FUTUREGEN:

THE WORLD’S CLEANEST COAL PLANT

EIS CASE STUDY

November 9, 2010
Objective and History

In 2003, President George Bush announced an initiative to research and develop coal-based, carbon-neutral electricity and hydrogen generation (see inset). To fulfill this initiative, the U.S. Department of Energy pledged $950 million dollars in March 2004 for a 74/26 funding split with a group named FutureGen Alliance. FutureGen Alliance included energy firms from the U.S., China, Australia, and England.

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Futuregen as a plant combining an Integrated Gasification Combined
Combustion (IGCC) process with CO2 capture and geologic sequestration technology, the Department of Energy and FutureGen Alliance began petitioning communities to submit plant siting proposals. They narrowed the list to four applicants in 2006: Mattoon, Illinois; Tuscola, Illinois; Jewett, Texas; and Odessa, Texas. The DoE made a formal notice of intent in November 2007. Shortly thereafter, the site near Mattoon was chosen.

Mattoon, Coles County, and the State of Illinois put an incentive package together including a $17 million direct cash grant from clean-coal technology fund, up to $50 million in reduced-interest loans, sales tax exemptions and business tax credits, public improvement funding, and reimbursement for employee training costs. In return, FutureGen estimated the plant would provide 1,300 temporary jobs and 150 permanent jobs in addition to its services as a 275-megawatt plant. The plant would dedicate six years for DoE research, and then continue selling electricity for its expected lifetime of twenty to fifty years.

The project was put into jeopardy in January 2008, as the Department of Energy backed out of its funding pledge. Although stimulus money was proposed in December 2008, the estimated costs had nearly doubled to over two billion dollars. The project as is was listed as "pork" by a CNN report, and in August 2010, the DoE and FutureGen Alliance announced a significant change in the project. Rather than building a new plant at the Mattoon site, the alliance would retrofit a shuttered Oxy-Coal Combustion process plant in Meredosia, Illinois. The alliance would still use the Mattoon site for Carbon sequestration. Mattoon declined, opting to instead look for other investors, and November 4, 2010, FutureGen gave the site back to Mattoon, severing the remaining ties with the community.

Technology

IGCC is a process in which coal is turned into gas at a high pressure. Hydrogen and impurities can be separated at this time, and when the coal is combusted, high-pressure Carbon Dioxide remains.

Geologic sequestration is a process in which Carbon Dioxide is captured and pumped underneath the ground, reacting with minerals in the cap rock to mineralize and capture the carbon. (See figure below.)

Timeline

Feb 27, 2003: Current President Bush announces $1 billion spent for clean coal research.
Mar, 2004: DoE pledges 950 million for a 74/26 ratio with FG.
Aug 31, 2006: Public scoping in Mattoon occurs.
Nov 2007: Final EIS published.
Dec 2007: Mattoon chosen among alternatives.
Jan 2008: DoE retracts funding for project.
Jan 2009: FutureGen listed as “Pork” by CNN.
Jun 12, 2009: DoE approves $2.4 billion to spend for Futuregen.
Aug 5, 2010: DoE announces FutureGen 2.0, retrofitting shuttered plant in Meredosia, IL and piping the CO2 to Mattoon for storage. Mattoon rejects.
2009-2012: Construction was projected to occur.
2013-2018: DoE research period.
2019-2069: Maximum projected operation.
EIS Summary

Alternatives

In addition to a no-action alternative, the EIS contained four major categories of alternatives:

- **No-action alternative**

  This alternative was dismissed because without Department of Energy funding, the FutureGen project would likely not be built. In this case, there was a less likely chance of carbon-neutral coal technology being developed, which was considered unfavorable.

- **Alternate power plant technology**

  Among alternate technologies, the EIS discussed four alternatives. Super-critical pulverized coal power plant technology was dismissed because at current technological levels, creation of Hydrogen was prohibitively inefficient and therefore this would not meet the project objective.

  Integrated gasification fuel cell power plant technology was dismissed because the risk levels were too high at this point in time and research and development of fuel cells still need to occur for this technology to be feasible.

  Nuclear power and renewable power were both dismissed because those technologies do not use coal; therefore they would not meet the project objective.

- **Alternate sequestration technology**

  Three alternate sequestration technologies were identified. Deep ocean sequestration was dismissed because it had relatively little research and had unproven consequences on marine life. Terrestrial sequestration, which is allowing trees and natural processes to sequester the CO2, was dismissed because of uncertain long-term accountability and inability to store CO2 directly from power plants. Mineral sequestration, which is directly mineralizing the CO2 into carbonates was dismissed because no commercial process had been developed. In addition, because of its slow nature, its economic viability was deemed uncertain.

  - **Retrofitting existing plants**

    The alternative of attaching CO2 capture devices and sequestration facilities to an existing or planned commercial power plant was also considered but eliminated. Such an approach could meet the FutureGen Project’s objectives without the cost of planning, designing, and building a new power plant. However, this alternative was eliminated for the reasons detailed below.

    Existing or planned non-IGCC power plants were dismissed because almost all non-IGCC power plants are not sufficiently pressurized to reduce the efficiency penalty associated with capture and compression of CO2. In addition, these plants cannot produce appreciable quantities of H2 without suffering an unreasonably large efficiency penalty when using the produced electricity to generate H2 (e.g., by electrolysis).

    Existing or planned IGCC power plants were dismissed because owners of these plants have not volunteered their existing or planned IGCC power plants for the FutureGen Project. Existing plants would not be able to accommodate equipment for pre-combustion capture of CO2 from synthesis gas without extensive modification, and would not have the necessary features that create a research platform to meet the FutureGen Project’s research, development, and demonstration objectives.

  - **Alternate sites**

    As discussed earlier, four alternate sites were considered from which the Mattoon site was chosen. Mattoon was considered preferable because it contained a sequestration site for CO2 injection on-site, the Mt. Simon saline-bearing sandstone at a depth of 1.3 to 1.6 miles. It contained utility connections, including process water that could be taken from wastewater treatment plants rather than groundwater, existing high-voltage power lines, and nearby sanitary systems. The site included convienent rail and highway connections. In addition, the 444-acre site was mostly farmland and right-of-way, easing property transfer.

Results of Public Scoping

- **Air Quality**: Potential impacts from air emissions (including mercury, VOCs, and particulate matter [PM]) during construction and operation of the power plant and impacts to sensitive receptors. Impacts of dust from construction, transportation, and storage of materials. Potential impacts on National Ambient Air Quality Standards (NAAQS).

- **Geology and Soils**: Potential for activation of surface or subsurface faults. Potential for seismic activity from carbon sequestration.

- **Water Resources**: Potential impact to drinking water supplies and freshwater aquifers. Potential impacts to surface water and groundwater flow and to water resources from wastewater discharge or runoff.

- **Wetlands and Floodplains**: Potential impacts to wetlands and floodplains.

- **Ecological Resources**: Potential on-site and off-site impacts to vegetation, terrestrial and aquatic wildlife, threatened and endangered species, and ecologically sensitive habitats.

- **Cultural Resources**: Potential for impacts to Native American cultural resources.

- **Land Use**: Potential impacts to prime farmland and conversion of land use from farming to industrial use. Use of site after plant closure. Property rights to store CO2 under adjoining property.

- **Aesthetics**: Impacts on viewsheds to residences, including views of transmission lines.

- **Transportation and Traffic**: Potential impacts to local traffic patterns, safety at railroad crossings, and traffic controls. Transportation and roadway infrastructure impacts from rail and truck transport of coal to the plant. Need for upgrades or improvements to local roadway infrastructure.

- **Noise and Vibration**: Noise levels generated from the unloading of coal from railcars and switching the train cars. Impacts to sensitive receptors from increased noise levels.

- **Materials and Waste Management**: Impact of accumulating piles of ash/slag and sulfur generated by the gasification process. Reuse or disposal of byproducts of the coal gasification process. The method and location by which solid and hazardous waste would be disposed, including mercury-containing materials and ash/slag.

- **Human Health, Safety, and Accidents**: The potential danger of an explosion at the plant to local community and the community safety measures that would be taken. The potential danger of a terrorist attack. Potential impact of electromagnetic fields on people who live near the proposed transmission lines, substations, and transformers.

- **Community Services and Socioeconomics**: Socioeconomic impacts on local job market, taxes, and impacts to property values, and commercial and residential growth. Use of the power plant after DOE involvement has ended. Impacts to emergency services (e.g., police and fire support).

The scoping document found thirteen categories of potential impacts to examine. (See above.) All of the categories had detailed analysis completed for each of the site alternatives. The analysis included temporary impacts during construction and operational impacts. Impacts were considered both at the site and also where infrastructure would be located.

Of these categories, air quality; soils; aesthetics; noise; human health, safety, and accidents; and community services and socioeconomics were deemed to contain unavoidable adverse impacts. Mitigation measures were developed for all of these impacts.
Mitigation

- **Soil**: Prime farmland soils could be stockpiled for future use.
- **Aesthetics**: FutureGen could employ landscaping and enclose the more industrial aspects in buildings.
- **Noise**: The FutureGen project could employ sound barriers and divert truck trips around the City of Mattoon.
- **Human Health & Safety**: FutureGen could employ thicker pipe guards, use deep burial for gas lines, and would consider smaller biweekly shipments of Ammonia rather than larger weekly shipments.
- **Socioeconomic**: FutureGen would consider purchasing residences affected by property value drops.
- **Air**: The FutureGen Project would employ the most advanced particulate control technologies available. Concentration of particulates in the cleaned syngas would be about 0.1 to 1 parts per million by weight, far lower than current environmental standards.

The project would use the most advanced combustion control technologies for NOX available when the turbine would be put into service. SCR is considered a possible option if suitable conditions exist to minimize potential interference by sulfur species.

The project would include a water-gas-shift reactor, plus an AGR system which would capture and remove acidic gases such as CO and H2 S.

References


