IEA CCS Regulatory Review: Recent US Actions

Jordan Kislear, US Department of Energy

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Agenda:

- EPA Regulations:
  - Greenhouse Gas, New Plants
  - Greenhouse Gas, Existing Plants
  - Regulatory Compliance Timeline
  - Class II and Class VI Updates and Considerations
- US Project Status
- R&D Status
- Moving Forward
New Fossil Baseload: [111(b)]

Coal-Fired Units: less than 1,100 lbs CO₂/MWh  [~500 gCO₂ / kWh]
Reference: New Super Critical: 1,800-2,000 lbs CO₂/MWh  [800-900 gCO₂ / kWh]

Coal may comply with ~ 40% capture

NGCC:  1,000 lbs CO₂/MWh  [453 gCO₂ / kWh]
Gas CT:  1,100 lbs CO₂/MWh  [500 gCO₂ / kWh]

- Compliance is on a 12 month rolling basis
- Captured CO₂ may be sent for geologic storage
- EOR may be used with appropriate reporting (Subpart RR)

Timeline:
Proposed Regulation:  November, 2013
Final Regulation expected Summer, 2015
   Note:  111(b) must be final before 111(d) is final!
## Clean Power Plan: The Building Blocks

<table>
<thead>
<tr>
<th>Building Block</th>
<th>Strategy EPA Used to Calculate the State Goal</th>
<th>Maximum Flexibility: Examples of State Compliance Measures</th>
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</thead>
<tbody>
<tr>
<td>1. Make fossil fuel-fired power plants more efficient</td>
<td>Efficiency Improvements</td>
<td>Efficiency improvements Co-firing or switching to natural gas Coal retirements Retrofit CCS (e.g., WA Parish in Texas)</td>
</tr>
<tr>
<td>2. Use lower-emitting power sources more</td>
<td>Dispatch changes to existing natural gas combined cycle (CC)</td>
<td>Dispatch changes to existing natural gas CC</td>
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<tr>
<td>4. Use electricity more efficiently</td>
<td>Demand-side energy efficiency programs</td>
<td>Demand-side energy efficiency programs Transmission efficiency improvements Energy storage</td>
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Existing Fossil Baseload [111(d)]

• Building blocks define emission rate for each state
• Can be translated into mass-based standard
• States can tailor their approach
• CCS Retrofits can be used as compliance
  – No plants are required to retrofit with CCS
111(d), Timing

• “Mid-Summer”, 2015: Final Rule Published
• Summer 2016: State Plans due
• Summer 2017: 1-Year Extension (If granted)
• Summer 2018: Multi-State Plans due

• 2020: Compliance begins
• 2025: Interim Target (“Glide path”)
• 2030: Full Compliance
Class VI Update

• “5” Permits Granted
• ADM: Drilling Injection well
• FutureGen Project Cancelled (4 wells)
  – Continuing through permit appeals process
  – May use injection site in the future
• EPA Developing Guidance: II-VI Transition
  – Focus: Protection of Underground Sources of Drinking Water (USDWs)
  – Summer 2015 Publication
FutureGen: Area of Review
Tax Credits

• Proposed: $2 Billion Investment Tax Credit (ITC)
• > 75% Capture of CO$_2$
• Up to 30% of capital investments

• Sequestration Tax Credit:
  – $50 / metric ton, Saline Storage
  – $10 / metric ton, Enhanced Oil Recovery
  – Guaranteed for 20 years of operation
    • Replaces 45Q: $20 / $10, 75 Million Metric Tons available
Loan Program Office Project Development Financing

LPO Advanced Fossil Energy Solicitation

**CARBON CAPTURE**
- From traditional coal or NG generation
- Saline formations or EOR

**ADVANCED RESOURCE DEVELOPMENT**
- ECBM, UCG, novel oil and gas drilling
- Use of co-produced waste gases vs. flaring

**LOW CARBON POWER SYSTEMS**
- Oxycombustion, chemical looping
- Syngas-, H2, or NG-based fuel cells

**EFFICIENCY IMPROVEMENTS**
- CHP and waste-heat recovery
- High-T or high-efficiency cycles
W.A. Parrish, TX
NRG/PetraNova project

Broke Ground January 2015!
### Brief history and roadmap for CCS

<table>
<thead>
<tr>
<th></th>
<th>Then</th>
<th>Now</th>
<th>Future (2030)</th>
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<tbody>
<tr>
<td></td>
<td>CCS Program Initiated (1997)</td>
<td>Progress to Date</td>
<td>Broad Commercial Deployment</td>
</tr>
<tr>
<td>CCS R&amp;D</td>
<td>• Niche commercial efforts</td>
<td>• Much knowledge gained</td>
<td>• “Commercial toolbox” developed</td>
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<td></td>
<td>• 1930’s and 1970’s tech for capture</td>
<td>• Major tech development</td>
<td>• Dramatic cost reductions</td>
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<td>• Little known for storage</td>
<td>• Tools being developed and tested</td>
<td>• 1000’s of sites worldwide</td>
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<tr>
<td>Storage Infrastructure/Field Tests</td>
<td>• Little known outside of oilfield services</td>
<td>• Increased visibility;</td>
<td>• Market frameworks in place</td>
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<td>• Sleipner project initiated</td>
<td>• Knowledge gained and lessons learned</td>
<td>• Novel regulatory mechanisms</td>
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<td>• 12 large projects world-wide</td>
<td>• Turnkey operation</td>
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U.S. DEPARTMENT OF ENERGY Fossil Energy
CCS: A Critical Crossroads

Success of the demos
• Serial # 1 in operation 2013-2018
• A deep and rich set of public learning

Regulatory Certainty
• CCS Required for New Plants
• Drivers in place for Existing Plants
• UIC Program, Existing Permits providing certainty

Financial Support
• Strong Tax incentives
• EOR is common; New approaches providing value