Clean Coal Power Initiative

- CCPI Overview
- Round 1 Status
- Round 2 Planning

Clean Coal and Power Conference &
2nd Joint U.S.-People’s Republic of China Conference on Clean Energy

Washington, D.C.
November 17-19, 2003

Mike Eastman, Technology Manager, NETL
Economic Growth Linked to Electricity

Index: 1973 = 100

Real GDP

Electricity Generation

Total Energy Consumption

Year

GDP: U.S. DOC, Bureau of Economic Analysis
Energy & Electricity: EIA, AER Interactive Data Query System

CCPI_status_DC111803
Presidential Priorities

National Energy Policy

• Increasing America’s domestic energy supplies
• Protecting America’s environment
• Ensuring a comprehensive delivery system
• Enhancing national energy security

Initiatives

• Clear Skies
• Climate Change
• Clean Coal Power
• FutureGen/Hydrogen
Clean Coal Power Initiative

- Implemented NEP recommendation to increase investment in clean coal technology

- $2 billion over 10 years starting in FY 02
  - Anticipates series of competitive solicitations
  - Industry cost share of at least 50%
DOE’s Coal Demonstration Programs

A History of Innovative Projects

Clean Coal Technology Program - 1985-1993

Power Plant Improvement Initiative - 2001

Clean Coal Power Initiative - 2002-2012
Linkages
Coal and Power Programs

Core R&D Program
• Clear Skies
• Climate Change
• Hydrogen
• Sequestration

Clean Coal Power Initiative
Lower Cost Hg & NO\textsubscript{x} Control
Round 1 Round 2 Round 3 Round 4

Increasing efficiency/
Sequestration friendliness
Decreasing cost

FutureGen Project

Clear Skies Compliance

Zero Emission Plants
CCPI Philosophy

- Demonstrations - necessary step between R&D and commercialization
- CCPI provides demonstration platform
- Multiple demonstrations needed for new capital intensive technologies
  - Each demo must raise bar
  - Industry cost share commensurate with risk
Coal Power Program Roadmap
Addresses Near- and Long-range Needs

- **Short-term: existing fleet**
  - Cost-effective environmental control technologies to comply with current and emerging regulations

- **Long-term: future energy plants**
  - Near-zero emissions power and clean fuels plants with CO₂ management capability

Can be found on CURC website
www.coal.org
Existing Plants
Roadmap Performance Objectives

- Reduced Cost for NOx Control
- Reduced Cost for High-Efficiency Hg Control
- Achieve PM Targets in 2010: 99.99% capture of 0.1 – 10 µ Particles
# Coal Power Program Roadmap

## New Plant Performance Targets

(Represents best integrated plant technology capability)

<table>
<thead>
<tr>
<th></th>
<th>Reference Plant</th>
<th>2010</th>
<th>2020 Vision 21</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air Emissions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SO₂ removal</td>
<td>98%</td>
<td>99%</td>
<td>&gt;99%</td>
</tr>
<tr>
<td>NOₓ (0.15 lb/10⁶ Btu)</td>
<td>0.05 lb/10⁶ Btu</td>
<td>&lt;0.01 lb/10⁶ Btu</td>
<td></td>
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<tr>
<td>Particulate Matter</td>
<td>0.005 lb/10⁶ Btu</td>
<td>0.002 lb/10⁶ Btu</td>
<td></td>
</tr>
<tr>
<td>Mercury (Hg)</td>
<td>90% removal</td>
<td>95% removal</td>
<td></td>
</tr>
<tr>
<td><strong>By-Product Utilization</strong></td>
<td>30%</td>
<td>50%</td>
<td>near 100%</td>
</tr>
<tr>
<td><strong>Plant Efficiency (HHV)</strong></td>
<td>40%</td>
<td>45-50%</td>
<td>50-60%</td>
</tr>
</tbody>
</table>
Coal Power Program Roadmap

**New Plant Performance Targets**
(Represents best integrated plant technology capability)

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<th>Reference Plant</th>
<th>2010</th>
<th>2020 Vision 21</th>
</tr>
</thead>
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<tr>
<td>Availability&lt;sup&gt;(3)&lt;/sup&gt;</td>
<td>&gt;80%</td>
<td>&gt;85%</td>
<td>≥90%</td>
</tr>
<tr>
<td>Plant Capital Cost&lt;sup&gt;(2)&lt;/sup&gt; $/kW</td>
<td>1000 – 1300</td>
<td>900 – 1000</td>
<td>800 – 900</td>
</tr>
<tr>
<td>Cost of Electricity&lt;sup&gt;(4)&lt;/sup&gt; ¢/kWh</td>
<td>3.5</td>
<td>3.0 - 3.2</td>
<td>&lt;3.0</td>
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</tbody>
</table>

(1) Targets are w/o carbon capture and sequestration and reflect current cooling tower technology for water use.
(2) Range reflects performance projected for different plant technologies that will achieve environmental performance and energy cost targets.
(3) Percent of time capable of generating power (ref. North American Electric Reliability Council).
(4) Bus-bar cost-of-electricity in today’s dollars; Reference plant based on $1000/kW capital cost, $1.20/10^6 Btu coal cost.
Demonstration Initiatives are Key Pathway to Benefits

Coal Program - Benefits/Investment

Cumulative Benefits

Cumulative Investment (public & private)

Demonstrations Enable Benefits

$ Billion

CCPI – Round 1

- Competitive solicitation FY 02
- Broad in scope
  - Advanced power generation
  - Efficiency, environmental, economic improvement
- Eight projects selected
  January 2003 (1 withdrawn)
  - $286M DOE cost share
  - $1.2B industry cost share
Clean Coal Power Initiative (CCPI) – Round 1 Projects

- **Great River Energy**
  - Lignite Fuel Enhancement
  - $11 Million – DOE
  - $11 Million – GRE

- **Wisconsin Electric Power Co.**
  - TOXCON Multi-Pollutant Control
  - $24.8 Million – DOE
  - $24.8 Million – WEP

- **NeuCo, Inc.**
  - Integrated Optimization Software
  - $8.4 Million – DOE
  - $10.2 Million – NeuCo, Inc.

- **Colorado Springs Utilities**
  - Advanced Emission Controls
  - $30 Million – DOE
  - $271.5 Million – CSU

- **Western Greenbrier Co-Production**
  - Clean Coal Co-Production
  - $107.5 Million – DOE
  - $107.5 Million – WGC

- **LG&E Energy Corp.**
  - Airborne Process
  - $31.1 Million – DOE
  - $89 Million – LG&E
  - Withdrawn

- **Univ. of Kentucky Research Foundation**
  - Multi-Product Coal Utilization
  - $4.4 Million – DOE
  - $4.5 Million – Univ. of KY

- **WMPI PTY., LLC**
  - Coal-to-Clean Fuels and Power
  - $100 Million – DOE
  - $512 Million – WMPI PTY., LLC
Wisconsin Electric Power Company

• An integrated emission control approach installed on combined flue gas for units 7, 8, and 9.
• Maximizes use of coal combustion by-products.
• Provides for timely compliance with future mercury regulations, such as Clear Skies Initiative.
• Total project funding: $49.5 million (DOE share: $24.7 million).
Colorado Springs Utilities

- One of cleanest U.S. coal-fired power plants for SOx, NOx and mercury control.
- Helps achieve compliance with upcoming regulations, such as Clear Skies Initiative.
- Uses variety of fuels: bituminous, subbituminous, coal wastes, and wood wastes.
- Total project funding: $301.5 million (DOE share: $30 million).
Great River Energy

- Lignite fuel enhancement - applicable to power plants burning inherently high-moisture coals.
- Achieving higher efficiencies to help meet Climate Change goals.
- Total project funding: 22 million (DOE share: $11 million).

Two-Stage Fluidized Bed Dryer System using Waste Heat

A CCPI Round 1 Project
NeuCo, Inc.

- Integrated optimization software on three 600 MW units reduces emissions, increases efficiency, and increases reliability.
- Five optimization modules: cyclone combustion, sootblowing, SCR operations, thermal performance, and profit optimization.
- Higher efficiencies help to meet Climate Change goals.
- Total project funding: $18.6 million (DOE share: $8.4 million).
University of Kentucky Research Foundation

• Next generation coal ash beneficiation processing plant addressing entire coal utilization by-product (CUB) stream and producing a variety of value-added products.
• Helps meet Climate Change goals: reduces emissions in cement manufacturing.
• Total project funding: $8.9 million (DOE share: $4.4 million).
Waste Management and Processors Inc. (WMPI PTY., LLC)

- First power plant in U.S. gasifying waste-coal and low-value resources to produce clean electrical power, thermal energy, and liquid fuels.
- Project enhances Nation’s energy security by producing liquid transportation fuels.
- Converts 4,700 tpd of coal waste into 41 MWe and 5,000 bpd of fuel.
- Total project funding: $612 million (DOE share: $100 million).
Western Greenbriar Co-Generation, LLC

- Anchor tenant in a proposed environmentally balanced industrial “Eco Park”; remediation model for State/Local Governments.
- 85 MW waste-coal to clean energy circulating fluid bed combustor with advanced multi-pollutant control system.
- Total project funding: $215 million (DOE Share: $107.5 million).

A CCPI Round 1 Project

Reclaimed Land

“Eco Park”

“Gob” Pile

A CCPI Round 1 Project
Preliminary NEPA Evaluation Strategy

• **Environmental Impact Statements (EIS)**
  – Colorado Springs Utilities
  – Waste Management & Processors, Inc.
  – Western Greenbrier Co-Gen LLC

• **Probable Environmental Assessments (EA)**
  – Great River Energy
  – Louisville Gas & Electric Corporation
  – University of Kentucky Research Foundation
  – Wisconsin Electric Power Company

• **Probable Categorical Exclusion**
  – NeuCo, Inc.
Funding

CCPI - Round 2

- Anticipate ~ $300 million DOE funding
  - FY 04 Appropriations
  - FY 05 Appropriations
  - Carryover from PPII and CCPI Round 1
## CCPI Program Funding
(in thousands)

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<tr>
<td>CCPI</td>
<td>150,000</td>
<td>130,000</td>
<td>130,000</td>
<td>130,000</td>
<td>172,000</td>
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**Presque Isle Power Plant**

![Diagram of Presque Isle Power Plant](image)

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**Netl**

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Tentative Priority Technologies

Future CCPI Rounds

- Emission control
  - Mercury
  - NO\textsubscript{x}

- Advanced Power Technologies
  - Improved efficiency/lower capital cost
  - Sequestration friendly

- Sequestration

Technologies for Clear Skies Compliance

Technologies For Zero-Carbon Emission Plants

Program Goals

Round 2 | Round 3 | Round 4
CCPI Round 2 Schedule

*Calendar Years*

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<tr>
<th>Year</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
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<tbody>
<tr>
<td>DOE Prepares Solicitation</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Prepare Applications</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>DOE Evaluates / Selects</td>
<td>**</td>
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Stakeholder Feedback (1)
Round 2

• From August 26, 2003 Workshop in Pittsburgh
  – Do not pre-select technology (e.g. gasification vs. combustion)
  – Consider distributed sources (e.g. industrial ~50MW scale)
  – Repayment as a “zero-interest” loan is an issue
    • Some feel it discourages risk-taking and some from applying
    • Some think it attracts non-commercial type projects
  – Other than “full-scale” demos may be appropriate
Stakeholder Feedback (2)

Round 2

- From August 26, 2003 Workshop in Pittsburgh
  - Clarify how much electricity needs to be generated in the demo
  - No incentive for CO₂ capture now
  - Some Energy Bill provisions (i.e. loan guarantees and investment tax credits) may be more attractive than CCPI
  - Good Q&A; DOE will make some improvements in next solicitation (i.e. clarifications on Project Definition Phase)

Workshop Summary and Transcript of Q&A session now posted on CCPI website
Challenges for CCPI Program

- Maintaining a priority for funding in a competitive budget climate
- Picking “winners”
  - Technology (e.g. gasification vs. combustion systems)
  - Projects (strong vs. technically significant)
- Need for multiple demonstrations
  - Narrowing down solicitation scope of interest (i.e. follow roadmap)
Closing Comments

• Coal must play a key role to secure a healthy economy
  – Is recognized in Presidential-level initiatives; Clear Skies, Climate Change, FutureGen, Hydrogen, Sequestration
  – Coal can play an important role in a potential future carbon-constrained world

• Regulatory uncertainty improving (e.g. NSR)

• Coal RD&D Roadmap charts challenging but doable path forward
  – Best ideas needed
  – Sustain Federal and private sector investments