

IGCC Working Group

August 3, 2006



Pacific Power | Rocky Mountain Power | PacifiCorp Energy

Agenda

- Introductions
- Marketplace Updates & European Advanced Coal & CO₂ Reduction Programs
 - ▶ Ian Andrews, PacifiCorp
 - ▶ Bryce Freeman, Wyoming Office of Consumer Advocate
- Big Sky Carbon Sequestration Partnership
 - ▶ Travis McLing – Idaho National Laboratories
- PacifiCorp – Current Activities & Moving Forward with IGCC
- Open Discussion & Planning for next meeting

Marketplace Updates & European Advanced Coal & CO₂ Reduction Programs

Ian Andrews, PacifiCorp

and

Bryce Freeman, Wyoming Office of Consumer
Advocate



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Market Place Updates - Siemens

- Siemens Power has acquired the Future Energy gasifier technology (**Gasification Schwarze Pumpe** or “GSP Process”), staff, and test facilities from Sustec. The acquisition includes a state-of-the-art pilot scale gasification test facility where potential feedstocks can be tested to better characterize design characteristics for a specific project. The Siemens GSP gasifier is entrained-flow, down-flow, oxygen blown, with slag covered cooling screen with the ability to gasify a wide range of feedstocks.
- The site where the 200 MWth (based on heat input, equivalent to ~80 MWe) GSP gasifier is installed, was the source of town gas in the former east Germany with a capacity of 700 metric tons per day of lignite. The GSP gasifier is currently used to gasify waste from older gasifiers on site. The syn-gas is used for co-production of methanol and power.
- The importance of this acquisition is the potential for IGCC applications on U.S. low rank coals (lignite and Powder River Basin) combined with the financial and technical strength of Siemens.

Market Place Updates – General Electric

- General Electric and BP have announced plans to jointly develop “power from hydrogen” projects (with CO₂ capture). Planned demonstration projects are Peterhead, Scotland (using natural gas) and Carson, California (using petcoke).
- General Electric has indicated that it will be making available a PRB coal optimization option, to its existing PRB capabilities, in the very near future.

Market Place Updates – Shell

- Nuon Power (Dutch utility) plans to build 1200 MWe “Magnum” IGCC project in the Netherlands based on their experience with the Shell gasifier at Buggenum, Netherlands
- Project in engineering
- Fuels: Coal, bio-mass, secondary fuels
- Targeted commercial operation date: 2010/2011

Wyoming Infrastructure Authority RFP

- Seeking proposals for a demonstration IGCC project in Wyoming that satisfies Section 413 of the U.S. Energy Policy Act of 2005:
 - ▶ At an elevation of 4,000' or above
 - ▶ Demonstrated ability to use coal with a heating value not greater than 9,000 Btu/lb
- Seeking to secure federal funding under Section 413 of 2005 US EPACT
- Minimum size - 200 MW
- Utilizes Wyoming coal
- Demonstrated capability to capture and sequester CO₂ (includes CO₂ for enhanced oil recovery)

Wyoming Infrastructure Authority RFP (cont'd)

- Requesting Expressions of Interest by August 17, 2006
- Formal Proposals submitted by October 17, 2006
- For more information:
 - ▶ <http://www.wyia.org> or:
 - ▶ Steve Waddington, 307-635-3573

European Advanced Coal and CO₂ Reduction

- Great Plains Institute organized a tour of European utilities, government agencies, research facilities, and power plants to learn more about European programs and projects involved with advanced coal and CO₂ reduction. The group consisted of representatives from US environmental organizations, government officials, utility regulators, charitable foundations, coal industry and electric utilities.
- Great Plains Institute facilitates the Coal Gasification Work Group in the Midwest (Dakotas, Minnesota, Indiana, Montana, Wisconsin)
- Presentations can be found:
<http://www.gpisd.net/resource.html?Id=240>

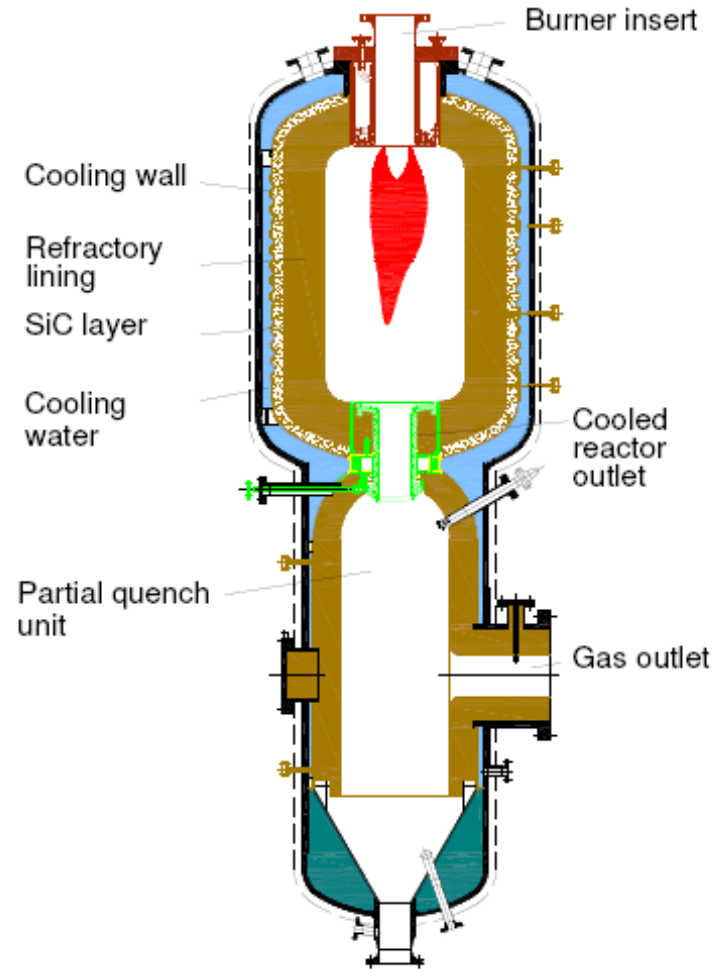
European Advanced Coal and CO₂ Reduction

Major Site Visits / Meetings & take-aways:

- Shell IGCC Facility in Buggenum, Netherlands
 - ▶ Embarking on 1200 MW IGCC expansion program using Shell technology
- Presentations on CO₂ cap & trade programs
 - ▶ Timing of future reduction requirements and clear pricing signals still in flux
- Future Energy (Siemens) gasifier research facility @ Freiberg/Schwarze Pumpe Complex
 - ▶ Solid experience base gasifying low rank coals and other materials with a defined program for scaling up

Future Energy Entrained Flow Gasifier

Reactor with Cooling Wall



Schwarze-Pumpe Complex - Gasifier Building



European Advanced Coal and CO₂ Reduction

Major Visits/Meetings & take-aways:

- Schwarze-Pumpe Complex – Vattenfall's 1600 MW lignite-fired supercritical generating station
 - ▶ State of the art lignite-fired plant
 - ▶ High efficiency, low emissions, high availability
 - ▶ Well-designed layout from an operability and design perspective

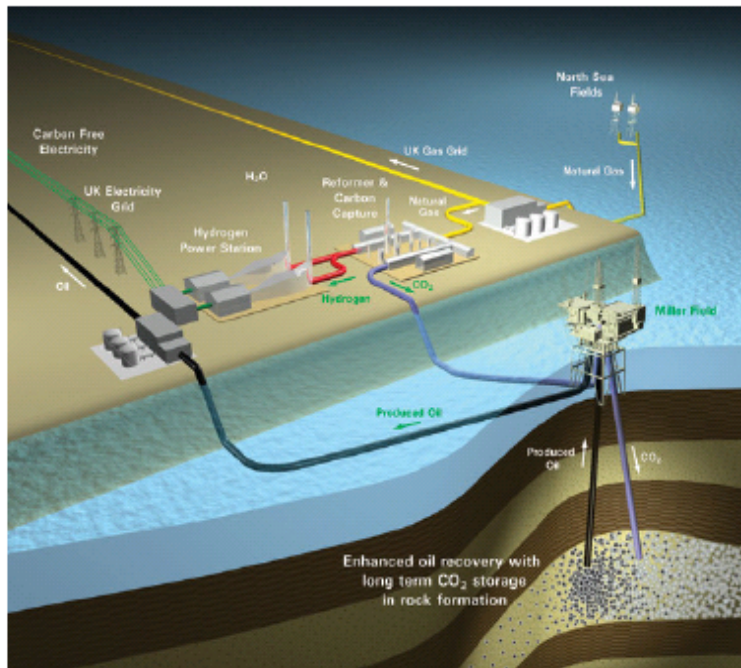
Schwarze-Pumpe Lignite Plant



European Advanced Coal and CO₂ Reduction

- Major Site Visits/Meetings & take-aways:
- BP Peterhead Hydrogen to Power Project with CO₂ sequestration
 - ▶ Natural gas fuel
 - ▶ CO₂ for Enhanced Oil Recovery in North Sea
- RWE (Large European utility) proposes to construct a 450 MW IGCC plant with sequestration
 - ▶ 360 MW net
 - ▶ Lignite or hard coal
 - ▶ Targeting sequestration of 2.3 million metric tons of CO₂ per year (90+% capture)
 - ▶ Targeted commissioning - 2014
 - ▶ Seeking partners and government funding

BP Peterhead (Natural Gas to Hydrogen)



- BP announced de-carbonised 350 MW electrical plant in Scotland on June 30th 2005 (now increased to 475 MW)
- It will convert natural gas to hydrogen and CO₂:
 - Hydrogen will be used for power generation
 - CO₂ will be exported to a North Sea oil reservoir
- \$600m investment, 2009 start-up
- CO₂ emissions reduced by 90% compared to gas fired power generation

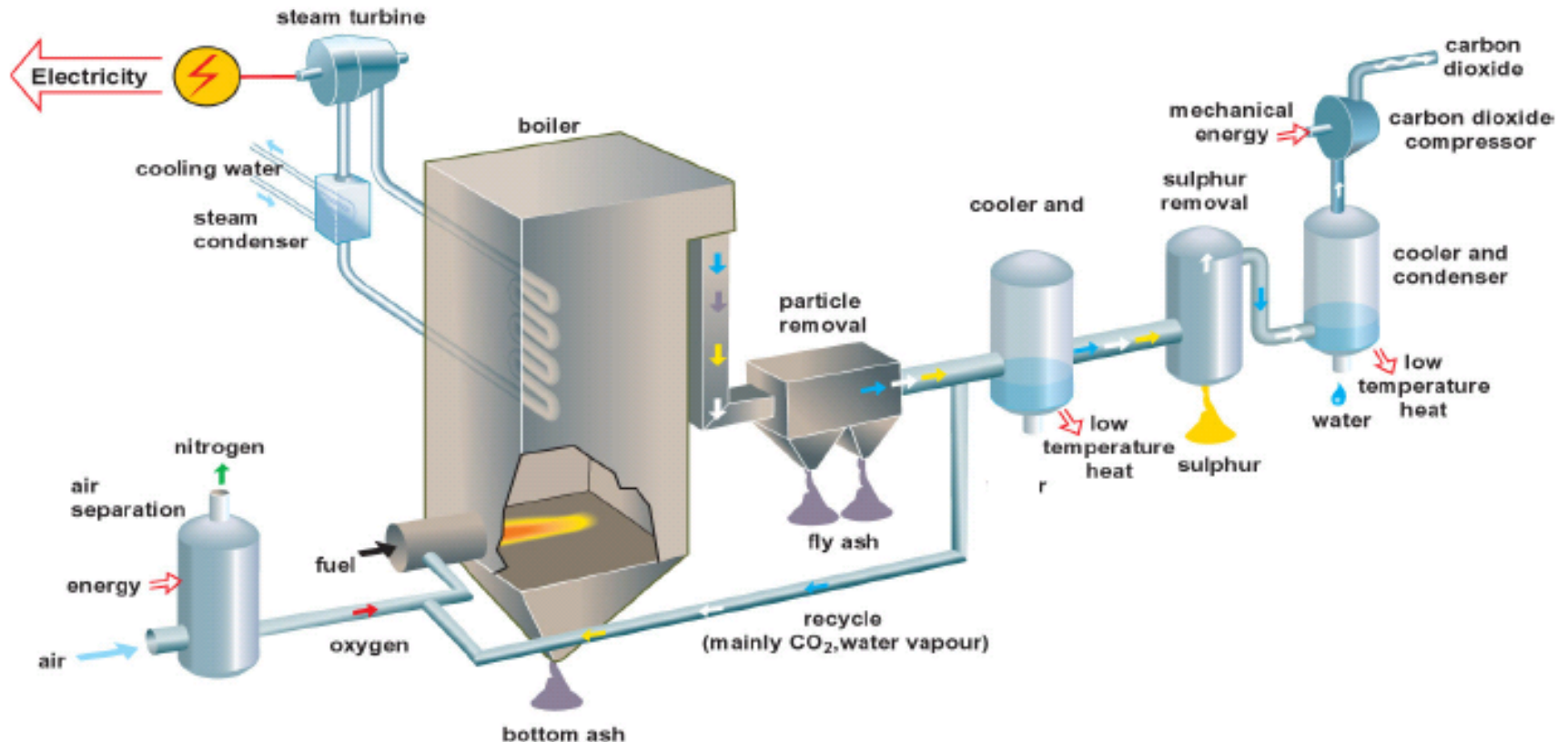
The project is expected to capture and store around 1.3 Mte CO₂ each year and provide 'carbon-free' electricity to the equivalent of 250,000 UK homes.

European Advanced Coal and CO₂ Reduction

- Vattenfall (German Utility) 30 MW (heat input)
Oxy-Fuel Pilot Plant
 - ▶ Pilot plant location: Schwarze Pumpe complex
 - ▶ Conceptual Design – oxy-fuel burners in development
 - ▶ 2008 Testing
 - ▶ Demonstration Plant (115-230 MWe) - 2015
 - ▶ Commercial Plant (~400 MWe) - 2020 time frame

Vattenfall Oxy-Fuel Plant with CO2 Capture

O₂/CO₂ recycle (oxyfuel) combustion capture



European Advanced Coal and CO₂ Reduction

Major Take-aways:

- Europeans are actively monitoring US geologic sequestration studies and EOR programs.
- German utilities strategy to achieve CO₂ target reductions is via system efficiency improvements. This will be accomplished via retirements of older units, fleet upgrades with new large high-efficiency coal units, some gas additions, and wind. They appear to be dealing with the same issues as US utilities (uncertainty on timing and targeted reductions).
- Germany is focusing on making reductions across the board from all sources that produce CO₂

Big Sky Carbon Sequestration Partnership

Travis McLing
Idaho National Laboratories



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IGCC Working Group Afternoon Session

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PacifiCorp Energy Current IGCC Development Activities

- Continuing discussions with Conoco & General Electric
- Starting discussions with Siemens Power
- Company has submitted an Expression of Interest as a major participant in Energy Northwest's Pacific Mountain Energy Center IGCC Project, Port of Kalama, Washington. Energy Northwest filed an application to US Department of Energy (DOE) for investment tax credits (ITC) as part of the 2005 US Energy Policy Act (EPACT) program for IGCC.
- Company submitted applications to the US DOE for ITCs as part of the 2005 US EPACT for Jim Bridger & Hunter plants.
- Evaluating strategy to develop IGCC benchmark costs at Jim Bridger Plant and other locations.

Going Forward With IGCC

ISSUE: COST PREMIUM & COST RECOVERY

The company has an obligation to supply resources deemed to be in the public interest that results in the lowest reasonable cost taking into account long & short term impacts, risk, reliability, financial impacts, and other factors determined to be relevant by the utility commissions.

COST: Our studies indicate that the cost of energy from an IGCC plant is *at least* 10-15+% higher compared to a similarly sized super critical pulverized coal resource.

PAVING THE WAY:

- Financial incentives to reduce the cost differential. May include: co-funding, tax credits, sales and property tax exemptions, tax holidays, accelerated depreciation, and tax-exempt financing.
- Regulatory approval of higher costs

Going Forward With IGCC

ISSUE: PROCUREMENT PROCESS

Need for a mature IGCC market so capital cost & performance certainty can be determined without incurring high costs

CURRENT PROCESS & COSTS

- “Feasibility Study” Phase – Technology/Consortium selection (~10-12 months, \$250-\$500,000 per Study for each supplier)
 - ▶ Indicative Pricing/terms from Feasibility Study has high uncertainty
- Front End Engineering Design (FEED) Phase – used to develop Engineer-Procure-Construct scope, cost, & commercial terms (~12 months, \$6-10 million) One supplier is selected after Feasibility Study phase due to high FEED cost.
 - ▶ Limited competitive position once supplier is selected
 - ▶ Concern about future prudence in selection

PAVING THE WAY:

Either a fundamental change in how IGCC suppliers provide firm lump sum pricing OR a mechanism, either through state funding and/or regulatory support to recover high costs of FEED studies.

Going Forward With IGCC

ISSUE: Technology & Performance Risk

Energy market exposure from reduced availability associated with emerging technology

CONCERNS:

- Availability/reliability of next-generation gasifiers & balance of plant systems.
 - ▶ More fully integrated gas turbine and air separation systems
 - ▶ Operation of enhanced environmental control systems
- Reliability of reference-plant gas turbines
- Specific provisions (both duration and coverage) of supplier performance “wraps” are an unknown

PAVING THE WAY:

Work with suppliers and regulators to address higher technology and performance risk associated with IGCC

Going Forward With IGCC

ISSUE Carbon Capture & Sequestration (CCS)

- The uncertainty about the form, substance, and timing of a carbon emissions market. The potential need for CCS influences initial design & technology selection.
- Cost recovery of additional investment made in the initial design to mitigate future impacts of CCS
- Sequestration through Enhanced Oil Recovery:
 - ▶ Long term market potential for the supply of CO₂ for enhanced oil recovery
 - ▶ Duration of supply and contract terms
 - ▶ Pipeline requirements to serve EOR projects
 - ▶ Credit worthiness of counterparty
- Long Term geologic sequestration concerns – migration and leakage, liability risks associated with geologic sequestration.

PAVING THE WAY:

- Clarity on the how, when, and cost of constraining carbon
- Reduced CO₂ geologic sequestration risk (i.e. Federal or state liability relief)

CO₂ Conversion Factors

- Utah/Colo bituminous coal ~205 lbs of CO₂/MMBtu
- Wyoming sub-bituminous coal ~213 lbs of CO₂/MMBtu
- A new 500 MW coal-fired unit burning Wyoming coal at a 90% capacity factor would produce:
 - ▶ IGCC ~ 3.74 million short tons per year
 - ▶ Supercritical ~ 3.95 million short tons per year
- 1 million short tons per year = 44.7 MM SCF/Day (million standard cubic feet per day)

Miscellaneous

Recommended Publications/websites:

- “IPCC Special Report on Carbon dioxide Capture and Storage,” Summary Report for Policy Makers (available off web)
- Great Plains Initiative website: <http://www.gpisd.net>

Please forward any email address changes to:

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