



# FutureGen: A Brief History and Issues for Congress

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## Summary

A decade after the George W. Bush Administration announced FutureGen—its signature clean coal power initiative—the program is still in early development. Since its inception in 2003, FutureGen has undergone changes in scope and design. As initially conceived, FutureGen would have been the world's first coal-fired power plant to integrate carbon capture and sequestration (CCS) with integrated gasification combined cycle (IGCC) technologies. FutureGen would have captured and stored carbon dioxide (CO<sub>2</sub>) in deep underground saline formations and produced hydrogen for electricity generation and fuel cell research. Increasing costs of development, among other considerations, caused the Bush Administration to discontinue the project in 2008. In 2010, under the Obama Administration, the project was restructured as FutureGen 2.0: a coal-fired power plant that would integrate oxy-combustion technology to capture CO<sub>2</sub>. FutureGen 2.0 is the U.S. Department of Energy's (DOE) most comprehensive CCS demonstration project, combining all three aspects of CCS technology: capturing and separating CO<sub>2</sub> from other gases, compressing and transporting CO<sub>2</sub> to the sequestration site, and injecting CO<sub>2</sub> in geologic formations for permanent storage.

Congressional interest in CCS technology centers on balancing the competing national interests of fostering low-cost, domestic sources of energy like coal against mitigating the effects of CO<sub>2</sub> emissions in the atmosphere. FutureGen would address these interests by demonstrating CCS technology. Among the challenges to the development of FutureGen 2.0 are rising costs of production, ongoing issues with project development, lack of incentives for investment from the private sector, time constraints, and competition with foreign nations. Remaining challenges to FutureGen's development include securing private sector funding to meet increasing costs, purchasing the power plant for the project, obtaining permission from DOE to retrofit the plant, performing the retrofit, and then meeting the goal of 90% capture of CO<sub>2</sub>.

The FutureGen project was conceived as a public-private partnership between industry and DOE with agreements for cost-share and cooperation on development, demonstration, and deployment of CCS technology. The public-private partnership has been criticized for leading to setbacks in FutureGen's development, since the private sector lacks incentives to invest in costly CCS technology. Regulations, tax credits, or policies such as carbon taxation or cap-and-trade that increase the price of electricity from conventional power plants may be necessary to make CCS technology competitive enough for private sector investment. Even then, industry may choose to forgo coal-fired plants for other sources of energy that emit less CO<sub>2</sub>, such as natural gas.

A proposed rule by the Environmental Protection Agency (EPA) to limit CO<sub>2</sub> emissions from new fossil-fuel power plants may provide some incentive for industry to invest in CCS technology. Alternatively, critics of the proposed rule have expressed concern over the loss of American competitiveness in a global market not subject to similar regulations. These critics point to China's increasing CO<sub>2</sub> emissions and argue that Chinese industries will surpass American industries in productive competitiveness and that this will lead to American companies outsourcing jobs and production. Delays in FutureGen's project development may have made full-scale demonstration of CCS technology by 2015—the year that federal stimulus funding for FutureGen expires—difficult to accomplish.

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## Introduction

FutureGen is a clean-coal technology program managed through a public-private partnership between the U.S. Department of Energy (DOE) and the FutureGen Industrial Alliance. The FutureGen program as originally conceived in 2003 by the George W. Bush Administration had the intent of constructing a net zero-emission fossil-fueled power plant with carbon capture and sequestration (CCS) technology.<sup>1</sup> CCS is a process envisioned to capture carbon dioxide (CO<sub>2</sub>) emitted from burning fossil fuels and store it in deep underground geologic formations, thus preventing its release into the atmosphere. If widely deployed in the United States, CCS could decrease the amount of U.S.-emitted CO<sub>2</sub>, a greenhouse gas associated with climate change. In 2008, DOE withdrew from the FutureGen partnership, citing rising costs of construction as its reason. Subsequently, DOE restructured the FutureGen program to instead develop two or three demonstration projects in different power plants around the country. In 2010, the Obama administration announced another change to the program with the introduction of FutureGen 2.0, which would retrofit an existing coal-fueled power plant in Illinois with CCS technology.<sup>2</sup>

Under the American Recovery and Reinvestment Act of 2009 (ARRA, P.L. 111-5), FutureGen received \$1 billion to proceed with the project. The FutureGen Alliance estimated the total cost of the program to be \$1.3 billion, with \$730 million used toward retrofitting and repowering Ameren Corporation's power plant and \$550 million used for the construction of a CO<sub>2</sub> pipeline, storage site, and training and research center. They also estimated that the project would create approximately 1,000 construction jobs and another 1,000 jobs for suppliers across the state.<sup>3</sup> A history of FutureGen is found at the end of this report.

This report briefly summarizes the history of FutureGen, discusses why it has gained interest and support from some Members of Congress and the Administration while remaining in initial stages of development, and offers some policy considerations on barriers that challenge its further development as a model for a CCS program.

## Issues for Congress

Congressional consideration of CCS has focused on balancing competing national interests such as fostering low-cost domestic sources of energy like coal against reducing greenhouse gas (GHG) emissions in the atmosphere. Legislative proposals during the 109<sup>th</sup> and 110<sup>th</sup> Congresses focused on advancing carbon capture technologies that reduce CO<sub>2</sub> emissions to mitigate GHG-induced global warming. Congress began appropriating funds specifically for FutureGen beginning in 2005. Previously, DOE had allocated funds under its Clean Coal Power Initiative (CCPI) program. With the American Recovery and Reinvestment Act of 2009, Congress appropriated \$1 billion for the FutureGen 2.0 project.

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<sup>1</sup> Congress first appropriated funds specifically for FutureGen in FY2005.

<sup>2</sup> U.S. Department of Energy National Energy Technology Laboratory, "Secretary Chu Announces FutureGen 2.0: Awards \$1 Billion in Recovery Act Funding for Carbon Capture and Storage Network in Illinois," press release, August 5, 2010, [http://www.netl.doe.gov/publications/press/2010/10033-Secretary\\_Chu\\_Announces\\_FutureGen\\_.html](http://www.netl.doe.gov/publications/press/2010/10033-Secretary_Chu_Announces_FutureGen_.html).

<sup>3</sup> FutureGen Alliance, "FutureGen 2.0," press release, February 24, 2011, <http://www.futuregenalliance.org/pdf/FutureGenFacts.pdf>.

The revival of FutureGen under the Obama Administration as FutureGen 2.0 has sparked increased scrutiny of the future of integrated CCS technology on a commercially viable scale. FutureGen was originally proposed to demonstrate the feasibility of using CCS technology to mitigate CO<sub>2</sub> emissions into the atmosphere. Among the challenges that continue to influence the development of FutureGen 2.0 are rising costs of production, ongoing issues with project development, lack of incentives for investment from the private sector, time constraints on project development, and competition with foreign nations. Despite congressional and Obama Administration commitments to the FutureGen 2.0 project, particularly the \$1.0 billion appropriation from ARRA, questions remain as to whether or not FutureGen 2.0 will succeed.

The Congressional Budget Office published a report in June 2012 stating that the success of CCS technology depends on reducing technical costs, ensuring the effectiveness of CCS, and adopting policies that provide incentives for industry to pursue the high-cost demonstration technologies.<sup>4</sup> The report explained that if regulations, tax credits, or policies such as carbon taxation or cap-and-trade that increase the price of electricity from conventional power plants are adopted, then CCS technology may become competitive enough for private sector investment. Even then, industry may choose to forgo coal-fueled plants for natural gas or other sources that emit less CO<sub>2</sub> compared to coal.<sup>5</sup>

## **DOE CCS Programs**

Current scientific thinking associates an increase in atmospheric GHGs (in particular CO<sub>2</sub>, methane, and nitrous oxides), which trap heat in the earth's atmosphere, with the potential for changing the Earth's climate. The increase in the atmospheric concentration of CO<sub>2</sub> in the 20<sup>th</sup> and 21<sup>st</sup> centuries is due almost entirely to human activities.<sup>6</sup> If successful, FutureGen 2.0 would demonstrate a technology that, if widely deployed, could capture a significant fraction of U.S. CO<sub>2</sub> emissions for geologic sequestration.

DOE's Office of Fossil Energy directs three major CCS programs: the Clean Coal Power Initiative (CCPI), Industrial Carbon Capture and Storage (ICCS), and FutureGen 2.0.<sup>7</sup> Through its CCPI program, DOE partners with industry leaders in a cost-share arrangement to develop CCS technologies. Of the six projects selected under the most recent funding for CCPI, three have withdrawn, citing concerns over costs and regulations. DOE's share for the three projects is \$881 million, of which \$800 million is from ARRA funds. DOE is also partnering with industry for 31 projects in the ICCS program. The combined total DOE share for all the ICCS projects is \$1.422 billion, of which 70% is from ARRA funds.

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<sup>4</sup> Philip Webre and Samuel Wice, *Federal Efforts to Reduce Cost of Capturing and Storing Carbon Dioxide*, Congressional Budget Office, June 2012, pp. 14-15, <http://www.cbo.gov/sites/default/files/cbofiles/attachments/43357-06-28CarbonCapture.pdf>.

<sup>5</sup> Several CRS reports cover the issues of technology and cost of capturing CO<sub>2</sub>, as well as the challenge of storage capacity in the United States for captured CO<sub>2</sub>, regulatory challenges, public acceptance, and others. See CRS Report R41325, *Carbon Capture: A Technology Assessment*, by Peter Folger; CRS Report R42532, *Carbon Capture and Sequestration (CCS): A Primer*, by Peter Folger; CRS Report RL34601, *Community Acceptance of Carbon Capture and Sequestration Infrastructure: Siting Challenges*, by Paul W. Parfomak, and others.

<sup>6</sup> For a more detailed examination of the science of climate change, see CRS Report RL34513, *Climate Change: Current Issues and Policy Tools*, by Jane A. Leggett.

<sup>7</sup> For a more detailed examination of DOE's CCS program, see CRS Report R42496, *Carbon Capture and Sequestration: Research, Development, and Demonstration at the U.S. Department of Energy*, by Peter Folger.

FutureGen 2.0 is DOE's most comprehensive CCS demonstration project, combining all three aspects of CCS technology: capturing and separating CO<sub>2</sub> from other gases, compressing and transporting CO<sub>2</sub> to the sequestration site, and injecting CO<sub>2</sub> in geologic formations.

## **Project Costs**

Increasing projected costs have posed significant problems to FutureGen's development since 2003. When Secretary of Energy Steven Chu announced the new FutureGen 2.0 in 2010, the cost was estimated at \$1.3 billion, with the DOE covering 80% of costs and industry partners contributing the remaining 20% of the total. FutureGen 2.0 was to be implemented through two separate cooperative agreements, with \$590 million of ARRA funds allocated to Ameren Corporation to retrofit a power plant<sup>8</sup> and \$459 million to the FutureGen Industrial Alliance to implement a pipeline and regional CO<sub>2</sub> storage reservoir project.<sup>9</sup>

Since 2010, the estimated price of the project has increased from \$1.3 billion to \$1.65 billion.<sup>10</sup> The Alliance was expected to cover the additional cost. Confronted with increasing projected costs in 2008, DOE under the George W. Bush Administration first restructured FutureGen, then postponed the program when cost projections rose from \$950 million to \$1.8 billion. Rising costs of production may continue to be a challenge to the project's development.

## **Public-Private Partnership**

The partnership between the federal government and the private sector in funding and developing FutureGen has been marked by a series of setbacks and challenges. Some critics of the public-private partnership attribute the project's decade-long stasis to a lack of incentives for industry leaders to invest seriously in clean coal technologies. A report released by the Massachusetts Institute of Technology in 2008 stated that government investment and leadership in carbon capture technologies are necessary. "Given the technical uncertainty and the current absence of a carbon charge, there is no economic incentive for private firms to undertake such projects."<sup>11</sup> Since the MIT report was published, Congress has appropriated over \$6 billion in CCS research and development (R&D), including FutureGen; however, Congress has not enacted any form of a "carbon charge," through either a cap-and-trade system or a carbon tax.

Ameren Corporation, which partnered with DOE to retrofit a power plant for FutureGen 2.0, discontinued its cooperative agreement, stating that it could no longer afford to implement the

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<sup>8</sup> DOE partnered with Ameren to retrofit the corporation's obsolete 200 MW power plant in Meredosia, IL, with oxy-combustion technology. The plans are for the retrofitted power plant to capture 90% of emitted carbon dioxide and transport it from Meredosia to a storage site in Morgan County, IL, to store up 1.3 million tons of carbon dioxide per year.

<sup>9</sup> U.S. Department of Energy National Energy Technology Laboratory, *FutureGen 2.0*, Project Facts, June 2011, <http://www.netl.doe.gov>. Funds apportioned from the DOE to the FutureGen Alliance include \$405 million from ARRA funds and \$53.6 million from prior year appropriations toward the FutureGen project through the Office of Fossil Energy.

<sup>10</sup> Steve Daniels, "Soaring prices of FutureGen clean-coal plant could singe Illinois consumers," *Crain's Chicago Business*, September 5, 2011, <http://www.chicagobusiness.com/article/20110903/ISSUE01/309039980/soaring-price-of-futuregen-clean-coal-plant-could-singe-illinois>.

<sup>11</sup> Massachusetts Institute of Technology, *The Future of Coal: An Interdisciplinary MIT Study* (2007), p. xiii.

new air pollution rules set forth by the EPA in July 2011.<sup>12</sup> In addition to the FutureGen project, DOE partnered with industry for six other commercial-scale CCS projects through its Clean Coal Power Initiative (CCPI) program.<sup>13</sup> The 2010 DOE Strategic Plan report predicted that at least five of DOE's major CCS projects would become operational by 2016.<sup>14</sup> Since the report was released, three of the six industry partners of CCPI projects have pulled out of agreements with DOE. The departure of several industry leaders from contracts with DOE demonstrates the volatility of the public-private partnership model.

## Current Status of FutureGen

In October 2010, FutureGen 2.0 developers began working on Phase 1 of the project with the Pre-Front End Engineering Design (Pre-FEED) report, which included plant design, estimated project cost, and basis for applying for NEPA and other state and local permits.<sup>15</sup> The report showed that the estimated price for FutureGen 2.0 had increased from \$1.3 billion to \$1.65 billion.

Subsequently, cost reduction measures were identified and implemented, including establishing the plant gross output at 168 MW (the steam turbine is nominally rated at 200 MW), and using a combination of 60% Illinois coal and 40% Powder River Basin (PRB) coal to reduce sulfur and chlorine emissions.<sup>16</sup> Furthermore, when Ameren announced it was closing its power plant in Meredosia, Illinois, and discontinuing its cooperative agreement with DOE, the project was redesigned to reflect that the Alliance would take control of the capture process as well as the transportation and storage site. The Alliance is currently negotiating the purchase of parts of the Meredosia Energy Center from Ameren to continue with project development. **Figure 1** shows the location of the town of Meredosia, Illinois, the proposed pipeline route, and the proposed carbon sequestration site where the captured CO<sub>2</sub> would be injected underground and stored.

The Alliance has submitted a proposal to DOE to begin work on Phase 2 of the project, which includes a detailed engineering design, schedule and cost analysis, and environmental studies. Throughout the summer and fall of 2012 the project continued to confront rising cost estimates as well as challenges in negotiating a long-term power purchasing agreement with the state of Illinois.<sup>17</sup> In late December 2012, the Illinois Commerce Commission voted 3-2 to approve a power procurement plan for the state that requires utilities to purchase all the electricity generated by the FutureGen 2.0 facility for 20 years. That decision clears a major hurdle for

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<sup>12</sup> Ameren Energy Resources Company, LLC, "Two Ameren Merchant Generating Company Energy Centers to Cease Operations," press release, October 4, 2011, <http://ameren.mediaroom.com/index.php?s=43&item=981>.

<sup>13</sup> CRS Report R42496, *Carbon Capture and Sequestration: Research, Development, and Demonstration at the U.S. Department of Energy*, by Peter Folger.

<sup>14</sup> Steve Koonin, DOE Strategic Plan, U.S. Department of Energy, December 8, 2010, p. 8, [http://efcog.org/library/council\\_meeting/SAMtg.120810/Presentations/Koonin,%20Steve.pdf](http://efcog.org/library/council_meeting/SAMtg.120810/Presentations/Koonin,%20Steve.pdf).

<sup>15</sup> D. K. McDonald, M. Estopinal, and H. Mualim, "FutureGen 2.0: Where Are We Now?," (Technical Paper, Babcock & Wilcox Power Generation Group, Inc., 2012), pp. 2-3, <http://www.babcock.com/library/pdf/BR-1870.pdf>. (Hereinafter referred to as McDonald.) Babcock & Wilcox Power Generation Group is a technology provider for FutureGen 2.0 carbon capture project.

<sup>16</sup> McDonald, p. 4.

<sup>17</sup> "At the Major CCS Projects: HECA, FutureGen," *GHG Reduction Technologies Monitor*, July 20, 2012, <http://ghgnews.com/index.cfm/at-the-major-ccs-projects-futuregen-20-heca/?mobileFormat=false>. (Hereinafter referred to as GHG Reduction Technologies Monitor, July 20, 2012.)

FutureGen 2.0, and the decision allows Commonwealth Edison and Ameren Illinois to collect costs for the project from the state's alternative retail electric suppliers.<sup>18</sup> Opposition to the power procurement proposal stemmed primarily from those opposed to its potential to raise costs for retail customers.<sup>19</sup>

Current projections for FutureGen predict construction on the power plant, pipeline, and storage facility will conclude by 2017.<sup>20</sup> The project faced delays while it was being redesigned following the release of the Pre-FEED report, so that demonstrating CCS technology at full-scale by December 31, 2015<sup>21</sup>—the date when ARRA funding expires—may be difficult.

**Figure 1. Map Showing the Town of Meredosia, IL, the Proposed Pipeline Route, and the Proposed CO<sub>2</sub> Sequestration Site**



**Source:** The FutureGen Alliance, <http://www.futuregenalliance.org/futuregen-2-0-project/pipeline/>.

<sup>18</sup> Tamar Hallerman, "Ill. Regulators Approve 20-Year Power Contract for FutureGen," *GHG Reduction Technologies Monitor*, December 21, 2012, <http://ghgnews.com/index.cfm/ill-regulators-approve-20-year-power-contract-for-futuregen/>. (Hereinafter referred to as *GHG Reduction Technologies Monitor*, December 21, 2012.)

<sup>19</sup> *GHG Reduction Technologies Monitor*, December 21, 2012.

<sup>20</sup> McDonald, p. 4.

<sup>21</sup> *GHG Reduction Technologies Monitor*, July 20, 2012.



## Policy Challenges

The FutureGen project was originally conceived as a cost-share between the federal government, which would cover 76% of the cost, and the private sector, which would provide the remaining 24%. Between FY2004 and FY2008, Congress appropriated \$174 million to the original FutureGen project. DOE obligated \$44 million and expended \$42 million between FY2005 and FY2010 toward the project.<sup>22</sup>

Under the Obama Administration, Congress appropriated another \$1 billion in ARRA funds for FutureGen. Since FY2010, DOE has spent nearly \$34 million from the ARRA funds toward FutureGen 2.0. Furthermore, DOE has obligated nearly \$60 million and spent \$2 million from regular appropriations to FutureGen 2.0 since FY2010.<sup>23</sup>

After DOE announced in March 2008 that it was canceling FutureGen in Mattoon, IL, in favor of a restructured FutureGen project, Senate Subcommittee on Energy and Water Development Chairman Byron Dorgan recommended postponing a decision on FutureGen until the next administration.<sup>24</sup> The subcommittee ultimately made the decision in July 2008 to divert \$156 million in funding requested for FutureGen to DOE's Clean Coal Power Initiative and to maintain \$134 million in prior-year appropriations for FutureGen until the next administration took office.<sup>25</sup> In March 2009, the Subcommittee on Energy and Environment, House Science Committee, held a hearing about DOE's decision to restructure FutureGen and the future of CCS technology deployment under the new administration.<sup>26</sup>

Since EPA proposed a new rule regulating GHG emissions from power plants that would likely require CCS, Congress has considered legislation to block the new regulations. The Subcommittee on Energy and Power of the House Science, Space, and Technology Committee held a hearing on June 19, 2012, where opponents of the new rule, including FutureGen Alliance Chairman Steven E. Winberg, criticized the regulations. "In effect, EPA's rule will eliminate any new coal for years to come because EPA is requiring new coal-fueled power plants to meet a natural gas equivalent CO<sub>2</sub> standard, before CCS technology is commercially available."<sup>27</sup>

Multiple analyses indicate that there will be retirements of coal-fired capacity; however, virtually all analyses agree that coal will continue to play a substantial role in electricity generation for decades. How many retirements will take place and the role of EPA regulations in causing them are matters of dispute.<sup>28</sup> The huge increases in the U.S. domestic supply of natural gas, due

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<sup>22</sup> Email correspondence with Jeff Hoffman of the Office of Major Demonstrations in the Department of Energy's National Energy Technology Laboratory.

<sup>23</sup> Ibid.

<sup>24</sup> U.S. Congress, Senate Committee on Appropriations, Subcommittee on Energy and Water Development, *Department of Energy's Decision to Restructure the FutureGen Program*, 110<sup>th</sup> Cong., 2<sup>nd</sup> sess., May 8, 2008, 110-826, pp. 1-3.

<sup>25</sup> Katherine Ling, "Senate panel freezes funding for restructured FutureGen," *Environment & Energy*, July 8, 2008, [http://www.eenews.net/eenewspm/climate\\_change/2008/07/08/3](http://www.eenews.net/eenewspm/climate_change/2008/07/08/3).

<sup>26</sup> U.S. Congress, House Committee on Science and Technology, Subcommittee on Energy and Environment, *FutureGen and the Department of Energy's Advanced Coal Programs*, 111<sup>th</sup> Cong., 1<sup>st</sup> sess., March 11, 2009.

<sup>27</sup> *The American Energy Initiative: A Focus on EPA's Greenhouse Gas Regulations*, p. 6.

<sup>28</sup> For a detailed discussion of the EPA's regulation of coal, see CRS Report R41914, *EPA's Regulation of Coal-Fired Power: Is a "Train Wreck" Coming?*, by James E. McCarthy and Claudia Copeland.

largely to the exploitation of unconventional shale gas reservoirs through the use of hydraulic fracturing, has also led to a shift to natural gas for electricity production.<sup>29</sup>

In addition to the rapid increase in the domestic natural gas supply as an alternative to coal, regulating CO<sub>2</sub> emissions may lead electricity producers to invest in natural gas-fired plants, which emit approximately half the amount of CO<sub>2</sub> per unit of electricity produced compared to coal-fired plants. Furthermore, power plants enhanced with CCS technology would likely be more costly to construct and operate than plants without CO<sub>2</sub> capture.<sup>30</sup> Consequently, regulations that limit CO<sub>2</sub> emissions and prompt switching to natural gas may raise questions about the rationale for CCS demonstration projects like FutureGen. Alternatively, GHG regulations may provide the necessary incentives for the industry to accelerate CCS development and deployment.

## Outlook

Nearly ten years and two restructuring efforts since FutureGen's inception, the project is still in its early development stages. Although the Alliance completed drilling a characterization well at the storage site in Morgan County, IL, and installed a service rig over the well for further geologic analysis, issues with the power plant itself have not yet been resolved. Among the remaining challenges are securing private sector funding to meet increasing costs, purchasing the Meredosia power plant from Ameren, obtaining permission from the DOE to retrofit the plant, performing the retrofit, and then meeting the goal of 90% capture of CO<sub>2</sub>.

Alternatively, coal-based power plants may be replaced by natural gas-fueled plants that emit less CO<sub>2</sub> as regulations on carbon emissions are implemented. Electricity generation from natural gas is expected to grow through 2035 because of the relatively low cost of natural gas-fired generation as compared with that of coal.<sup>31</sup> With more stringent emission regulations—including the proposal by EPA to limit coal-fired power plant emissions of hazardous air pollutants—the cost of coal-fired power plants may no longer be competitive with lower-cost natural gas plants. Consequently, the electricity industry may increasingly shift construction toward natural gas-fired power plants, which cost less and emit approximately half the CO<sub>2</sub> of coal-fired power plants per unit electricity generated. Such a shift would likely affect the coal industry and DOE's CCS program, including FutureGen.

A further challenge for Congress to consider is the international ramifications of American leadership in developing and deploying CCS technology. Recently proposed regulation of coal-fired power plants that emit hazardous air pollutants has been criticized for possibly harming American electricity generating capacity and causing job losses.<sup>32</sup> Critics of these regulations express concern over the loss of American competitiveness as a result of increased economic burdens on coal-based industries while technologies that can mitigate emissions—like CCS—

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<sup>29</sup> For a detailed discussion of how natural gas is affecting electric power generation, see CRS Report R42814, *Natural Gas in the U.S. Economy: Opportunities for Growth*, by Robert Pirog and Michael Ratner.

<sup>30</sup> Massachusetts Institute of Technology, *The Future of Coal: An Interdisciplinary MIT Study* (2007), p. 147.

<sup>31</sup> U.S. Energy Information Administration, "Annual Energy Outlook 2012 with Projections to 2035," June 12, 2012, 86-88, <http://www.eia.gov/forecasts/aeo>.

<sup>32</sup> For a more detailed examination of recent EPA regulations, see CRS Report R41914, *EPA's Regulation of Coal-Fired Power: Is a "Train Wreck" Coming?*, by James E. McCarthy and Claudia Copeland.

have not yet been successfully developed.<sup>33</sup> They argue that Chinese industries, which emit twice as much CO<sub>2</sub> as American industries, will surpass the United States in productive competitiveness and that this will lead to American industries shipping more jobs and production overseas.<sup>34</sup>

While U.S. policies and regulations call into question the utilization of coal for electricity generation at current levels, the United States continues its international financial assistance to foreign nations like China for their development of global climate change initiatives.<sup>35</sup> Effectively, the United States is helping to develop CCS technologies in foreign countries while domestic CCS projects, including FutureGen, are still in their early stages of construction. An important question policymakers may consider is whether the United States should continue to fund foreign CCS technologies while decreasing domestic coal production and utilization through new regulations.

## Timeline

Since its inception, FutureGen has been restructured twice and has undergone changes in funding, technology, location, and scope. The timeline that follows shows a chronology of the history of FutureGen since 2003.

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<sup>33</sup> U.S. Congress, House Committee on Energy and Commerce, Subcommittee on Energy and Power, *The American Energy Initiative: A Focus on EPA's Greenhouse Gas Regulations*, Steven E. Winberg testimony, 112<sup>th</sup> Cong., 2<sup>nd</sup> sess., June 19, 2012, 4-5.

<sup>34</sup> U.S. Congress, Senate Committee on Environment and Public Works, *EPA'S Anti-Industrial Policy: "Threatening Jobs and America's Manufacturing Base*, Minority staff report on EPA regulations, 112<sup>th</sup> Cong., 2<sup>nd</sup> sess., September 28, 2010, pp. 14-16.

<sup>35</sup> For a more detailed examination of the most recent administrative funding for global climate change initiatives, see CRS Report R41845, *The Global Climate Change Initiative (GCCI): Budget Authority and Request, FY2010-FY2013*, by Richard K. Lattanzio.

PHASE 1

2003

**February 27:** President George W. Bush proposed a 10 year, \$1 billion project to build a 275 MW coal-fired power plant that would integrate carbon sequestration and hydrogen production.

2004

**March:** In its 2004 Report to Congress, the DOE estimated that FutureGen would cost \$950 million with the DOE contributing 76% and the private sector the remaining 24% of the total cost.

**July:** The FutureGen Industrial Alliance, a non-profit company comprised of the largest international coal companies and electric utilities, was formed to partner with the DOE on the development of FutureGen. The seven founding Alliance members are American Electric Power, BHP Billiton, CONSOL Energy Inc., Foundation Coal Corporation, Kennecott Energy Company (a member of the Rio Tinto group), Peabody Energy, and Southern Company.

2005

**October 27:** China Huaneng Group, China's largest coal-fueled power generator, joined the Alliance.

**December:** The DOE and the Alliance signed a Cooperative Agreement partnering in all development aspects of the \$1 billion FutureGen project, including site and technology selection, construction and operation.

2006

**February 23:** Anglo American, one of the world's largest diversified mining and natural resource groups, joined the FutureGen Industrial Alliance as its ninth member.

**March 8:** The Alliance released the final Request for Proposals (RFPs) for regions interested in hosting the world's first coal-fueled "zero emissions" power plant.

**May 23:** PPL Corporation, an electric company delivering electricity and natural gas in the United States and United Kingdom, joined the FutureGen Industrial Alliance as its tenth member.

**July 25:** The Alliance selected four finalist hosting sites for FutureGen: Mattoon, IL, Tuscola, IL, Odessa, TX and Jewett, TX.

**October 31:** E.ON US, the world's largest investor-owned electric utility service provider, joined the Alliance as its eleventh member.

**December 7:** Xstrata Coal, Australia-based exporter of high energy thermal coal, joined the Alliance as its twelfth member.

**December 15:** The United States and China announced their cooperation on FutureGen and signed an Energy Efficiency Protocol during the first U.S.-China Strategic and Economic Dialogue.

2007

**January:** The Alliance produced an initial conceptual design report for the original FutureGen project estimating the cost of the program at \$1.8 billion accounting for inflation through 2017.

**March 23:** The DOE and Alliance signed a Cooperative Agreement stipulating that the DOE would cover 74% and the Alliance would share the remaining 26% of the \$1.8 billion cost.

**May 25:** The DOE released a Draft Environmental Impact Statement (DEIS) that included a review of all four candidate sites in Illinois and Texas.

**November 9:** The DOE released a final Environmental Impact Statement (EIS) predicting program costs at \$1.8 billion with projected revenues from the sale of electricity at \$301 million.

**December:** Given rising costs of FutureGen development, DOE's Office of Fossil Energy attempted to negotiate a new cost-sharing arrangement with the Alliance before continuing the cooperative agreement in June 2008.

**December 6:** Luminant, a Texas-based electric utility, joined the FutureGen as the thirteenth member.

**December 10:** The DOE advised the Alliance not to announce the selected plant site.

**December 11:** Peabody Energy, a founding member of the Alliance, became an equity partner in China's \$1 billion GreenGen project, a near-zero emission carbon capture project modeled after FutureGen. Peabody has a 6% stake in GreenGen.

**December 18:** The Alliance announced its selection of Mattoon, IL as the final site to host the FutureGen power plant.

2008

**January 8:** Alliance board of directors elected Paul W. Thompson of E.ON U.S. as its next chairman of the board to replace outgoing chairman Greg A. Walker.

PHASE 2

**April 9:** Alliance CEO Michael J. Mudd told the Senate Subcommittee on Science, Technology and Innovation that DOE's recent proposal to restructure FutureGen failed to address the challenges of climate change and energy security and would delay CCS technology by several years.

**April 15:** Alliance Chairman Paul Thompson testified before the House Science and Technology Committee that costs of all global energy infrastructure projects increased due to inflation. Thompson said that FutureGen costs were consistent with industry average increases.

**May 7:** The DOE released a draft Funding Opportunity Announcement for restructured FutureGen to receive public input and gauge public interest in the project.

**May 8:** Secretary of Energy Samuel Bodman testified before the Senate Subcommittee on Energy and Water Development that the cost of the FutureGen project doubled from \$950 million to \$1.8 billion. Alliance Chairman Paul Thompson told members of the subcommittee to continue supporting the original FutureGen project in Mattoon, IL because of predicted delays and reduced standards of CO<sub>2</sub> capture in DOE's restructured FutureGen project. The Senate subcommittee held the oversight hearing to discuss DOE's decision to restructure FutureGen.

**PHASE 2 CON'T**

**May 19:** Senators Kit Bond (R-MO) and Dick Durbin (D-IL) sent a letter to Secretary of Energy Samuel Bodman to extend the budget period of the existing cooperative agreement from June 15, 2008 to March 30, 2009 in order to retain funds already appropriated for FutureGen, maintain the original FutureGen program and allow the incoming administration to make a decision on the future of FutureGen.

**June:** Senior DOE officials directed the office of Fossil Energy to negotiate a new cost-sharing agreement with the Alliance under the Cooperative Agreement that was scheduled for a continuation in June. The negotiations failed to yield an agreement.

**June:** The DOE formally discontinued its cost-share with the Alliance for FutureGen. Luminant and PPL Corporation pulled out of the FutureGen Alliance.

**July:** The Senate Energy and Water Appropriations Subcommittee approved a measure that would maintain \$134 million in prior year appropriations for FutureGen at Mattoon, IL.

**July:** Southern Illinois University's Clean Coal Review Board voted to award \$2 million in grants for the FutureGen project for gasification, plant production and plant efficiency studies. The Alliance matched the grant and spent approximately \$6 million on engineering and cost control studies.

**December 12:** The Alliance and Coles Together, a non-profit economic development organization in Coles County where FutureGen would be built, combined funds to purchase more than 420 acres of land in Mattoon, IL for approximately \$7 million.

**PHASE 3**

2009

**January 29:** A bipartisan group of senators including Dick Durbin (D-IL), Kit Bond (R-MO), Claire McCaskill (D-MO) urged Secretary Chu to release the Record of Decision (ROD) certifying that a \$1.8 billion coal-fueled experimental power plant would be built in Mattoon, IL.

**February:** A Government Accountability Office report showed that the DOE miscalculated the cost of FutureGen at \$1.8 billion. GAO showed that in constant 2005 dollars from DOE's predicted cost estimate of \$950 million, the Alliance's predicted cost for FutureGen increased by 37% or \$370 million to \$1.3 billion by 2017.

**February 17:** The American Recovery and Reinvestment Act provided \$1.073 billion to the FutureGen program to advance construction of a plant built in Mattoon, IL.

**June:** Southern Company withdrew from the Alliance stating its intention to focus on coal gasification in its Kemper County, MS power plant and a carbon research center in Wilsonville, Alabama.

**June 12:** The Alliance and DOE reached an agreement to proceed with the preliminary design and cost estimate of FutureGen, estimated at \$2.4 billion.

**July 1:** American Electric Power pulled out of the Alliance stating that FutureGen was moving too slowly and the company wanted to focus on carbon-sequestration projects like the Mountaineer plant in West Virginia.

**July 14:** The DOE issued the ROD, a final public decision that certifies that the Mattoon, IL site meets environmental requirements for the project.

**September 2:** The Alliance board of directors elected Steven Winberg of CONSOL Energy Inc. as the new chairman of the board to replace outgoing chairman Paul Thompson.

2010

**January 12:** The Illinois Finance Authority passed a resolution (Resolution Number 2010-01-09) providing the necessary financial mechanisms to issue bonds to help fund FutureGen.

**January 30:** Exelon Corporation, one of the nation's largest electric utilities, joined FutureGen Alliance.

**February 8:** Caterpillar Inc., a world-leading manufacturer of construction and mining equipment, joined the FutureGen Alliance.

**PHASE 4**

**August 5:** Secretary Chu announced the administration's new FutureGen 2.0 project, which would retrofit Ameren's existing power plant in Meredosia, IL with oxy-combustion technology at a 202 MW oil-fired unit. FutureGen 2.0 would be funded by \$1 billion stimulus money and \$247 million in private funds.

**August 11:** After DOE announced that Mattoon, IL would serve as the storage site for CO<sub>2</sub> captured in Meredosia, IL, Coles Together removed Mattoon from participation in the FutureGen 2.0 project.

**August 31:** The Alliance Board of Directors offered support to DOE on its new FutureGen 2.0 program if mutual agreement on terms and conditions could be reached in fall, 2010.

**September 28:** DOE signed final cooperative agreements with the Alliance and Ameren Energy Resources that formally commit \$1 billion in ARRA funds.

**October 25:** The Alliance issued requests for regions to submit proposals for hosting the carbon dioxide storage site.

**December 20:** Four Illinois counties (Christian County, Douglas County, Fayette County and Morgan County) were selected to advance to the next stage of site selection.

PHASE 4 CON'T

2011

**February 28:** The Alliance announced that it had selected Morgan County, IL as the location for the FutureGen 2.0 storage site.

**April 5:** The Alliance created FutureGen Citizens' Board to receive community feedback on geologic storage of CO<sub>2</sub> and on visitors and training facilities.

**June 7-9:** DOE held public hearings in Taylorville, Tuscola and Jacksonville, IL about the environmental effects of storing carbon dioxide under these communities.

**August 23:** Illinois Legislature passed the "Carbon Dioxide Transportation" (S.B. 1821) legislation to aid with pipeline construction from Meredosia to the storage site in Morgan County.

**October:** The Alliance completed Phase 1: Pre-Front End Engineering Design (Pre-FEED) work which included plant design, estimated project cost and basis for applying for NEPA and other permits. The Pre-FEED report showed that the price of FutureGen increased from \$1.3 billion to \$1.65 billion.

**October 4:** Ameren said it will close its Meredosia and Hutsonville plants in Illinois because it could not afford to implement EPA regulations issued in July to reduce sulfur dioxide by 73% and nitrogen oxide by 54% from 2005 levels.

**October 14:** Developers began drilling a test well of about 5,000 feet in Springfield in Morgan County, IL. The plan is to pump carbon dioxide into the well in 2016.

**October 31:** Illinois Legislature passed "Clean Coal FutureGen for Illinois Act of 2011" (S.B. 2062) addressing liability management and "providing the FutureGen Alliance with adequate liability protection, land use rights, and permitting certainty to facilitate the siting of the FutureGen Project in Illinois.

**November 28:** The Alliance negotiated an option to purchase portions of the Meredosia Energy Center from Ameren in order to continue the development of the FutureGen 2.0 power plant.

**December 20:** The FutureGen Alliance successfully completed drilling a 5,000 foot characterization well in Morgan County, IL and preliminary data indicated that the local geology is suitable for carbon dioxide storage.

2012

**January 26:** A service rig was installed over the well in order to conduct hydrologic and geologic testing.

**January 26:** The Alliance finalized the sale of land originally purchased from Coles Together for the original FutureGen project. The conclusion of this transaction will allow Coles Together to continue to pursue economic development opportunities for the site and the Alliance will redirect funds from the sale to the FutureGen 2.0 project in Morgan County.

**April:** A revised Phase 1 report was submitted to the DOE with changes in project structure and schedule. The plant was rescaled to 168 MW capacity and the start of commercial operations changed from late 2015 to 2017.

**July:** After months of geologic and engineering studies, the Alliance confirmed Morgan County, IL as FutureGen 2.0's CO<sub>2</sub> sequester site (the Alliance was considering Christian and Douglas Counties as alternative sequestration sites). The Alliance secured underground rights and began its application to the EPA for a CO<sub>2</sub> storage permit.

**December:** The Illinois Commerce Commission voted 3-2 to approve a power procurement plan for the state that requires utilities to purchase all the electricity generated by the FutureGen 2.0 facility for 20 years. The order requires Commonwealth Edison and Ameren Illinois to purchase all of the gross electricity generated at the FutureGen 2.0 facility beginning in 2017.

2013

**February 28,** The Illinois Competitive Energy Association, which represents alternative retail electric suppliers in the state, filed notice with the Illinois Appellate Court that it would challenge FutureGen's sourcing agreement, approved by the Illinois Commerce Commission (ICC) by a 3-2 vote in December. Commonwealth Edison (ComEd), one of the state's two main utilities, also announced its plans to challenge the sourcing agreement

2015

**December 31:** ARRA award expires



**Sources:** Information for the FutureGen Timeline has been acquired from the following sources.

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