APPENDIX A:

CCPI AND ICCS PROJECT FACT SHEETS

CLEAN COAL POWER INITIATIVE

INDUSTRIAL CARBON CAPTURE AND SEQUESTRATION

APPENDIX A: CCPI AND ICCS PROJECT FACT SHEETS

CLEAN COAL POWER INITIATIVE

the ENERGY lab

PROJECT FACTS

Clean Coal Power Initiative (CCPI 3)

Summit Texas Clean Energy, LLC: Texas Clean Energy Project: Pre-Combustion CO_2 Capture and Sequestration

Background

A need exists to further develop and bring to commercial practice carbon management technologies that capture and store or beneficially reuse the carbon dioxide (CO_2) that would otherwise be emitted into the atmosphere from coal-based electric power generating facilities. Carbon capture and storage (CCS) technologies offer great potential for reducing CO_2 emissions and mitigating mankind's contribution to global climate change without seriously impacting energy use or hindering economic growth.

Under the second closing of the Clean Coal Power Initiative (CCPI) Round 3 program, the U.S. Department of Energy (DOE) is providing financial assistance, including funding under the American Recovery and Reinvestment Act (ARRA) of 2009, to industry for the purpose of demonstrating the commercial viability of next generation technologies that will capture CO_2 emissions from coal-based electric power generating facilities and either sequester those emissions, or beneficially reuse them. Once demonstrated, the technologies can be readily considered in the commercial marketplace by the electric power industry.

Project Description

The Texas Clean Energy Project (TCEP) was awarded under the CCPI Round 3 program on January 29, 2010. The TCEP will be a green-field integrated gasification combined cycle (IGCC) poly-generation facility with fully integrated CO_2 capture to be located in Penwell, Ector County, Texas. The TCEP will produce electricity for export to the grid and other high-value marketable products, such as sulfuric acid, urea, and CO_2. The IGCC facility will deploy Siemens commercial gasification and power block technologies, including Siemens combustion and steam turbine-generator sets. The facility will use water-gas

Conceptual Illustration of IGCC Facility (Courtesy Siemens)

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U.S. DEPARTMENT OF ENERGY

PROJECT DURATION

Start Date
02/01/2010

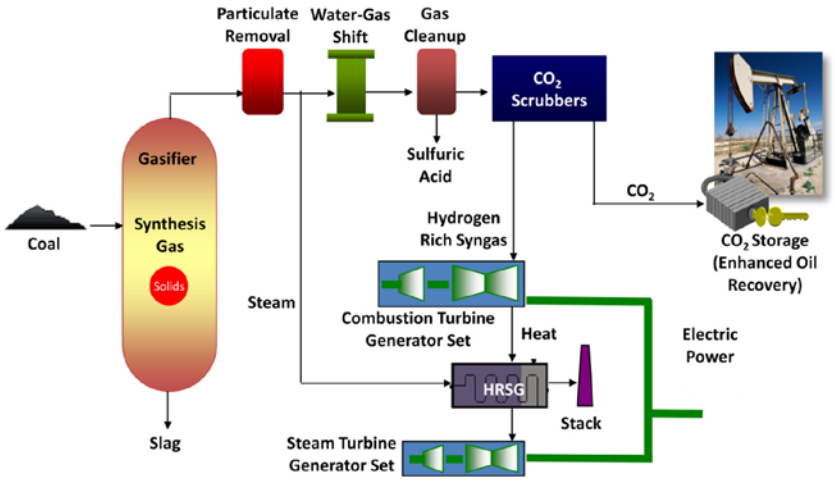
End Date
07/15/2017

COST

Total Project Value
$1,726,628,229

DOE/Non-DOE Share
$450,000,000 / $1,276,628,229

Government funding for this project is provided in whole or in part through the American Recovery and Reinvestment Act.



CO_2 Capture and Storage Concept

shift and Rectisol® CO_2 scrubber technology to capture about 90 percent of the CO_2 produced from the 400 megawatt (gross) facility. The CO_2 will be compressed and transported by existing regional pipelines to oilfields in the west Texas Permian Basin for beneficial use in enhanced oil recovery (EOR) operations with concomitant geologic sequestration. The west Texas Permian Basin is the largest market in the world for CO_2-flood EOR.

Goals/Objectives

The project goal is to advance CCS technologies from the demonstration stage to commercial viability. The project objective is to demonstrate CO_2 removal from the entire pre-combustion synthesis gas (syngas) stream of a green-field IGCC poly-generation facility, the compression and transport of the pipeline quality CO_2, and the monitoring, verification and accounting (MVA) of the disposition of the CO_2 as used in EOR applications with concomitant sequestration.

Benefits

The Texas Clean Energy Project represents an important step in advancing the commercialization of technologies that capture CO_2 from pre-combustion syngas in existing and new electric generating power plants. Standards that limit CO_2 emissions from coal-based electric generation stations do not yet exist, but it is possible that this type of regulation may be enacted in the near future. By producing electricity and other marketable products, while simultaneously capturing and sequestering greenhouse gas emissions, the project will demonstrate that domestic coal can remain a viable energy source to meet the Nation's growing energy demands while minimizing the potential environmental impact. Specific project benefits are as follows:

- The capture of up to 3,000,000 tons per year of CO_2 from the entire plant syngas stream prior to combustion.
- Permanent sequestration of the captured CO_2.
- Increased domestic oil production, which will contribute to national energy security.
- A path forward for existing and new coal-based power plants to continue to provide energy production while meeting environmental sustainability goals.

FE0002650, August 2010

PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Clean Coal Power Initiative (CCPI 2)

09/2008

DEMONSTRATION OF A COAL-BASED TRANSPORT GASIFIER

Project Description

Southern Company, through its affiliate Mississippi Power, plans to develop an air-blown Integrated Gasification Combined Cycle (IGCC) power plant demonstration project utilizing a coal-based transport gasifier. This demonstration highlights a technology – the transport gasifier – that has been used successfully for over 50 years in the petroleum refining industry. The transport gasifier has a fuel-flexible design projected to have higher efficiency and lower capital and operating costs than the currently available oxygen-blown entrained-flow gasifiers. The Demonstration Plant will be built in Kemper County, Mississippi and generate electricity using Mississippi lignite.

This project was one of two selected in Round 2 of the Clean Coal Power Initiative to demonstrate advanced power generation systems using Integrated Gasification Combined Cycle technology. The project will utilize two transport gasifier trains each with its own coal feed and ash handling systems. In a combined cycle plant two power generators, or cycles, are used in combination to generate electricity in a very efficient manner. Coal is first heated in a specialized process vessel with air and steam to drive off the gas from the coal. The gas is then cleaned and then used to fire a gas turbine to generate electricity. The hot exhaust gas leaving the turbine is then used to heat water to produce steam to power a steam turbine and generate additional electricity. Using the gas in two different cycles increases the amount of electricity that can be generated from a ton of coal and does so in an environmentally friendly manner.

Benefits

The transport gasifier technology offers a simpler and more robust method for generating power from coal than other alternatives. It is unique among coal gasification technologies in that it is cost-effective when handling low rank coals and when using coals with high moisture or high ash content. These coals make up half the proven reserves in both the U.S. and the world. Moreover, the transport gasifier is capable of both air- and oxygen-blown operation. This inherent flexibility will allow future applications of this technology to be readily adapted to other applications beyond power generation such as the production of chemicals used in industrial operations.

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(Owner)

KBR
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LOCATION

Kemper County, MS

ESTIMATED PROJECT DURATION

142 months

COST

Total Estimated Cost
$1,625,082,040

DOE/Non-DOE Share
$293,750,000 / $1,331,332,040

*Note: The cost above represents only the scope in which DOE is participating under the CCPI. The DOE scope only represents a portion of the total project scope.

CUSTOMER SERVICE

1-800-553-7681

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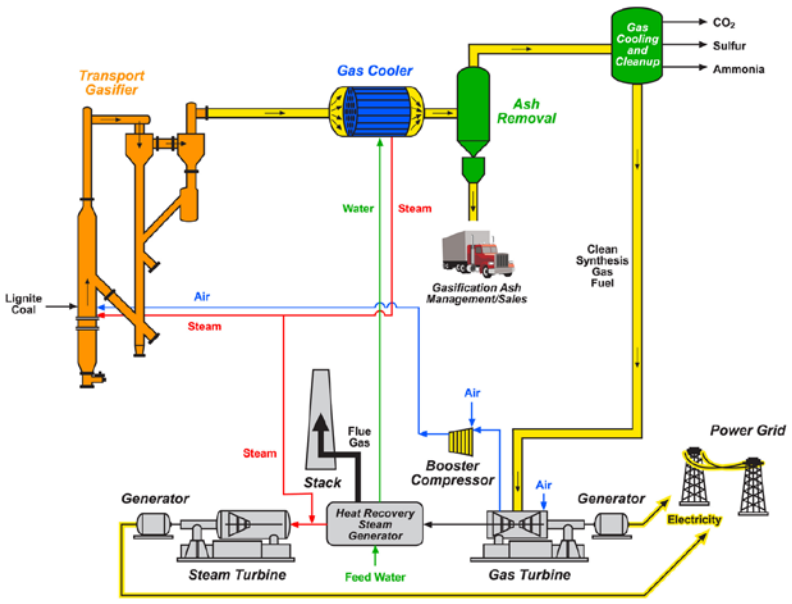
IGCC Transport Gasifier Flow Diagram

This gasifier will also readily adapt to possible future greenhouse gas management requirements that may result from the Global Climate Change Initiative (GCCI). The GCCI's goal is the significant reduction of greenhouse gas intensity of the United States economy over the next 10 years. Analysis shows that the economic benefits offered by the air-blown transport gasifier relative to other IGCC systems, including those that are oxygen-blown, are preserved even when CO_2 capture and sequestration is incorporated into the design. The transport gasifier is further projected to achieve high environmental standards for SO_2, NO_X, particulates, and mercury. Means of reducing water consumption are incorporated in the design and possible gasifier ash utilization applications have been identified.



Kemper County Integrated Gasification Combined Cycle Project Flow Diagram

Project341.indd

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PROJECT FACTS

Clean Coal Power Initiative (CCPI 3)

Hydrogen Energy California Project: Commercial Demonstration of Advanced IGCC with Full Carbon Capture

Background

A need exists to further develop carbon management technologies that capture and store or beneficially reuse carbon dioxide (CO_2) that would otherwise be emitted into the atmosphere from coal-based electric power generating facilities. Carbon capture and storage (CCS) technologies offer great potential for reducing CO_2 emissions and mitigating global climate change, while minimizing the economic impacts of the solution.

Under the Clean Coal Power Initiative (CCPI) Round 3 program, the U.S. Department of Energy (DOE) is providing financial assistance, including funding under the American Recovery and Reinvestment Act (ARRA) of 2009, to industry to demonstrate the commercial viability of next generation technologies that will capture CO_2 emissions and either sequester those emissions, or beneficially reuse them. Once demonstrated, the technologies can be readily considered in the commercial marketplace by the electric power industry.

Artists Rendition of HECA 250 MW IGCC Plant with Carbon Capture and Sequestration

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GE Energy (Gasifier and Power Block)

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U.S. DEPARTMENT OF ENERGY

LOCATION

Greenfield Site in
Kern County, CA

PROJECT DURATION

Start Date
10/01/2009

End Date
11/01/2018

COST

Total Project Value
$2,839,577,774

DOE/Non-DOE Share
$308,000,000 / $2,531,577,774

Government funding for this project is provided in whole or in part through the American Recovery and Reinvestment Act.

Project Description

The DOE selected Hydrogen Energy California LLC (HECA) to receive funding from the American Recovery and Reinvestment Act (ARRA) of 2009, in addition to private capital cost sharing, through the CCPI Round 3 program for its HECA project. The HECA project is a commercial demonstration of an advanced integrated gasification combined cycle (IGCC) power plant with full carbon capture. HECA will design, build, and operate a greenfield commercial scale, fully integrated, advanced IGCC power plant in Kern County, California. The plant will convert coal and petroleum coke into synthesis fuel gas for power generation while removing impurities and pollutants, and have fully integrated CCS processing capabilities.

The HECA project will employ GE gasification technology to generate approximately 250 MW (net) of electricity using a 75 percent western bituminous coal/25 percent petroleum coke fuel blend. CO_2 produced from the facility will be captured, compressed, and transported by pipeline to the Elk Hills oil field approximately five miles from the HECA power plant site. These oil fields are well characterized and operated by Occidental of Elk Hills Inc. The Rectisol® process will be used for acid gas recovery and to achieve high CO_2 capture efficiency.

The project will use local, non-potable, brackish groundwater for all of its processes and water cooling supply. The project's consumption of this brackish water will beneficially impact local agricultural activity and subsurface water quality. The project will also incorporate a 100 percent zero liquid discharge (ZLD) system. All project wastewater, including wastewater generated from the IGCC, raw water treatment, and cooling tower blowdown, will be directed to ZLD systems with the recovered water recycled for reuse in the process. This further reduces the project's water demands.

Goals/Objectives

The goal of the project is to advance CCS technologies from the demonstration stage to commercial viability. The objective of the project is to demonstrate a commercial IGCC plant that will generate electrical power with low emissions of criteria pollutants while capturing, beneficially reusing, and permanently sequestering CO_2 that would otherwise be emitted to the atmosphere.

Benefits

The HECA project represents an important step toward the commercialization of clean technologies that will enable use of our country's vast energy resources. By producing electricity and other marketable products, while simultaneously capturing and sequestering greenhouse gas emissions, the project will demonstrate that domestic coal can be used to meet the Nation's growing energy demands with minimal environmental impact. This same technology could be applied to many additional gigawatts of coal-based electric capacity in the United States and throughout the world.

Specific project benefits include:

- Having the lowest power plant emissions of any commercial coal plant built or currently under construction in the United States.
- Achieving approximately 90 percent CO_2 capture efficiency.
- Sequestering approximately 2 million tons of CO_2 per year.
- Incorporating the beneficial use of CO_2 for EOR and sequestration (which is likely to play a major role in commercialization of IGCC) with high levels of CO_2 capture. EOR brings economic as well as energy security benefits.
- Meeting California's increasing power demands by generating low-carbon hydrogen power.
- Maximizing the use of non-potable water for power production, thereby preserving California's limited freshwater sources.
- Boosting California's economy by creating 1,500 local construction jobs and over 100 permanent operational positions.

FE0000663, June 2010

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PROJECT FACTS

Clean Coal Power Initiative (CCPI 3)

NRG Energy: W.A. Parish Post-Combustion CO_2 Capture and Sequestration Project

Background

A need exists to further develop carbon management technologies that capture and store or beneficially reuse carbon dioxide (CO_2) that would otherwise be emitted into the atmosphere from coal-based electric power generating facilities. Carbon capture and storage (CCS) technologies offer great potential for reducing CO_2 emissions and mitigating global climate change, while minimizing the economic impacts of the solution.

Under the second closing of the Clean Coal Power Initiative (CCPI) Round 3 program, the U.S. Department of Energy (DOE) is providing financial assistance, including funding under the American Recovery and Reinvestment Act (ARRA) of 2009, to industry to demonstrate the commercial viability of next generation technologies that will capture and sequester CO_2 emissions. Once demonstrated, the technologies can be readily considered in the commercial marketplace by the electric power industry.

Project Description

The U.S. Department of Energy (DOE) will provide financial assistance under CCPI Round 3 to NRG Energy (NRG) to demonstrate the addition of a commercial-scale post-combustion carbon capture and sequestration technology on its existing coal-fired W.A. Parish Generating Station (PGS) located in Thompsons, Texas, southwest of Houston, Texas. The project will demonstrate the ability of the Fluor Econamine FG Plus^{SM} technology to capture 90% of the CO_2 emitted from a 60 Megawatt (MW) flue gas slipstream from PGS.

The project will also demonstrate a number of innovative technological advances to the Fluor Econamine FG PlusSM solvent technology and captured CO_2 processing systems. The solvent was designed to remove CO_2 from coal-fired plant flue gas in which other components such as ash, sulfur dioxide, sulfur trioxide, nitrogen oxides and oxygen are also present. Additionally, the solvent is readily available, inexpensive and has relatively low energy requirements. The plant configuration will also allow the testing of advanced solvents being developed by Fluor and the University of Texas. Innovations in process equipment performance such as absorber intercooling and lean solution vapor compression have the potential to reduce the energy requirements of these systems by as much as 20 percent. And finally, efficiency improvements in the supporting balance of plant processes such as process steam generation and CO_2 compression will also reduce energy requirements. These advances are anticipated to lower carbon capture costs and increase system flexibility and efficiency.

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Ramgen

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U.S. DEPARTMENT OF ENERGY

PROJECT DURATION

Start Date
06/01/2010

End Date
11/30/2017

COST

Total Project Value
$333,608,850

DOE/Non-DOE Share
$166,804,425/ $166,804,425

Government funding for this project is provided in whole or in part through the American Recovery and Reinvestment Act.

The captured CO_2 will be compressed and transported through a pipeline and sequestered in geologic formations located in the mature oil fields of Texas's gulf coast region via enhanced oil recovery (EOR). Candidate geologic formations have been identified and an analysis of the reservoir's suitability to contain the injected CO_2 is in progress.

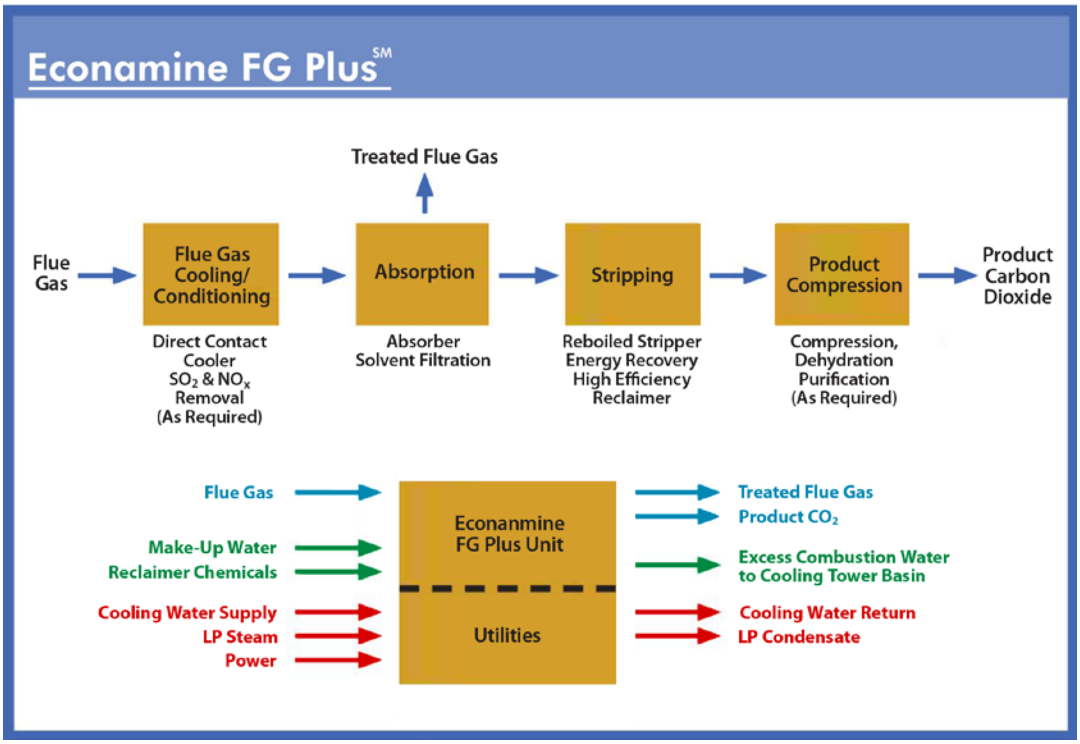
Goals/Objectives

The project goal is to advance CCS technologies from the demonstration stage to commercial viability. The project objective is to demonstrate CO_2 removal from treated flue gas from an existing coal-fired electrical generating station, and the compression and transport of the pipeline quality CO_2 to a sequestration site where it will be used for EOR.

Benefits

The W.A. Parish Post-Combustion CO_2 Capture and Sequestration Project represents an important step in advancing the commercialization of technologies that capture CO_2 from the flue gas of existing power plants. Standards that limit CO_2 emissions from coal-fired electrical generating stations do not yet exist, but it is possible that this type of regulation may be enacted in the future. The addition of CO_2 capture capability to the existing fleet of power plants will enable those plants to continue to produce clean electricity and simultaneously reduce the impact of CO_2 emissions. Specific project benefits are as follows:

- The capture of up to 400,000 metric tons per year of CO_2 from a PGS flue gas stream.
- Permanent sequestration of the captured CO_2.
- Increased domestic oil production in the U.S., which contributes to national energy security.
- A path forward for existing coal-fired power plants to continue energy production while meeting environmental sustainability goals.



FE0003311, May 2010

the ENERGY lab

PROJECT FACTS

Clean Coal Power Initiative (CCPI 3)

American Electric Power (AEP): Mountaineer Carbon Dioxide Capture and Storage Demonstration

Background

A need exists to further develop carbon management technologies that capture and store or beneficially reuse carbon dioxide (CO_2) that would otherwise be emitted into the atmosphere from coal-based electric power generating facilities. Carbon capture and storage (CCS) technologies offer great potential for reducing CO_2 emissions and mitigating global climate change, while minimizing the economic impacts of the solution.

Under the second closing of the Clean Coal Power Initiative (CCPI) Round 3 program, the U.S. Department of Energy (DOE) is providing financial assistance, including funding under the American Recovery and Reinvestment Act (ARRA) of 2009, to industry to demonstrate the commercial viability of next generation technologies that will capture CO_2 emissions and either sequester those emissions, or beneficially reuse them. Once demonstrated, the technologies can be readily considered in the commercial marketplace by the electric power industry.

Project Description

The DOE selected American Electric Power (AEP) to receive funding from the American Recovery and Reinvestment Act (ARRA) of 2009, in addition to private capital cost sharing, through the CCPI Round 3 program for its Mountaineer Carbon Dioxide Capture and Storage Demonstration Project. The Mountaineer project will capture and sequester approximately 1.5 million tons per year of CO_2 that would otherwise be emitted into the atmosphere. The project is comprised of members from government, industry, and academia. American Electric Power (AEP) will lead the design, construction, and operation of a CCS system using the Alstom Chilled Ammonia Process (CAP), which is expected to effectively capture at least 90% of the carbon dioxide from a 235 megawatt electric (MWe) slipstream of the 1300 MWe Mountaineer coal-fired power plant located near New Haven, West Virginia. The CO_2 will be captured, compressed, and transported by pipeline to injection sites located on AEP property near the capture facility. The target storage reservoirs are the Rose Run sandstone and the Copper Ridge formations which are capped by multiple extensive containment layers.

The project represents the culmination of a systematic process of scaling up carbon capture technology from pilot and validation to commercial-scale demonstration. The CAP technology was first tested at 1.7 MWe equivalent size at the We Energies Pleasant Prairie plant and then at a 20 MWe validation scale facility

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U.S. DEPARTMENT OF ENERGY

PROJECT DURATION

Start Date
02/01/2010

End Date
06/30/19

COST

Total Project Value
$668,000,000

DOE/Non-DOE Share
$334,000,000 / $334,000,000

Government funding for this project is provided in whole or in part through the American Recovery and Reinvestment Act.

Figure 1. Chilled Ammonia CO_2 Capture Process Validation Facility

(shown in Figure 1 above) at the Mountaineer plant. Successful demonstration of the CAP system coupled with sequestration will reduce CCS technology risks. This will enable subsequent commercial deployment by significantly reducing overall capture costs compared to existing conventional carbon dioxide post combustion capture systems and by demonstrating the viability of sequestration in regional deep saline reservoirs.

The project consists of four phases: Project Definition (Phase I), Design and Permitting (Phase II), Construction and Startup (Phase III), and Operations/Demonstration (Phase IV). Sequestration of 1.5 million tons per year of CO_2 will begin by the end of 2015.

Goals/Objectives

The goal of the project is to advance CCS technologies from the demonstration stage to commercial viability. Project objectives include:

- Utilizing Alstom Power's CAP to capture at least 90 % of CO_2 from a flue gas slipstream.
- Compressing and transporting CO_2 by pipeline to injection sites.
- Permanently storing CO_2 in two separate saline formations located approximately 1.5 miles below the surface.

Benefits

The CAP system is expected to reduce overall costs compared to existing conventional CO_2 post combustion capture systems. Based on the cost savings, AEP will consider the application of CAP to both existing and new pulverized coal-based units in the AEP system. This same technology could be applied to many additional gigawatts of coal-based electric capacity in the United States and throughout the world.

The AEP project presents unique advantages:

- It will achieve approximately 90% CO_2 capture efficiency and sequester approximately 1,500,000 tons of CO_2 per year.
- It will demonstrate commercial scale CO_2 storage in deep saline aquifers which would be a likely sequestration target for most coal-fired power plants in the U.S. and the world.
- It will demonstrate a capture technology that could potentially reduce post-combustion CO_2 capture costs over that of conventional amine based systems by over 50%.
- The new plant is anticipated to boost the local economy by creating approximately 800 local construction jobs.

FE0002673, June 2010

APPENDIX A: CCPI AND ICCS PROJECT FACT SHEETS

INDUSTRIAL CARBON CAPTURE AND SEQUESTRATION

the ENERGY lab

PROJECT FACTS

Industrial Carbon Capture and Sequestration (ICCS)

Leucadia Energy, LLC: Lake Charles Carbon Capture & Sequestration Project

Background

Carbon dioxide (CO_2) emissions from industrial processes are linked to global climate change. Advancing development of technologies that capture and store or beneficially reuse CO_2 that would otherwise reside in the atmosphere for extended periods is of great importance. Carbon capture and storage (CCS) technologies offer significant potential for reducing CO_2 emissions and mitigating global climate change, while minimizing the economic impacts of the solution.

Under the Carbon Capture and Sequestration from Industrial Sources and Innovative Concepts for Beneficial CO_2 Use (ICCS) program, the U.S. Department of Energy (DOE) is collaborating with industry in cost sharing arrangements to demonstrate the next generation of technologies that will capture CO_2 emissions from industrial sources and either sequester those emissions or beneficially reuse them. The technologies included in the ICCS program have progressed beyond the research and development stage to a scale that can be readily replicated and deployed into commercial practice within the industry.

Project Description

The DOE selected Leucadia Energy, LLC to receive ICCS program funding through the American Recovery and Reinvestment Act (ARRA) of 2009, for its Lake Charles CCS Project. The ICCS project will demonstrate the capture of CO_2 from a Lake Charles industrial facility for use in an independent enhanced oil recovery (EOR) application. The industrial source of CO_2 will be a petroleum-coke-to-chemicals (methanol and other by-products) plant being developed by Lake Charles Cogeneration LLC (a Leucadia Energy, LLC affiliate) in Lake Charles, Louisiana. Once the CO_2 is captured, it will be purified to remove contaminants and compressed to a pressure suitable for commercial pipeline transport to oil fields in Texas and Louisiana for EOR. The project will also implement a comprehensive monitoring, verification, and accounting (MVA) program to confirm the long-term sequestration of a minimum of one million tons per year of the injected CO_2 at the Hastings oil field.

The project will involve the design and construction of CO_2 capture, compression, pipeline, and monitoring infrastructure followed by the operation of the system to capture, transport, and then sequester CO_2 in an EOR application. A comprehensive MVA program to monitor the injected CO_2 will be implemented.

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USA Energy Advisors

PROJECT DURATION

Start Date
11/16/2009

End Date
09/30/2015

COST

Total Project Value
$435,587,194

DOE/Non-DOE Share
$261,382,310/ $174,204,884

U.S. DEPARTMENT OF ENERGY

Goals/Objectives

The project goal is to advance CCS technologies from the demonstration stage to commercial viability. The project objective is to design, construct, and operate an integrated system of industrial-scale CO_2 capture, compression, and sequestration for the beneficial reuse of CO_2 through EOR.

Benefits

The project will result in the large-scale recovery, purification, and compression of more than 4 million tons of CO_2. The sale of CO_2 from the ICCS project for use in independent EOR operations by Denbury affords a cost effective means to increase domestic oil production while using advanced gasification technology to reduce the release of CO_2. On a global scale, petroleum coke currently being exported from the U.S. to regions where little if any environmental controls are required or implemented will now be used in a domestic chemical project that achieves superior environmental performance and captures CO_2 for beneficial use.

With the completion of the Green Pipeline by Denbury and an affiliate, naturally occurring CO_2 taken from the Jackson Dome in Mississippi will be used for EOR in oil fields in Texas and Louisiana. CO_2 from the project that is compressed and delivered to the Green Pipeline will represent approximately 25 percent of the daily amount of CO_2 that Denbury will use in these oil fields. By using the anthropogenic CO_2 from the Lake Charles plant, Denbury will be able to reduce the amount taken from the Jackson Dome and prolong the life of this naturally occurring source of CO_2. Additionally, a comprehensive MVA program will be implemented in the Hastings oil field that will confirm the long-term sequestration of injected CO_2 in the EOR project application.

The infrastructure developed by the ICCS project could potentially enable other industrial and power plant CO_2 sources in the Lake Charles industrial community to commercially dispose of CO_2 in Gulf Coast EOR operations. Expansion of EOR in the Gulf Region will promote greater energy security by increasing domestic energy supplies. The Lake Charles gasification facility and CCS project alone are expected to provide up to 1,100 construction jobs and 200 permanent operation jobs, as well as millions of dollars in severance taxes and royalties to the States of Louisiana and Texas.

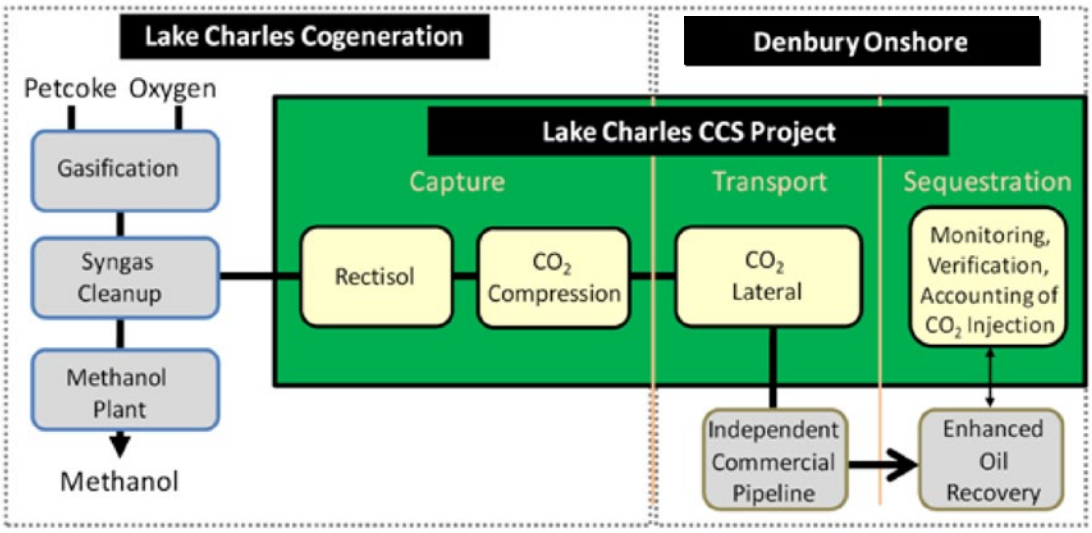

Diagram of the Lake Charles CCS Project

2314, October 2010

the ENERGY lab

PROJECT FACTS

Industrial Carbon Capture and Sequestration (ICCS)

Archer Daniels Midland Company: CO_2 Capture from Biofuels Production and Sequestration into the Mt. Simon Sandstone

Background

Carbon dioxide (CO_2) emissions from industrial processes, among other sources, are linked to global climate change. Advancing development of technologies that capture and store or beneficially reuse CO_2 that would otherwise reside in the atmosphere for extended periods is of great importance. Carbon capture and storage (CCS) technologies offer significant potential for reducing CO_2 emissions and mitigating global climate change, while minimizing the economic impacts of the solution.

Under the Carbon Capture and Sequestration from Industrial Sources and Innovative Concepts for Beneficial CO_2 Use (ICCS) program, the U.S. Department of Energy (DOE) is collaborating with industry in cost sharing arrangements to demonstrate the next generation of technologies that will capture CO_2 emissions from industrial sources and either sequester those emissions or beneficially reuse them. The technologies included in the ICCS program have progressed beyond the research and development stage to a scale that can be readily replicated and deployed into commercial practice within the industry.

Project Description

The DOE selected Archer Daniels Midland Company (ADM) to receive ICCS program funding through the American Recovery and Reinvestment Act (ARRA) of 2009. The project will demonstrate an integrated system of CO_2 capture in an ethanol production plant and geologic sequestration in a sandstone reservoir. The CO_2 used in this project is produced by ADM as a by-product in the production of fuel grade ethanol. ADM will capture approximately one million tons of CO_2 per year using dehydration and compression. The ethanol plant and the sequestration site are both located in Decatur, Illinois. The compressed CO_2 will be sequestered in Mt. Simon Sandstone Formation (saline reservoir). The project team members include ADM, Illinois State Geological Survey (ISGS), Schlumberger Carbon Services, and Richland Community College (RCC).

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PROJECT DURATION

Start Date
11/16/2009

End Date
09/30/2015

COST

Total Project Value
$207,942,199

DOE/Non-DOE Share
$141,405,945 / $66,536,254

Government funding for this project is provided in whole or in part through the American Recovery and Reinvestment Act.

The scope of the project includes design, construction, and demonstration of CO_2 capture, CO_2 sequestration, and monitoring, verification, and accounting (MVA) of stored CO_2. The project development activities include project schedule, project cost estimate, host-site commitments, financial commitments and funding plans for the non-DOE share of the project costs, and NEPA and environmental permitting.

Goals/Objectives

The overall project objective is to develop and demonstrate an integrated system of CO_2 capture from an ethanol plant and geologic sequestration in the Mt. Simon Sandstone Formation (saline reservoir).

Benefits

The project addresses climate change concerns by capturing CO_2 from a large-scale industrial process and by storing the compressed and dehydrated CO_2 in a saline reservoir. Specific advantages of the project include:

- Design, construction, and operation of a collection, compression, and dehydration facility capable of delivering up to 1,980 MT/day of CO_2 to an injection and sequestration site.
- Integration of the new facility with an existing 990 MT/day CO_2 compression and dehydration facility to achieve a total CO_2 sequestration capacity of approximately one million tons annually.
- Implementation and validation of the monitoring, verification, and accounting plan for the stored CO_2.
- Demonstrate the cost advantages and economic viability of CCS technologies at ethanol production facilities.

ADM's Agricultural Processing and Biofuels Plant, Decatur, IL.

ADM Schlumberger Carbon Services Richland Community College

FE0001547, December 2010

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PROJECT FACTS

Industrial Carbon Capture and Sequestration (ICCS)

Air Products and Chemicals, Inc.: Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large-Scale Hydrogen Production

Background

Carbon dioxide (CO_2) emissions from industrial processes are linked to global climate change. Advancing development of technologies that capture and store or beneficially reuse CO_2 that would otherwise reside in the atmosphere for extended periods is of great importance. Carbon capture and storage (CCS) technologies offer significant potential for reducing CO_2 emissions and mitigating global climate change, while minimizing the economic impacts of the solution.

Under the Carbon Capture and Sequestration from Industrial Sources and Innovative Concepts for Beneficial CO_2 Use (ICCS) program, the U.S. Department of Energy (DOE) is collaborating with industry in cost sharing arrangements to demonstrate the next generation of technologies that will capture CO_2 emissions from industrial sources and either sequester those emissions or beneficially reuse them. The technologies included in the ICCS program have progressed beyond the research and development stage to a scale that can be readily replicated and deployed into commercial practice within the industry.

Project Description

The DOE selected Air Products and Chemicals, Inc. (Air Products) to receive ICCS program funding through the American Recovery and Reinvestment Act (ARRA) of 2009, for its Demonstration of CO_2 Capture and Sequestration of Steam Methane Reforming Process Gas Used for Large-Scale Hydrogen Production project. For this project, Air Products will design and demonstrate a state-of-the-art system to concentrate CO_2 from two steam methane reformer (SMR) hydrogen production plants, and purify the CO_2 to make it suitable for delivery via pipeline for sequestration by injection into an oil reservoir for an enhanced oil recovery (EOR) project. Air Products plans to retrofit its two Port Arthur SMRs with a vacuum swing adsorption (VSA) system to separate the CO_2 from the process gas stream, followed by compression and drying processes. This process will convert the initial stream containing more

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PROJECT DURATION

Start Date
11/16/2009

End Date
09/30/2015

COST

Total Project Value
$430,648,802

DOE/Non-DOE Share
$284,012,496 / $146,636,306

U.S. DEPARTMENT OF ENERGY

than 10 percent CO_2 to greater than 98 percent CO_2 purity for delivery to the pipeline, with negligible impact on the efficiency of hydrogen production. The technology will remove more than 90 percent of the CO_2 from the process gas stream used in a world-class scale hydrogen production facility.

Project activities include engineering and design, construction, commissioning and startup, and the operation of all components of the project. A monitoring, verification and accounting (MVA) program to monitor the injected CO_2 will be designed and implemented.

Port Arthur 1 & 2 plants

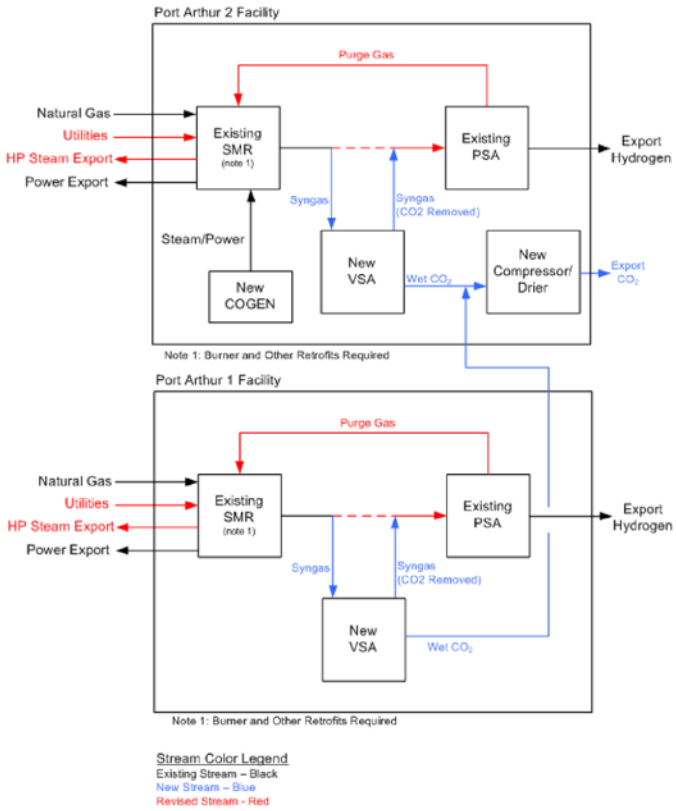
Goals/Objectives

The project goal is to advance CCS technologies from the demonstration stage to commercial viability. The project objective is to capture CO_2 from two SMR hydrogen production plants and sequester it in an oil reservoir for EOR in order to successfully demonstrate the technology and maximize the economic viability of commercial-scale CCS.

Benefits

Overall the project will address climate change concerns, enhance U.S. economic and energy security, and boost domestic oil production. Specific project advantages and benefits include:

- Capturing approximately 1 million metric tons per year of CO_2, that would otherwise be emitted to the atmosphere, for permanent sequestration in geologic formations for EOR applications.
- The CO_2 to be used for EOR will result in approximately 1.6 to 3.1 million barrels of additional domestic oil production.



CO_2 System Sketch

2381, October 2010

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DOE/NETL Advanced Carbon Dioxide Capture R&D Program: Technology Update

May 2011