

**Statement of Abraham Breehey**  
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**Ship Builders, Blacksmiths, Forgers and Helpers**

**United States Senate, Committee on Finance**

**Climate Change Legislation: Considerations for Future Jobs**

**November 10, 2009**

Chairman Baucus, Senator Grassley, and Members of the Committee, my name is Abraham Breehey and I am the Director of Legislative Affairs for the International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers and Helpers. On behalf of the members of my union and our International President Newton B. Jones, thank you very much for the opportunity to testify today.

The members of the Boilermakers Union will be among those workers on the front lines of our nation's transition to a clean energy, low-carbon economy. While we recognize that such a transition will not be easy or without cost, it is essential that the United States begin the important work of reducing emissions that cause climate change. Further, if Congress moves forward with a comprehensive cap and trade program to reduce emissions, the demand for climate solutions will create job opportunities across the economy. We can put American ingenuity and skills to work reducing emissions. With the right market signals, we can turn the jobs union members do everyday into the environmental solutions our nation needs to meet this enormous challenge.

Establishing Environmental and Economic Certainty

The lack of a clear, comprehensive policy on global warming and the uncertainty associated with the future regulation of greenhouse gases is delaying the creation of job opportunities our nation needs. The longer we wait to provide investors, regulated entities, and entrepreneurs the market signals that will reward innovation to reduce emissions, the more our nation's competitors get a head start on the clean energy race.

The Senate must demonstrate bipartisan leadership and develop the kind of policies that will provide certainty, control costs, and encourage job-creating investments in clean energy technology. Without clear policies regarding performance standards and emissions limits – including appropriate incentives for the installation of new technology – we could miss an opportunity to make the United States the leader in advanced coal-technology development, an undertaking that is essential to meeting any significant global effort to reduce emissions.

In addition, our union greatly prefers effective, balanced climate legislation to the regulation of greenhouse gases by the U.S. Environmental Protection Agency under the Clean Air Act. We believe legislation would more effectively balance regional,

environmental, and economic concerns, while providing the necessary incentives for the technology deployment that will create jobs.

### Low-Carbon Coal Jobs

The development and deployment of carbon capture and storage (CCS) technology at power plants and industrial facilities is among the technological breakthroughs that could not only reduce our nation's carbon footprint, but also create significant job opportunities for American workers. The level of investment, both federal and private, necessary to ensure the widespread commercialization of CCS is highly unlikely in the absence of comprehensive clean energy legislation.

Climate legislation, such as S. 1733, the Clean Energy Jobs and American Power Act, must rightfully recognize that the widespread deployment of carbon capture and storage technology is essential to our nation's energy future. Economic growth in the U.S. has been fueled by affordable, reliable energy from coal. Countless jobs in communities across the country are dependant upon our ability to continue the use of coal for power generation. However, the Boilermakers recognize the adverse environmental consequences associated with business as usual. Just as our union and other crafts provided the man-power necessary to assemble and deploy the technology to reduce particulate emissions, NO<sub>x</sub>, and SO<sub>2</sub>, we are confident that technology will enable continued responsible use of coal with CCS.

We appreciate Chairman Baucus, Senator Carper and the other Senators involved for their work in the development of the provisions of S. 1733 designed to encourage the early and widespread deployment of CCS technology at coal plants, including new generating capacity and retrofit applications. The deployment of this technology will not only have tremendous environmental benefits, but also will have employment and economic benefits for workers in the Boilermakers Union, other building and construction trades, and other industries engaged in CCS development.

Our union strongly supports a robust bonus allowance program, such as that established under Section 780 of S. 1733, to provide financial incentives and assistance for the commercial deployment of carbon capture technology. Establishing the advance payment of bonus allowances will provide the financial incentives necessary for utilities to undertake these capital intensive, yet vital projects. Advanced payments of bonus allowances will also assist energy developers to secure the financing necessary for these essential energy infrastructure projects to move forward.

Section 780 will encourage CCS applications at both new and existing units, and provides additional incentives for early adopters and projects achieving the highest rate of capture and storage. Also, expanding the availability of fixed payments for CCS to a greater number of projects increases both its environmental and employment benefits. Providing these bonus allowances to cover the entire marginal increase in costs between an advanced coal plant with CCS and a standard, supercritical pulverized coal plant should support widespread adoption without a significant increased cost to ratepayers.

The construction of coal based generation facilities and CCS technology is tremendously labor intensive, requiring the skills from a wide range of crafts in the building and construction trades. CCS projects will be long-lasting job opportunities for boilermakers, pipefitters, laborers, millwrights, and other workers who are engaged in construction of this technology.

The Boilermakers and other unions whose members rely on employment opportunities at coal-fired power generation facilities recently commissioned a study conducted by BBC Research and Consulting to illustrate the potential jobs and other economic benefits of advanced coal-fired electric generation using CCS technologies. A copy of the full results of that study is included in my written testimony as Attachment 1.

The study found that the economic benefits from construction of a single 540 MW pulverized coal plant with CCS include employment benefits during the construction phase totaling nearly 14,000 job-years. The benefits associated with construction of an advanced coal unit with CCS reach 36,000 total job-years, when indirect and induced employment impacts are included. Similarly, the study found that the job creation potential of just the CCS related employment from deploying a 20 GW fleet of advanced coal facilities is tremendously promising. In the construction sector alone, 20 GW of capacity would support 500,000 direct job-years of employment.

The National Commission on Energy Policy recently issued a report from its “Task Force on America’s Future Energy Jobs.” The Task Force included representatives of academic, industry, environmental, and labor organizations, including the Boilermakers, the AFL-CIO, the United Mineworkers of America, and the International Brotherhood of Electrical Workers. The Task Force relied in part on job data provided by Bechtel Power Corporation, a major international power engineering and construction firm, to estimate the labor needs associated with construction of new clean energy generation infrastructure.

The workforce estimates for alternative generation technologies indicates that the coal-based CCS and nuclear power generation options have the highest job creation potential, relative to other supply options, such as natural gas.

Person-Years per GW of New Generation Capacity,  
Development and Construction Phases

Technology	Salaried Workforce	Hourly Workforce	Total Person-Years
Nuclear	4,785	9,575	14,360
Supercritical PC w/CCS	2,140	8,435	10,575
IGCC coal w/CCS	2,795	8,145	10,940
Natural Gas Com. Cycle	485	1,270	1,765
Onshore wind	305	1,180	1,485

Source: National Commission on Energy Policy, Task Force Report on America's Future Energy Jobs (2009).

These figures are based on 1 GW of electric power capacity, equivalent to one 1,000 MW coal or nuclear facility, or 250 4 MW wind turbines. Based on Bechtel's analysis, the development and construction phase of deploying a normalized 1 GW of power generated by an Integrated Gasification Combined Cycle coal plant equipped with CCS would employ 2,795 salaried workers and an hourly workforce of over 8,000 skilled workers. Comparatively, 1 GW onshore wind generation would require a salaried workforce of 305 and 1,180 hourly workers.

In sum, it is clear that Carbon Capture and Storage development and deployment represents a tremendous employment opportunity for the members of my union, and other workers. Early deployment and bonus allowance programs for CCS included in comprehensive climate legislation will be a tremendous driver for job creation in a low-carbon economy.

### Commitment to High Quality Employment

Of course, it is not just jobs or even "green" jobs that our union is interested in. Our members are interested in high-quality jobs, that provide the kind of wages and benefits that can enable a clear path to the middle-class and support a family. However, good jobs will not necessarily be created by any climate change legislation without the inclusion of fair, enforceable labor standards. The application of wage standards to the deployment of energy infrastructure will ensure the benefits of federal investment in clean energy are extended not just to developers and businesses, but also to the workers whose skills are essential to building a clean energy economy.

Our union believes climate legislation must not only encourage a commitment to environmental protection, but also to fair and decent labor standards. For example, under the Clean Energy Jobs and American Power Act of 2009, workers employed on projects assisted or incentivized through allowance allocations or other means will be assured wage rates no less than those prevailing in their local community through the consistent application of the Davis-Bacon Act.

This law protects both communities and employers by preventing the undercutting of local standards, and ensuring that federally assisted projects neither drive-down nor artificially inflate wages. This law protects workers in both big cities and rural areas, and protects union and non-union workers alike. In short, Davis-Bacon will ensure that "green jobs" are also good jobs.

Workers employed on clean energy infrastructure projects should be well trained and highly experienced – all construction project characteristics encouraged by the Davis-Bacon Act. Numerous studies show that projects built under prevailing wage provisions are more likely to be completed on time, within budget and with fewer future repair costs. Ensuring these high standards for both workers and contractors will be particularly

important when applied to new, highly technical construction projects, such as CCS technology.

Neither American taxpayers, facility owners, nor the environment can afford anything less than the high-standards ensured by the application of prevailing wages. We strongly urge the Senate to include the application of Davis-Bacon prevailing wage standards to the programs that will be a part of any comprehensive climate change and energy legislation.

#### Avoiding Adverse Employment Impacts and Maximizing Job-Creation Potential

While the adoption of comprehensive climate legislation that establishes a declining cap on carbon will lead to the creation of new employment opportunities in low-carbon industries, Congress must also act to mitigate adverse employment impacts. Among the most significant concerns of our union regarding efforts to regulate carbon emissions is its impact on energy intensive, trade exposed industries, particularly if major trading partners fail to take similar responsible action.

While the Boilermakers Union directly represents workers in the cement industry, other energy intensive industries – such as steel – provide employment opportunities for our construction members. These industries are the backbone of American manufacturing, and a source of high-wage employment for millions of workers and their families. It is essential that comprehensive climate legislation include adequate provisions to prevent employment losses in these industries.

Climate policy must not undermine the competitiveness of U.S. manufacturers in the global marketplace. Industries such as steel, cement, and chemicals are more sensitive to energy cost increases than other sectors of the economy. An adequate allocation of allowances to an output-based rebate program for energy-intensive, trade exposed industries will help ensure that the migration of jobs and pollution does not undermine the environmental and economic development goals of domestic action. In addition, climate policy should not incentivize fuel switching for power generation from coal to natural gas, a fuel that also serves as a raw material input in many manufacturing processes.

Further, while the allocation of allowances to energy-intensive industries is essential, it is not sufficient to address all of the concerns related to job losses in the manufacturing sector. At its core, global warming is the most negative consequence of misguided trade and globalization policies that fail to account for the negative environmental impacts of shipping, for example, a container vessel full of cement from an inefficient facility in Thailand to San Francisco for use on U.S. highways. In addition, simply providing an allocation of allowances to domestic industries would be a missed opportunity to encourage – using both “carrots” and “sticks” – responsible action from major emitters in those rapidly developing countries that are a major source of global emissions.

It is critically important that the Senate include a strong, yet fair border measure to prevent so-called carbon leakage. Energy-intensive imported goods from countries that fail to take action comparable to any domestic emission reduction program should be required to purchase and submit a type of “emissions allowance” that accounts for the carbon content and price of the imported good. Such provisions should be triggered shortly after domestic industries are subject to the requirements of a domestic program. We believe this approach would provide significant leverage for U.S. negotiators in the context of global climate change negotiations, while remaining consistent with our existing trade obligations.

In addition, it was deeply disconcerting to learn this week that federal clean energy investments made through the American Recovery and Reinvestment Act have been used for projects that generate jobs in China, not the United States. As was widely reported, a Texas wind farm project that will rely exclusively on wind turbines manufactured in China has applied for financial assistance from the U.S. Department of Energy. If the United States fails to include appropriate domestic content requirements on projects financed or incentivized by a domestic climate program, we will have failed to capitalize on what is likely our last best opportunity to revitalize American manufacturing.

It will be American workers and American taxpayers making sacrifices to reduce domestic carbon emissions. It must also be American workers who benefit from the job creation opportunities these climate solutions create. There are new opportunities for American workers not just in the final construction jobs, but all throughout the supply chains of clean energy technology. For example, members of my union in Indiana who produce gear blanks for heavy equipment could easily do the same work producing gear blanks used in wind turbines. But the demand for U.S. parts and components will never materialize if American workers are undercut by Chinese workers that are denied the most basic labor rights. Projects that receive allowance allocations or other assistance through U.S. climate legislation must be required to incorporate domestic content if the full job creation potential of the clean energy economy is to be realized.

On behalf of my union’s members in the Boilermaker’s Cement, Lime, Gypsum and Allied Workers Division, we have some suggestions regarding provisions specific to cement manufacturing. An additional challenge for cement occurs because the process of calcining limestone into cement releases carbon dioxide regardless of the energy source it uses. We suggest that this variety of process emissions – emissions that essentially cannot be reduced – not be included under the cap. In addition, we ask that energy-intensity be properly calculated, reflecting actual clinker production from U.S. cement kilns. We must ensure the production of this strategic commodity not shift overseas. The result of such a shift would be to harm domestic employment, and to increase emissions as less efficient foreign kilns replace more modern domestic ones.

Our union believes that the allocation of allowances to electricity consumers through local distribution companies (LDCs) is the most effective approach for preventing increased utility costs for families, and avoiding adverse employment impacts. While there are certainly a number of worthy options for allocating emissions allowances, we

suggest the allocations to LDCs for electricity consumer relief be consistent with the level of emissions from the power sector in the early years of the program. The allocation of allowances to electric utility “wires” companies avoids the risk of windfall profits, will reduce the risk of fuel switching from coal to natural gas, and helps offset compliance costs.

Further, as was mentioned early in my testimony, a priority is to provide the greatest level of regulatory certainty possible when it comes to the permitting of new power generation facilities. One key objective of federal climate change legislation must be to establish a new framework for reducing economy-wide greenhouse emissions. In Waxman-Markey, this framework relies on a cap-and-trade program that allows companies to achieve emissions reductions in the most efficient, cost-effective manner possible. To do so, the new cap-and-trade program must replace existing command-and-control programs

The House legislation appropriately provided exemptions from permitting and other air regulatory requirements established for conventional air pollutants under the Clean Air Act. These exemptions were carefully tailored to apply only to greenhouse gas emissions from sources that would be regulated under the new cap-and-trade regime. The goal of a cap-and-trade program is not just to reduce emissions, but also to do so in the most efficient and cost-effective manner. Failure to address these issues could undermine that goal and blunt the beneficial employment opportunities available through emissions reductions from the power sector.

In addition, we believe that an effective cost containment provision is essential to not only limiting the overall economic impact of the program, but minimizing allowance price volatility and discouraging market manipulation. Carbon allowance price certainty is another mechanism that would enable predictable investment planning that is important to job creation. A price collar that includes both minimum and maximum allowance prices would not only encourage job creation, but minimize any adverse employment should clean energy technology deployment not proceed at the pace hoped for or expected.

Finally, we have some concern regarding the stringency of the emissions reductions targets in the early years of the cap and trade program. Should the development of CCS technology not proceed quickly enough, these early caps may encourage some plants that could otherwise be retrofitted to shut down or switch to natural gas. As I mentioned, the job creation opportunities available from CCS far exceed those from new construction of a natural gas combined cycle plant. Therefore, we encourage the Senate to consider an emissions reduction target in 2020 of 14% below 2005 levels, consistent with the program called for in President Obama’s budget proposal.

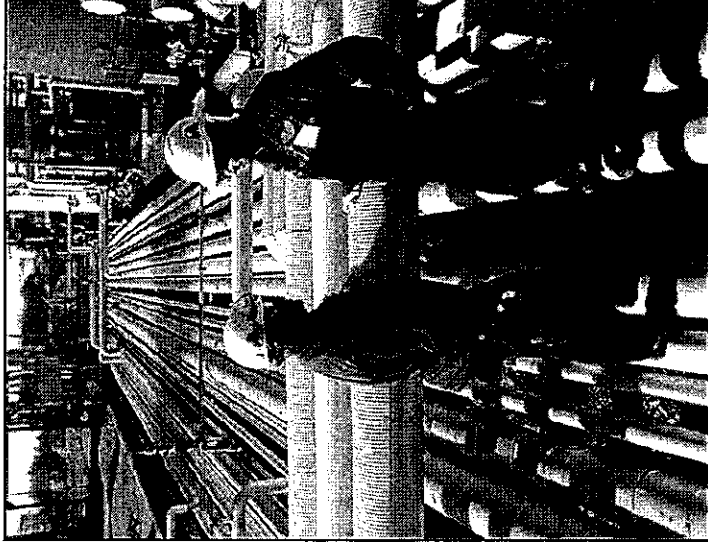
Again, I thank the Committee for the important work you are doing here today, and the opportunity to express my views.

# **Attachment 1**



# Employment and Other Economic Benefits from Advanced Coal Electric Generation with Carbon Capture and Storage

(Preliminary Results)



## Prepared for:

- Industrial Union Council, AFL-CIO
- International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers, and Helpers
- International Brotherhood of Electrical Workers
- United Mine Workers of America
- American Coalition for Clean Coal Electricity

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## Introduction

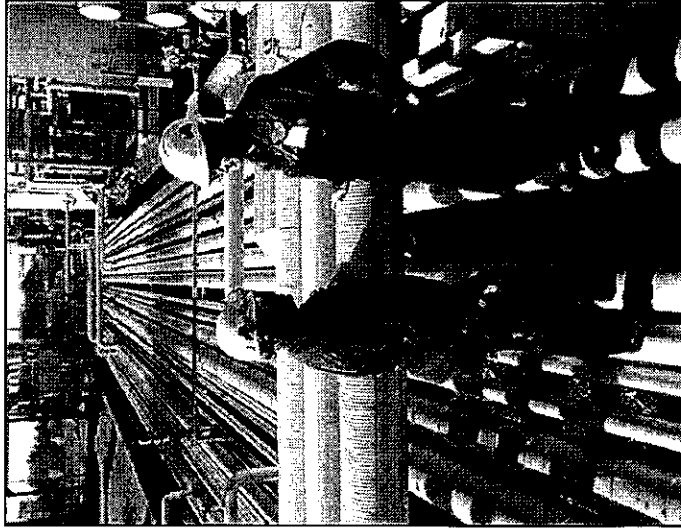
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- The development and broad deployment of CCS technologies can be a key part of a national strategy to reduce CO<sub>2</sub> emissions and address climate change concerns.
- Initiatives to reduce greenhouse gas emissions are likely to stimulate the deployment of new, advanced coal generation facilities with carbon capture and storage (CCS), provided CCS technology development is successful and timely.
- In addition to environmental benefits, this study also shows that the development and deployment of CCS technologies can serve as an economic stimulus.
- This study estimates the capital, operating and maintenance costs (O&M), jobs and other economic benefits associated with the deployment of advanced coal generation with CCS.

## Purpose and Caveats

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- The purpose of this study is to illustrate the potential job and other economic benefits from the deployment of advanced coal-fueled electric generation using carbon capture and storage technologies (“CCS-only benefits”).
- ***The study does not take into account adverse economic impacts that may result from proposals to reduce greenhouse gas emissions.***
- Numerous analyses by EIA, DOE, and NGO’s have shown that complying with emission reduction targets is likely to have adverse economic impacts on the coal and electric generation sectors, along with other industries and sectors.
- Study results are presented at the national level to illustrate the potential magnitude of job, GDP and income benefits associated with the construction and operation of these new advanced coal-fueled electric generation technologies.
- ***This study is not intended to imply support for any policy position regarding climate change legislation, or to endorse assumptions regarding the level of future deployment of Advanced Coal facilities with CCS.***



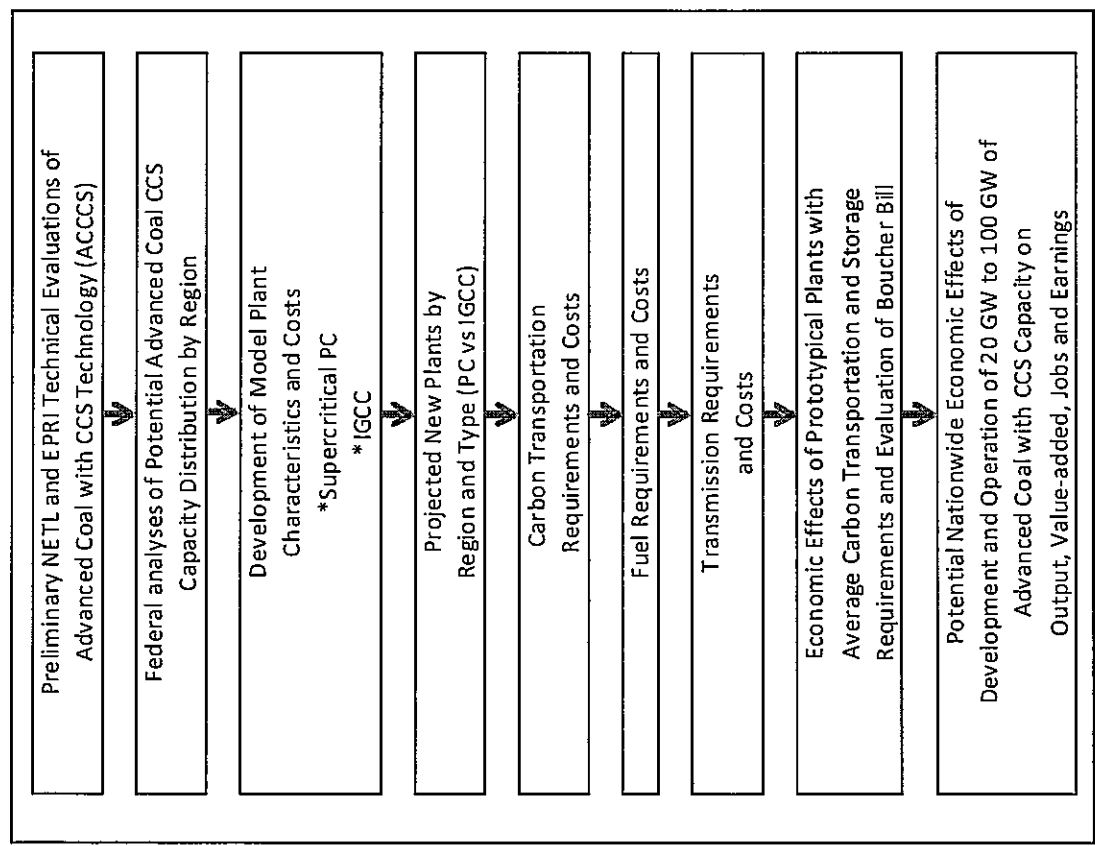
## ***Part 1:*** **Background and Study Approach**

## Overview of Study Approach

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- The study team:
  - Analyzed recent studies from the U.S. Department of Energy's National Energy Technology Laboratory (NETL) and the Electric Power Research Institute (EPRI) to estimate the costs and operating characteristics of typical Advanced Coal CCS facilities.
  - Estimated the infrastructure and operating requirements for carbon capture and storage by examining regional projections of future Advanced Coal CCS capacity from EPA analyses of climate change proposals to determine possible plant locations relative to potential CO<sub>2</sub> storage locations.
  - Estimated the coal mining and fuel transportation requirements, and likely sources, for new Advanced Coal CCS facilities based on the potential regional distribution of Advanced Coal CCS facilities from the EPA analyses.
- Construction and operating expenditures were incorporated into the IMPLAN input-output model to estimate the national effects of construction and ongoing operations on economic output, value-added, jobs and labor earnings.
- The flow chart on the following page illustrates the study approach.

# Study Approach



## Advanced Coal Plant Technology

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- Based on recent NETL and EPRI research, this study focuses on two technologies: Advanced Supercritical Pulverized Coal (PC) with CCS and Integrated Gasification Combined Cycle (IGCC) with CCS.
  - PC – Pulverized coal is used in a boiler designed to deliver "supercritical" steam conditions, generating power with high plant generating efficiency. Combustion products, after removal of nitrogen oxides, particulate matter, mercury and sulfur dioxide, are processed in a post-combustion scrubber to remove approximately 90% of the CO<sub>2</sub>.
  - IGCC – Coal is partially oxidized in oxygen, generating a synthetic gas (syngas). Steam is injected into the syngas to "shift" most of the chemical energy in the CO to H<sub>2</sub>, producing mostly CO<sub>2</sub> and H<sub>2</sub>. After cooling, the CO<sub>2</sub>, mercury and SO<sub>2</sub> are removed, leaving H<sub>2</sub> to fuel a combined cycle generating plant, and the byproducts include sulfur compounds and highly concentrated CO<sub>2</sub>. As envisioned for this study, IGCC designs remove approximately 90% of the CO<sub>2</sub>.

## Terminology

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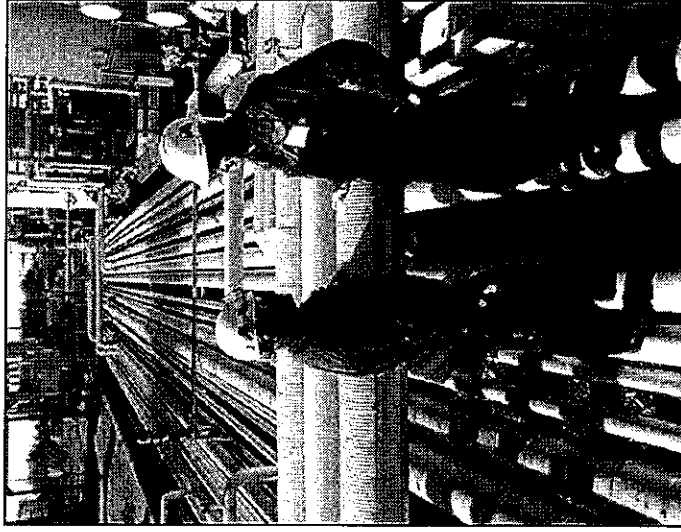
- **Direct economic effects** – Output, jobs and other economic measures at electric generating plants, sites manufacturing the equipment used in the plants, coal mines, carbon transportation and storage facilities and for firms transporting coal to plants.
- **Indirect economic effects** – Output, jobs and other economic activity stimulated by purchases of goods and services by directly affected industries from other firms. Purchases of equipment or consulting services by coal mines would be examples of indirect effects.
- **Induced economic effects** – Output, jobs and other economic activity stimulated by purchases by employees of directly and indirectly affected businesses. Purchases of groceries and home rental expenditures would be examples of induced effects.
- **Multiplier effects** – Sum of indirect and induced economic effects.
- **Output** – Generally equivalent to sales.
- **Value-added** – Sales net of the costs of inputs. When summed across all industries, generally equivalent to gross domestic product (GDP).
- **Job-year** – One job for a one-year period.



## Notes

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- Monetary economic effects (e.g., output, value-added and labor income) are reported in year 2007 dollars.
- Expenditures for plant construction, operations and maintenance were estimated and are reported in year 2007 dollars.
- All other capital and operating expenditures (e.g., coal costs, pipeline construction costs) were estimated and are reported in year 2006 dollars. The IMPLAN model was used to update these costs to year 2007 dollars prior to estimating economic effects.



***Part 2:***  
**Expenditures, Jobs and Other Economic**  
**Benefits from an Individual Advanced Coal**  
**Plant with CCS**

## Summary of Benefits from an Individual Advanced Coal Unit with CCS

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- Advanced coal units with CCS are assumed to have net generating capacities of 520 megawatts (MW) for IGCC and 540 MW for PC.
- Construction expenditures for either a Supercritical PC unit with CCS or an IGCC unit with CCS are approximately \$2.0 to \$2.1 billion.
- Annual O&M expenditures are \$137 million for an IGCC unit with CCS and \$127 million for a Supercritical PC unit.
- Construction of either type of facility is expected to support about 13,000 to 14,000 direct job-years and about 36,000 to 38,000 total job-years (including indirect and induced effects throughout the economy).
- Ongoing annual employment from O&M activity at an individual unit, including coal purchases and transportation, is projected at between 250 and 270 direct jobs. Including multiplier effects, between 1,200 and 1,300 total jobs would be supported throughout the economy.

# Construction and Operating Expenditures for an Advanced Coal Facility with CCS



Expenditure Category	Advanced Coal Facility Type		
	Supercritical Pulverized Coal	540 MW	Integrated Gasification Combined Cycle
Net Generating Capacity		540 MW	520 MW
Capital Costs for Construction (\$ Millions)			
Plant		\$2,090	\$1,976
Transmission Upgrades		\$32	\$32
Pipelines and Compressors		\$21	\$21
Carbon Storage Site		<u>\$2</u>	<u>\$2</u>
Total Construction Costs		\$2,145	\$2,031
Annual Operating & Maintenance Costs (\$ Millions)			
Plant		\$50.0	\$61.8
Coal (minemouth cost)		\$29.3	\$54.9
Coal (transportation)		\$39.3	\$12.6
Pipeline and Compressor Stations		\$7.4	\$7.4
Storage Site		<u>\$0.6</u>	<u>\$0.6</u>
Total Annual O&M Costs		\$126.6	\$137.2

## Benefits from a Supercritical PC Plant with CCS

<b>Economic Benefits from Construction (one-time)</b>		
<b>Economic Measure</b>	<b>Direct Benefit</b>	<b>Total Benefit</b>
Output	\$2.1 Billion	\$6.0 Billion
Value-added	\$0.9 Billion	\$2.9 Billion
Employment	13,952 Job-years	37,878 Job-years
Labor Income	\$0.8 Billion	\$2.0 Billion

<b>Economic Benefits from Operations &amp; Maintenance (annual)</b>		
<b>Economic Measure</b>	<b>Direct Benefit</b>	<b>Total Benefit</b>
Output	\$126.6 Million	\$285.4 Million
Value-added	\$73.6 Million	\$157.0 Million
Employment	251 Jobs	1,225 Jobs
Labor Income	\$30.7 Million	\$81.9 Million

## Benefits from an IGCC Plant with CCS

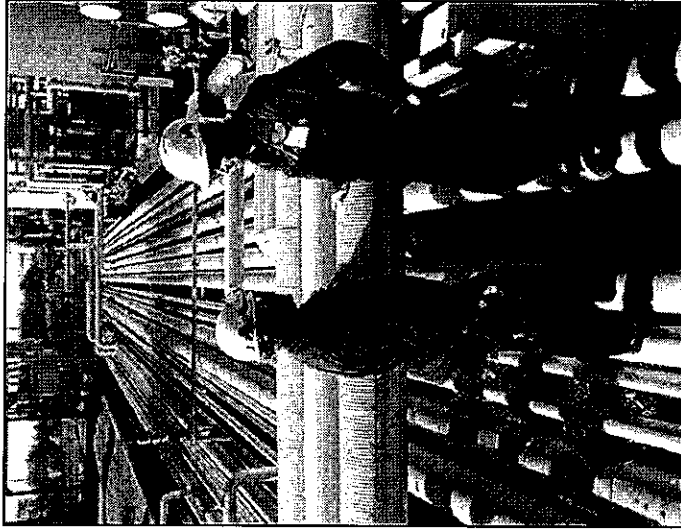
<b>Economic Benefits from Construction (one-time)</b>		
<b>Economic Measure</b>	<b>Direct Benefit</b>	<b>Total Benefit</b>
Output	\$2.0 Billion	\$5.7 Billion
Value-added	\$0.9 Billion	\$2.7 Billion
Employment	13,219 Job-years	35,893 Job-years
Labor Income	\$0.8 Billion	\$1.9 Billion

<b>Economic Benefits from Operations &amp; Maintenance (annual)</b>		
<b>Economic Measure</b>	<b>Direct Benefit</b>	<b>Total Benefit</b>
Output	\$135.6 Million	\$299.6 Million
Value-added	\$81.5 Million	\$168.2 Million
Employment	269 Jobs	1,260 Jobs
Labor Income	\$34.0 Million	\$86.5 Million

## **Benefits from Rep. Boucher's Bill (HR 6258)**

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- HR 6258, the "Early Carbon Capture and Storage Commercial Demonstration Act of 2008," is designed to advance the commercial deployment of Advanced Coal CCS facilities.
- If the proposed \$10 billion in funding under HR 6258 for early commercial deployment of CCS technology leads to development and operation of six (6) plants:
  - Including multiplier effects, construction would stimulate between \$33 billion and \$36 billion in total economic output, about 225,000 total job-years of employment, and about \$12 billion in labor income.
  - Ongoing operations and maintenance would support about 7,500 permanent jobs throughout the economy and about \$500 million in annual labor income.
  - Economic benefits would occur in virtually all sectors of the economy. The largest number of jobs from new facility development would be in the construction, manufacturing and professional services sectors. The largest number of jobs supported by ongoing operations would be in mining, transportation and utilities.



### ***Part 3:*** **Benefits From Future Deployment of a Fleet of Advanced Coal CCS Facilities**



## Potential Extent of Advanced Coal CCS Development

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- This study illustrates the potential magnitude of CCS-only benefits under three alternative levels of deployment: 20 gigawatts (GW), 65 GW and 100 GW. The study assumes an equal mix of PC plants with CCS and IGCC plants with CCS.
- The study is not intended to imply any policy endorsement of these levels of deployment; rather, the study simply assumes these levels for purposes of analysis. Moreover, these results do not consider any potential economic impacts of emission reduction requirements.
- 20 GW of advanced capacity would require deployment of about 38 plants, based on the generating capacities for typical plants (540 MW for PC and 520 MW for IGCC). 65 GW of advanced capacity would require development of approximately 122 plants, and 100 GW of advanced capacity would require approximately 188 plants.
- The following pages summarize projected expenditures for construction and O&M for Advanced Coal facilities with CCS under this assumed range of future deployment, as well as projected nationwide economic benefits from construction and O&M.

## Summary of National Economic Benefits from 20-100 GW of Advanced Coal Facilities with CCS

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- Construction expenditures for this range of capacity of Advanced Coal facilities with CCS are projected at \$79 billion to \$393 billion.
- Annual O&M expenditures, including coal purchase and transportation, are projected at \$5 billion to \$25 billion for this range of future Advanced Coal with CCS capacity.
- Construction of 20 GW of capacity would require about 0.5 million direct job-years of labor and support about 1.4 million job-years of labor throughout the economy.
- Development of 100 GW of capacity would require about 2.6 million direct job-years for construction and support about 6.9 million total job-years of labor throughout the economy.
- Annual O&M for this range of Advanced Coal with CCS capacity would directly support between 10,000 jobs and 49,000 jobs. Including indirect and induced effects (sometimes referred to as “multiplier effects”), deployment in this range would create between 48,000 and 235,000 permanent jobs throughout the economy.
- Economic benefits would be widely distributed across sectors. The largest benefits from construction would be in the construction, manufacturing and professional services sectors. Mining, utilities and transportation would be among the sectors most benefited by ongoing operations and maintenance activities.

## Nationwide Expenditures for Construction of 20-100 GW of Advanced Coal Facilities with CCS

	20 GW	65 GW	100 GW
New Supercritical PC Plants (540 MW)	19 plants	61 plants	94 plants
New IGCC Plants (520 MW)	19 plants	61 plants	94 plants
Total Capital Cost for New Plants	\$78.5 Billion	\$251.9 Billion	\$388.2 Billion
Total Capital Cost for Transportation & Storage Infrastructure	\$0.9 Billion	\$2.8 Billion	\$4.4 Billion
Total Overall Capital Investment	\$79.4 Billion	\$254.8 Billion	\$392.6 Billion

## Nationwide Expenditures for Annual O&M for 20-100 GW of Advanced Coal Facilities with CCS



	20 GW	65 GW	100 GW
New Supercritical PC Plants (540 MW)	19 plants	61 plants	94 plants
New IGCC Plants (520 MW)	19 plants	61 plants	94 plants
Plant Fixed and Variable O&M	\$2.1 Billion	\$6.8 Billion	\$10.5 Billion
Coal Costs (minemouth)	\$1.6 Billion	\$5.1 Billion	\$7.9 Billion
Coal Transportation Costs	<u>\$1.0 Billion</u>	<u>\$3.2 Billion</u>	<u>\$4.9 Billion</u>
Total Fuel Costs	\$2.6 Billion	\$8.3 Billion	\$12.8 Billion
Power and O&M for Transportation & Storage	<u>\$0.3 Billion</u>	<u>\$1.0 Billion</u>	<u>\$1.5 Billion</u>
Total Annual Costs	\$5.0 Billion	\$16.0 Billion	\$24.7 Billion