</td>
</tr>
</tbody>
</table>
Clean coal, with CCUS, will be the cheapest option in many markets

<table>
<thead>
<tr>
<th>2100 concentrations (ppm CO₂eq)</th>
<th>no CCS</th>
<th>nuclear phase out</th>
<th>limited solar/wind</th>
<th>limited bioenergy</th>
</tr>
</thead>
<tbody>
<tr>
<td>450</td>
<td>138%</td>
<td>7%</td>
<td>6%</td>
<td>64%</td>
</tr>
</tbody>
</table>

Symbol legend – fraction of models successful in producing scenarios (numbers indicate number of successful models)

- All models successful
- Between 80 and 100% of models successful
- Between 50 and 80% of models successful
- Less than 50% of models successful

“We will respond to the threat of climate change, knowing that the failure to do so would betray our children and future generations.”

—President Barack Obama
January 21, 2013
Technical status: pretty much ready to go

15 years of concerted global research have shown:

- Multiple world-wide large projects and large injections
- No major risks (geochemical, geomechanical, hydrologic)
- Cost reduction, with room for additional large reductions

Office of Fossil Energy commitment: $6.5 billion

Work work to be done

- More large-scale saline fm. Injections would help
- More Focus on transformational technology and large pilots

_financing (cost recovery) is the main issue_
Large Scale Integrated Projects
World Wide

Data from Global CCS Institute
Kemper County, MS
Southern Co., 2013
(Anticipated start late 2014 or early 2015)
W.A. Parrish, TX
NRG/PetraNova project

Broke Ground Last Week!!
Skyonic “Skymine” project, San Antonio, TX
Operational !!

75,000 tons/y CO2 captured - >200,000 tons avoided
Algenol pilot project, Fort Myers, FL
Operational !!

Scaling up technology with Duke Energy
Regional Carbon Sequestration Partnerships
Large-Scale Geologic Tests

- Seven partnerships
- 40 states and 4 provinces
- Over $600M spent
- 23 small projects
- 8 large projects (100,000 to 3.5 million tons CO2)

Provided critical knowledge and infrastructure to the states and to the US

Two projects in Montana
Wyoming in three partnerships
Montana in two partnerships
Cost, policy, and parity

Figure 1.2 | Levelized Cost of Electricity ($/MWh) for New Generation Sources and Levelized Power Purchase Agreement Prices for Recent Wind and Solar Projects

<table>
<thead>
<tr>
<th>Low Estimates</th>
<th>High Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Levelized Cost of Electricity</strong></td>
<td><strong>Levelized PPAs with Incentives</strong></td>
</tr>
<tr>
<td>BNEF (no Incentives)</td>
<td>BNEF (no Incentives)</td>
</tr>
<tr>
<td>AEO2014 (with incentives)</td>
<td>AEO2014 (no incentives)</td>
</tr>
<tr>
<td>DOE Sunshot (with incentives)</td>
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<th><strong>Levelized Cost of Electricity (2013 $/MWh)</strong></th>
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<tbody>
<tr>
<td>Coal</td>
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</tr>
<tr>
<td>Coal w/carbon capture and storage (CCS)</td>
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<tr>
<td>Natural gas combined cycle (NGCC)</td>
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</tr>
<tr>
<td>NGCC w/CCS</td>
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</tr>
<tr>
<td>Nuclear</td>
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</tr>
<tr>
<td>Geothermal</td>
<td>Geothermal</td>
</tr>
<tr>
<td>Biomass</td>
<td>Biomass</td>
</tr>
<tr>
<td>Wind (onshore)</td>
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<tr>
<td>Solar PV</td>
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<tr>
<td>Solar thermal</td>
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President’s FE portfolio and FY 16 budget

More than just FE RD&D budget

- Loan Program Office: $8B in clean fossil authorities
- ARRA projects: >$4.5B commitment
- Tax credit proposal: comparable to renewable ITC’s + PTC’s
  - $2B ITC credits: 30% capital investment (incl. infrastructure)
  - Uncapped (!) STC’s (sequestration tax credits) – scored at $3B
  - New authorities, not extensions/modifications of existing

- FE RD&D: $564M for FY16; $400M for clean coal and CCUS
Other policy actions

New EPA Rule
- CCUS is Best System or Emissions Reduction for new plants: 1400 lbs/MW-hr (~635 kg/MW-hr) standard
- CCUS is compliance mechanism for existing plants
- Great flexibility in implementation

Executive order: government power and efficiency
- >10% power from clean energy by 2016
- >25% power from clean energy by 2025
- Includes CCUS, nuclear, renewables
Clean Coal deployment: urgent and important

Not just about cost
• Costs are higher than plants without CCS
• Costs are lower than many clean energy alternatives

Not just about technology
• Many technologies are well demonstrated
• Improvement potential is very large

Policy Issue: could finance many ways
• Rate recovery; feed-in tariffs; direct grants
• Clean energy portfolios; tax-free debt financing; others

Financing is the priority action
International partnerships required

Many platforms (APEC; G7; Boao; UNFCCC; WEC)

CSLF: Multinational platform
  – 22 countries + E.C.
  – 11 years in practice
  – Productive technical and policy working groups

Partnerships in Commerce
  – Joint ventures
  – International investment
  – “Showcase” projects

Accelerated deployment
  – Data sharing
  – International Science Projects
Changing International Landscape for CCUS

New EU accord
- Policy Parity for CCUS and nuclear (also UNECE)
- Innovation funds

New actors
- UK: White Rose +
- KSA and UAE: EOR + coal
- Mexico: growing interest

US-China Accord
- Includes large CCS project
- Includes enhanced water recovery projects
China is the critical partner

- China and US are #1 and #2 in
  - Economies
  - Energy use
  - Coal use
  - Emissions

- Coal use immense
  - 67.5% of primary energy
  - near 4B tons/y today
  - Continued growth

- Substantial govt. interest
  - Focus on pollution reduction
  - Chiefly interested in CO2 utilization
  - New investment in clean energy, R&D (including CCUS)
Counterfacing projects under CCWG/S&ED

Includes three large-scale CCS-EOR projects
Technology leads and informs policy

Must build and deploy large projects
- Learning opportunity in CCS and clean fossil
- Information sharing: partnership as product
- Financing is the key challenge; many paths to success

Must develop 2\textsuperscript{nd} and 3\textsuperscript{rd} generation technology

Must partner with many

\textit{Coal will be used}
\textbf{CO}_2 \textit{must be controlled}
\textit{Time to build}